UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM 10-K

☒ **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the fiscal year ended December 31 , 2023

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15 (D) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the transition period from _____to_____

Commission file number: **001-40766**

Lightwave Logic, Inc.

(Exact name of registrant as specified in its charter)

Nevada	**82-0497368**
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification No.)
369 Inverness Parkway , Suite 350 , Englewood , CO	**80112**
(Address of principal executive offices)	(Zip Code)

(Registrant's Telephone Number, including Area Code): **720 - 340-4949**

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Trading Symbol(s)	Name of each exchange on which registered
Common Stock, $0.001 par value per share	LWLG	The NASDAQ Stock Market

Securities registered pursuant to section 12(g) of the Act: None

Indicate by check mark if the Registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ☐ No ☒

Indicate by check mark if the Registrant is not required to file reports pursuant to Section 13 or 15(d) of the Act. Yes ☐ No ☒

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes ☒ No ☐

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). Yes ☒ No ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer ☒
Non-accelerated filer ☐
Accelerated filer ☐
Smaller reporting company ☐
Emerging growth company ☐

If an emerging growth company, indicate by checkmark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☐

Indicate by check mark whether the registrant has filed a report on and attestation to its management's assessment of the effectiveness of its internal control over financial reporting under Section 404(b) of the Sarbanes-Oxley Act (15 U.S.C. 7262(b)) by the registered public accounting firm that prepared or issued its audit report. ☒

If securities are registered pursuant to Section 12(b) of the Act, indicate by check mark whether the financial statements of the registrant included in the filing reflect the correction of an error to previously issued financial statements. ☐

Indicate by check mark whether any of those error corrections are restatements that required a recovery analysis of incentive-based compensation received by any of the registrant's executive officers during the relevant recovery period pursuant to § 240.10D-1(b). ☐

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act of 1934). Yes ☐ No ☒

The aggregate market value of the voting and non-voting common equity held by non-affiliates of the registrant was approximately $ 805,311,165 as of June 30, 2023.

As of February 29, 2024, there were 119,184,778 shares outstanding of the registrant's common stock, $.001 par value.

Documents incorporated by reference. Portions of the registrant's Definitive Proxy Statement for the registrant's 2024 Annual Meeting of Shareholders are incorporated by reference in Part III of this report. The Definitive Proxy Statement or an amendment to this Form 10-K will be filed with the Securities and Exchange Commission within 120 days after the registrant's fiscal year ended December 31, 2023.

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Forward-Looking Statements

This Annual Report on Form 10-K contains forward-looking statements. Forward-looking statements involve risks and uncertainties, such as statements about our plans, objectives, expectations, assumptions or future events. In some cases, you can identify forward-looking statements by terminology such as "anticipate," "estimate," "plan," "project," "continuing," "ongoing," "expect," "we believe," "we intend," "may," "should," "will," "could" and similar expressions denoting uncertainty or an action that may, will or is expected to occur in the future. These statements involve estimates, assumptions, known and unknown risks, uncertainties and other factors that could cause actual results to differ materially from any future results, performances or achievements expressed or implied by the forward-looking statements. You should not place undue reliance on these forward-looking statements.

Factors that are known to us that could cause a different result than projected by the forward-looking statement, include, but are not limited to:

- inability to generate significant revenue or to manage growth;
- lack of available funding;
- lack of a market for or market acceptance of our products;
- competition from third parties;
- general economic and business conditions;
- intellectual property rights of third parties;
- changes in the price of our stock and dilution;
- regulatory constraints and potential legal liability;
- ability to maintain effective internal controls;
- security breaches, cybersecurity attacks and other significant disruptions in our information technology systems;
- changes in technology and methods of marketing;
- delays in completing various engineering and manufacturing programs;
- changes in customer order patterns and qualification of new customers;
- changes in product mix;
- success in technological advances and delivering technological innovations;
- shortages in components;
- production delays due to performance quality issues with outsourced components;
- those events and factors described by us in Item 1.A "Risk Factors";
- other risks to which our Company is subject; and
- other factors beyond the Company's control.

Any forward-looking statement made by us in this Annual Report on Form 10-K is based only on information currently available to us and speaks only as of the date on which it is made. We undertake no obligation to publicly update any forward-looking statement, whether written or oral, that may be made from time to time, whether as a result of new information, future developments or otherwise.

PART I

Item 1. Business.

Overview

Lightwave Logic, Inc. is a technology company focused on the development of next generation electro-optic photonic devices made on its P ^{2}IC™ technology platform which we have detailed as: 1) Polymer Stack™, 2) Polymer Plus™, and 3) Polymer Slot™. Our unique polymer technology platform uses in-house proprietary high-activity and high-stability organic polymers. Electro-optical devices called modulators convert data from electric signals into optical signals for multiple applications.

Our differentiation at the modulator device level is in higher speed, lower power consumption, simplicity of manufacturing, small footprint (size), and reliability. We have demonstrated higher speed and lower power consumption in packaged devices, and during 2023, we continued to make advances in techniques to translate our world class material properties to efficient, reliable modulator devices with commercial foundries. We are currently focused on testing and demonstrating the simplicity of manufacturability and reliability of our devices, including in conjunction with the silicon photonics manufacturing ecosystem. In 2023 we worked with silicon-based foundry partners to help scale in volume our polymer modulator devices and we received working modulator chips from these foundries. We have advanced and matured our interactions with our foundry partners and we continue to receive working modulator chips for prototyping. Silicon-based foundries are large semiconductor fabrication plants developed for the electronics IC business, that are now engaging with silicon photonics to increase their wafer throughput. Partnering with silicon-based foundries not only demonstrates that our polymer technology can be transferred into standard production lines using standard equipment, it also allows us to efficiently utilize our capital. The foundry partnerships will allow us to scale our high-performance polymer optical engines quickly and efficiently. We have now received

silicon wafers that range up to 200mm in diameter, which aligns well with foundry manufacturing.

Our extremely strong and broad patent portfolio allows us to optimize our business model in three areas: 1) Traditional focus on product development, 2) Patent licensing and 3) Technology transfer to foundries. We are continually looking to strengthen our patent portfolio both by internal inventions and acquisition of intellectual property.

We are initially targeting applications in fiber optic data communications and telecommunications markets and are exploring other applications that include automotive/LIDAR, sensing, displays etc., for our polymer technology platform. Our goal is to have our unique polymer technology platform become ubiquitous across many market verticals over and above the optical fiber optic communications markets.

Generative Artificial Intelligence (G-AI) has been integrating deeper within our daily activities with applications to make us more efficient and possibly smarter. The impact on the internet is huge, and the internet is based on an optical network that utilizes data centers to route and switch traffic or information to and from destinations. Data centers are being upgraded today in a fashion that the industry has not seen before with significant investments of capital. The expected demands of increased traffic, information, and data driven by G-AI is changing the way the internet is being operated. G-AI is now creating new and interesting market opportunities to upgrade the internet. Three of these opportunities are important today: density, speed, and low power and these are very well aligned with our high performance electro-optic polymers modulator platform. We are designing high performance polymer modulator optical engines to support the rise and growth of G-AI as it generates more information that will travel through the internet and optical network. While we are not directly a G-AI company designing electronic processors, we do see immediate benefits of enabling higher levels of information to cross the internet using our optical polymer modulator platform.

Unless the context otherwise requires, all references to the “Company,” “we,” “our” or “us” and other similar terms means Lightwave Logic, Inc. Also, this Form 10-K Annual Report includes the names of various government agencies and the trade names of other companies. Unless specifically stated otherwise, the use or display by us of such other parties’ names and trade names in this report is not intended to and does not imply a relationship with, or endorsement or sponsorship of us by, any of these other parties.

Commencement of Commercial Operations

We commenced commercial operations in May 2023. Presently, our commercial operations consist of a material supply license agreement to provide Perkinamine® chromophore materials for polymer based photonic devices and photonic integrated circuits (PICs). The license agreement represents tangible commercial progress for electro-optic polymers as part of our Company's business plan. Our Company is also in various stages of photonic device and materials development and evaluation with potential customers and strategic partners. We expect to continue to obtain a revenue stream from technology licensing agreements, and to obtain additional revenue streams from technology transfer agreements and direct sale of our electro-optic device components. We have seen increased interest in our materials during 2023 and we are in discussions on future license agreements.

Materials Development

Our Company designs and synthesizes organic chromophores for use in its own proprietary electro-optic *polymer systems* and photonic device designs. A polymer system is not solely a material, but also encompasses various technical enhancements necessary for its implementation. These include host polymers, poling methodologies, and molecular spacer systems that are customized to achieve specific optical properties. Our organic electro-optic polymer systems compounds are mixed into solution form that allows for thin film application. Our proprietary electro-optic polymers are designed at the molecular level for potentially superior performance, stability, and cost-efficiency. We believe our proprietary and unique polymers have the potential to replace more expensive, higher power consuming, slower-performance materials such as semiconductor-based modulator devices that are used in fiber-optic communication networks today.

Our patented and patent pending molecular architectures are based on a well-understood chemical and quantum mechanical occurrence known as *aromaticity*. Aromaticity provides a high degree of molecular stability that enables our core molecular structures to maintain stability under a broad range of operating conditions.

We expect our patented and patent-pending optical materials along with trade secrets and licensed materials, to be the core of and the enabling technology for future generations of optical devices, modules, sub-systems, and systems that we will develop or enable our partners to fully commercialize. Examples of our partners include: electro-optic device manufacturers, contract manufacturers, original equipment manufacturers, foundries, packaging and assembly manufacturers etc. Our Company contemplates future applications in market verticals that may address the needs of semiconductor companies, optical network companies, Web 2.0/3.0 media companies, high performance computing companies, telecommunications companies, aerospace companies, automotive companies, as well as for example, government agencies and defense entities.

Device Design and Development

Electro-optic Modulators

Our Company designs its own proprietary electro-optical modulation devices. Electro-optical modulators convert data from electric signals into optical signals that can then be transmitted over high-speed fiber-optic cables. Our modulators are electro-optic, meaning they work because the optical properties of the polymers are affected by electric fields applied by means of electrodes. Modulators are key components that are used in fiber optic telecommunications, data communications, and data centers networks etc., to convey the high data flows that have been driven by applications such as pictures, video streaming, movies etc., that are being transmitted through the Internet. Electro-optical modulators are expected to continue to be an essential element as the appetite and hunger for data increases every year as well as the drive towards lower power consumption, and smaller footprint (size).

Polymer Photonic Integrated Circuits (P^2IC™)

Our Company also designs its own proprietary Photonic Integrated Circuits (otherwise termed a polymer PIC). A polymer PIC is a photonic device that integrates several photonic functions on a single chip. We believe that our technology can enable an ultra-miniaturization footprint that is needed to increase the number of photonic functions residing on a semiconductor chip. We see this creating a progression like what was seen in the computer integrated circuits, commonly referred to as Moore’s Law. One type of integration is to combine several instances of the same photonic functions such as a plurality of modulators to create a multi-channel polymer PIC. The number of channels can be varied depending on application. For example, the number of photonic components could increase by a factor of 4, 8, or 16. Another type of integration is to combine different types of devices including from different technology bases such as the combination of a semiconductor laser with a polymer modulator. Our P^2IC™ platform encompasses both these types of architecture.

Current semiconductor photonic technology today is struggling to reach faster device speeds. Our modulator devices, enabled by our electro-optic polymer material systems, work at extremely high frequencies (wide bandwidths) and possess inherent advantages over current crystalline electro-optic material contained in most modulator devices such as bulk lithium niobate (LiNbO3), indium phosphide (InP), silicon (Si), and gallium arsenide (GaAs). Our advanced electro-optic polymer platform is creating a new class of modulators such as the Polymer Stack™, Polymer Plus™, Polymer Slot™, and associated PIC platforms that can address higher data rates in a lower cost, lower power consuming manner, smaller footprint (size) with much simpler data encoding techniques. Our electro-optic polymer material will boost the performance of standard PIC platforms such as silicon photonics and indium phosphide.

Our electro-optic polymers can be integrated with other materials platforms because they can be applied as a thin film coating in a fabrication clean room such as may be found in semiconductor foundries using standard clean room tooling. These approaches enable our Polymer Plus™ and Polymer Slot™ device platforms to not only be competitive but fully integrated with foundries. Our polymers are unique in that they are stable enough to seamlessly integrate into existing CMOS, Indium Phosphide (InP), Gallium Arsenide (GaAs), and other semiconductor manufacturing lines. Of relevance are the integrated silicon photonics platforms that combine optical and electronic functions. These include a miniaturized modulator for ultra-small footprint applications in which we term the Polymer Slot™. This design is based on a slot modulator fabricated into semiconductor wafers that can include either silicon or indium phosphide.

Our Company has a fabrication facility in Colorado to apply standard fabrication processes to our electro-optic polymers which create modulator devices. While our internal fabrication facility is capable of manufacturing modulator devices, we have partnered with commercial silicon-based fabrication companies that are called

foundries who can scale our technology with volume quickly and efficiently. The process recipe for fabrication plants or foundries is called a 'process development kit' or PDK. We are currently working with commercial foundries to implement our electro-optic polymers into accepted PDKs by the foundries. One of the metrics for successful implementation of PDK is to receive working modulator chips. Our work with the foundries is being focused with the Polymer Plus™ and the Polymer Slot™ polymer modulators.

Glossary

Glossary of select technology terms to provide you with a better understanding our Company's technology and devices:

Electro-optic devices **-** Electro-optic devices convert data from electric signals into optical signals for use in communications systems and in optical interconnects for high-speed data transfer.

Electro-optic material **-** Electro-optic material is the core active ingredient in high-speed fiber-optic telecommunication systems. Electro-optic materials are materials that are engineered at the molecular level. Molecular level engineering is commonly referred to as "nanotechnology."

Electro-optic modulators **-** Electro-optic (E/O) modulators are electro-optic devices that perform electric-to-optic conversions within the infrastructure of the internet. Data centers may also benefit from this technology through devices that could significantly increase bandwidth and speed while decreasing costs. Polymer E/O modulators can be designed and fabricated with multiple structures such as Ridge waveguide (Polymer™ Stack) and slot waveguide (Polymer Slot™). The waveguides allow the light to be efficiently coupled into and out of the modulators, and provide a basis for integrating modulators together.

Gbaud - The rate of symbol changes in data transmission in billions of symbol changes per second. Each symbol can support one or more bits, the number of bits depending on the modulation format.

NRZ – See PAM2.

PAM2 – 2 level Pulse Amplitude Modulation, a modulation format in which the optical power in each symbol can assume either of two different levels, low or high, representing, respectively, a 0 or a 1. PAM2 supports 1 bit per symbol so the bit rate is equal to the baud rate or symbol rate. For example, a modulator capable of supporting 100 Gbaud can transmit 100 Gbps with PAM2 modulation. This modulation format is often called NRZ (Non Return to Zero).

PAM4 - 4 level Pulse Amplitude Modulation, a modulation format in which the optical power in each symbol can assume any one of 4 different levels. PAM4 supports 2 bits per symbol so the bit rate is equal to two times the baud rate or symbol rate. For example, a modulator capable of supporting 100 Gbaud can transmit 200 Gbps with PAM4 modulation.

PAM8 - 8 level Pulse Amplitude Modulation, a modulation format in which the optical power in each symbol can assume any one of 8 different levels. PAM4 supports 3 bits per symbol so the bit rate is equal to three times the baud rate or symbol rate. For example, a modulator capable of supporting 100 Gbaud can transmit 300 Gbps with PAM8 modulation.

Photonic Devices **-** Photonic devices are components for creating, manipulating, or detecting light. This can include modulators, laser diodes, light-emitting diodes, solar and photovoltaic cells, displays and optical amplifiers. Other examples are devices for modulating a beam of light and for combining and separating beams of light of different wavelength.

Polymers - Polymers, also known as plastics, are large carbon-based molecules that bond many small molecules together to form a long chain. Polymer materials can be engineered and optimized using nanotechnology to create a system in which unique surface, electrical, chemical, and electro-optic characteristics can be controlled. Materials based on polymers are used in a multitude of industrial and consumer products, from automotive parts to home appliances and furniture, as well as scientific and medical equipment.

Our Business Opportunity

Lightwave Logic, Inc. is developing next generation proprietary photonic devices that are based on our advanced electro-optical polymer material systems. Current legacy technology is based on inorganic crystalline materials, which has allowed for the proliferation of data over fiber optic cables. However, there are inherent molecular deficiencies that have prevented this technology from scaling down in price and up in functionality, especially in terms of $/Gbps. This is primarily due to a closed valence structure that does not allow for the molecular improvements. The valence or valency of an element is a measure of its combining power with other atoms when it forms chemical compounds or molecules. Also, the physical properties of a crystal do not allow for its implementation into highly miniaturize slot structures that are in simple terms the pathways that light travels through in the device.

Organic polymer materials have free electrons that allow for limitless potential to combine with other molecular structures, which allows for multiple options and combinations to improving performance characteristics. Importantly, because they can be applied to optical structures in thin-film liquid form, it is possible to imbue electro-optic ability to highly miniaturized slot structures. Organic polymer materials are also more economic to manufacture in comparison to growing exotic crystals that are prone to contamination and further must be sliced into thin wafers. Our Company believes that the combination of less expensive manufacturing cost, ease of application, and better scalability, together with a lower cost of ownership due to lower heat dissipation (requiring less cooling), will create enormous demand for our polymer material through supply agreements as well as polymer based products.

Many companies' early attempts at developing commercially reliable organic polymers were stymied due to the difficulty of creating organic molecules that could remain electro-optically active after being subjected to the high heat of semiconductor manufacturing temperatures (such as silicon CMOS, InP, GaAs etc.). These early attempts also encountered difficulty synthesizing materials that could withstand photochemical bleaching (loss of sensitivity to specific frequencies) and material degradation due to high operating temperatures.

Over the last several years, our Company has made various scientific breakthroughs that have allowed for the synthesis of proprietary organic polymer materials that can withstand extremely high process temperatures that exceed 175^0C. Additionally, these materials have demonstrated photochemical stability, even after being subjected to high intensity light for over 5,000 hours and exhibited little electro optic degradation even after being continuously exposed at 110^0C. This operating temperature exceeds the maximum commercial operating temperatures of approximately 85^0C, found in large data centers. These devices were prototyped using ridge waveguide design. Polymer based ridge waveguide modulators prototypes called a Polymer Stack™ have performed with 3dB bandwidths that exceed 70GHz.

The Ridge Waveguide Modulator (Polymet Stack™)

A ridge waveguide modulator is a type of modulator where the waveguide is fabricated within a layer of our electro-optic polymer system. Various cladding materials and electrodes are layered over the core polymer. The polymer materials are then part of an integrated photonics platform that can house other photonic devices, such as lasers, waveguides etc.

In April 2017 we achieved bandwidth suitable for 25Gbps data rates in an all-organic polymer ridge waveguide intensity modulator prototype, a significant improvement over our initial 10Gbps device modulator prototype that was announced the previous year. This breakthrough was significant because a 25Gbps data rate is important to the optical networking industry because this data rate is a key requirement for achieving 100 Gbps (using 4 channels of 25 Gbps). In July 2017 we advanced our high-speed modulation performance to satisfy 28Gbps data rates for QSFP28 standards which are also utilized for 100Gbps data center applications.

In September 2017 we achieved outstanding performance of our ridge waveguide Mach-Zehnder modulators ahead of schedule, with bandwidth performance levels that will enable 50Gbaud modulation in fiber-optic communications. This important achievement will allow users to utilize arrays of 4 x 50Gbaud polymer modulators using PAM-4 encoding to access 400Gbps data rate systems. Pulse-Amplitude Modulation (PAM-4) is an encoding scheme that can double the amount of data that can be transmitted.

We are now further optimizing our high-performance modulators for additional specifications that are beginning to be required by the fiber communications industry for applications such as networks running at data rates of 800Gbps and 1600Gbps. 800Gbps will require combining 4 channels of 200Gbps utilizing PAM4 encoding schemes which will prove challenging for many existing modulator technologies. Our technology platform has the capability and potential to address 4 channels of 400Gbps utilizing PAM4 encoding schemes in the near future, thus creating a roadmap of increased performance for the industry. Furthermore, we are collaborating with industry partners to optimize the packaging our modulators so that potential customers can evaluate our high-performance modulators in their systems. This effort will also aid in addressing one of the most under-evaluated processes of developing high speed devices onto a new and novel technology platform which is robustness and reliability. We have already made extensive progress with our polymer materials on this front, and now we are integrating our robust polymer materials onto an integrated photonics platform to provide customers with a more miniaturized, higher performance solution for their data rich systems.

While our initial focus is to address data communications and telecommunications network applications along with cloud computing/data center needs, we believe that in the future we will have additional opportunities over and above G-AI to address other applications such as: backplane optical interconnects, photovoltaic cells, medical applications, satellite reconnaissance, navigation systems, radar applications, optical filters, spatial light modulators; and all-optical switches.

Electro-Optic Polymer Production – Our Approach vs. the BLA Approach

Our Electro-Optic Material Approach

Our core material expertise relates to the production of high-performance, high-stability electro-optic polymers for high-speed (wide bandwidth) telecommunication and data communications applications. More specifically, it lies in a less mainstream, yet firmly established, scientific phenomenon called aromaticity. Aromaticity causes a high degree of molecular stability. It is a molecular arrangement wherein atoms combine into multi-membered rings and share their electrons among each other. Aromatic compounds are stable because the electronic charge distributes evenly over a great area preventing hostile moieties, such as oxygen and free radicals, from finding an opening to attack.

Previous and Current Competitive Organic Electro-Optic Polymer Efforts

For the past several decades, diverse corporate interests, including, to our knowledge, IBM, Lockheed Martin, DuPont, AT&T Bell Labs, Honeywell, Motorola, HP, 3M, and others in addition to numerous universities and U.S. Government Agencies, have attempted to produce high-performance, high-stability electro-optic polymers for high-speed (wide bandwidth) telecommunication applications. These efforts were largely unsuccessful due, in our opinion, to the industry's singular adherence to an industry pervasive engineering model known as the Bond Length Alternation ("BLA") theory model, which none of our patented molecular designs rely upon. The BLA model, like all other current industry-standard molecular designs, consists of molecular designs containing long strings of atoms called polyene chains. Longer polyene chains provide higher electro-optic performance, but are also more susceptible to environmental threats, which result in unacceptably low-performing, thermally unstable electro-optic polymers.

As a result, high frequency modulators engineered with electro-optic polymers designed on the BLA model or any other polyene chain design models are unstable over typical operating temperature ranges, and often exhibit performance degradation within days, hours or even minutes. Similarly, lower frequency modulators exhibit comparable failings, but to a lesser extent. These flaws, in most cases, have prevented commercial quality polymer-based modulators from entering the commercial marketplace. The thermal stability of these devices does not generally meet the minimum Telcordia GR-468 operating temperature range (-40 degrees Celsius to +85 degrees Celsius) much less the harsher MILSPEC 883D (military specification) range of -55 degrees Celsius to 150 degrees Celsius. While many new applications do not require meeting full military or Telcordia GR-468 specifications for polymers, many potential customers prefer to see polymer operate at or near these conditions to convey confidence in the material system. We understand from initial conversations with data center architects and designers that the temperature specifications that our materials achieve are compliant with their equipment design needs.

We are aware of other academic and commercial development efforts—some by larger companies with vastly more financial resources than we possess. However, we believe that no one yet has developed organic polymer materials that have demonstrated the combination of thermal stability, photochemical stability and reliability that can meet or exceed commercial specifications.

Our Electro-Optic Photonic P^2IC™ Device Approach

Our electro-optic devices are built around our proprietary organic polymer material systems that we believe will enable better performance than the current embedded legacy technology built around inorganic materials. We also believe that the inherent flexibility of being able to apply our organic polymer materials in liquid thin-film form will accelerate the move toward ultra-miniaturization of Polymer Photonic Integrated Circuits (P^2IC^{TM}) by increasing the number of photonic circuits on a single chip. Polymer photonics is the application of polymers on to a platform such as silicon where there are both active and passive photonic component designs. In polymer photonics, polymer devices such as modulators, waveguides, and multiplexers can be fabricated on to a silicon platform that acts as a package as well as a base for mounting lasers (which are needed to source the light).

Our initial device, though highly miniaturized, utilizes conventional design and fabrication techniques in the industry. Our future devices will utilize silicon photonics (SiPh) technology, which can support highly miniaturized slot waveguides structures etched in large format (200mm), low cost, and less expensive silicon wafers coated with our organic electro-optic polymers. The low-cost structure compares well to compound semiconductor technologies such as GaAs (Gallium arsenide) and InP (Indium Phosphide), which suffer from small format wafers that do not allow the economies of scale in high volume fabrication plants. The degree of miniaturization possible of the slot modulator using SiPh is not technically feasible to accomplish with inorganic crystalline materials. Although this may not always remain the case, presently there are nearly insurmountable technical difficulties that are inherent to a crystalline molecule. We now have the capability to model, simulate and design photonic integrated circuits (PICs) in-house and we are currently developing 4 channel electro-optic polymer modulators.

Our Intellectual Property

Our research and development efforts over the last 10+ years have yielded our Company an extensive patent portfolio as well as critical trade secrets, unpatented technology and proprietary knowledge related to our optical polymer materials. Our intellectual property portfolio has expanded significantly over the few years as we are developing our P^2IC™ into prototypes. We have actively filed technical utility patents and are currently in the process of readying a number of other inventions for formal filings in 2024 and 2025. We expect to continue innovating with our P^2IC platform over the next decade. We had additional patents issued or published over the past year indicating that our technology is being recognized as being unique.

In 2018, we acquired the polymer technology intellectual property assets of BrPhotonics Productos Optoelectrónicos S.A., a Brazilian corporation, which significantly advanced our patent portfolio of electro-optic polymer technology with 15 polymer chemistry materials, devices, packaging and subsystems patents and further strengthened our design capabilities to solidify our market position as we prepare to enter the 400Gbps integrated photonics marketplace with a highly competitive, scalable alternative to installed legacy systems.

In 2022, we acquired the polymer technology and intellectual property assets of Chromosol Ltd (UK), which significantly strengthened our Company's design capabilities with foundry PDKs with extremely low temperature atomic layer deposition (ALD) processes that effectively hermetically seal polymer devices that have been prepared for high volume manufacturing. The advanced fabrication processes of ALD with temperatures below 100C will solidify our market position with both the Company's manufacturing foundry partners as well as end-users as we prepare to enter the 800Gbps integrated photonics marketplace. The acquisition also advanced our Company’s patent portfolio of electro-optic polymer technology with an innovative polymer chemistry device patent that has potential to increase the performance of integrated modulators through optical amplification in a photonic integrated circuit (PIC) and enhance the functionality of the PIC by integrating laser light sources made using the polymer-based gain and a laser optical cavity defined on the Silicon photonic platform, with our Company’s high speed, high efficiency modulators.

In total, our patent portfolio currently consists of 67 granted patents that include 54 from the US, 1 from World International Property Organization (WIPO), 1 from Canada, 6 from the EU, 2 from Japan and 3 from China.

Our materials patent portfolio has also strengthened significantly with the filing of additional new patent applications on our core Perkinamine™ molecular compounds as well as recent, innovative inventions that are expected to protect our P^2IC polymer PIC platform from potential competition.

Included in our patent portfolio are the following nonlinear optic chromophore designs:

- Stable Free Radical Chromophores, processes for preparing the same
- Stable Free Radical Chromophores, processes for preparing the same
- Tricyclic Spacer Systems for Nonlinear Optical Devices
- Anti-Aromatic Chromophore Architectures
- Heterocyclical Anti-Aromatic Chromophore Architectures
- Heterocyclical Chromophore Architectures
- Heterocyclical Chromophore Architectures with Novel Electronic Acceptor Systems
- Multi-fiber/port hermetic capsule sealed by metallization and method

Our patent portfolio includes patents not only on nonlinear optic chromophore designs, but also device designs and inventions, fabrication process inventions, packaging design inventions, as well as novel chemistry to enable high performance, low power, small footprint polymer PIC technology.

Our strategic plan is to utilize our core proprietary technology and leverage our proprietary optical materials to be the core of and the enabling technology for future generations of optical devices, modules, sub-systems and systems that we will develop or potentially out-license to electro-optic device manufacturers. Our Company contemplates future applications that may address the needs of semiconductor companies, automotive/LiDAR companies, sensing companies, aerospace companies and government agencies.

We rely on a combination of patents, patent applications, trademarks, trade secrets and contractual provisions to protect our technologies. Further, employees are required to surrender any inventions or intellectual property developed as part of their employment agreements. We also have a policy of requiring prospective business partners to enter into non-disclosure agreements (NDAs) before disclosure of any of our confidential or proprietary information. Our Company can make no assurances that we will be able to effectively protect our technologies and know-how or that third parties will not be able to develop similar technologies and know-how independently.

Recent Significant Events and Milestones Achieved

During February and March 2018, we moved our Newark, Delaware synthetic laboratory and our Longmont, Colorado optical testing laboratory and corporate headquarters to office, laboratory and research and development space located at 369 Inverness Parkway, Suite 350, Englewood, Colorado. The 13,420 square feet Englewood facility includes fully functional 1,000 square feet of class 1,000 cleanroom, 500 square feet of class 10,000 cleanroom, chemistry laboratories, and analytic laboratories. The Englewood facility streamlines all of our Company’s research and development workflow for greater operational efficiencies.

During March 2018, our Company, together with our packaging partner, successfully demonstrated packaged polymer modulators designed for 50Gbaud, which we believe will allow us to scale our P^2IC™ platform with our Mach-Zehnder ridge waveguide modulator design as well as other photonics devices competitively in the 100Gbps and 400Gbps datacom and telecommunications applications market. We are currently fine-tuning the performance parameters of these prototypes in preparation for customer evaluations.

During June 2018, our Company Acquired the Polymer Technology Intellectual Property Assets of BrPhotonics Productos Optoelectrónicos S.A., a Brazilian corporation, which significantly advanced our patent portfolio of electro-optic polymer technology with 15 polymer chemistry materials, devices, packaging and subsystems patent and further strengthened our design capabilities to solidify our market position as we prepare to enter the 400Gbps integrated photonics marketplace with a highly competitive, scalable alternative to installed legacy systems.

Also, during June 2018, our Company promoted polymer PICs and Solidified Polymer PICs as Part of the Photonics Roadmap at the World Technology Mapping Forum in Enschede, Netherlands, which includes our Company’s technology of polymers and polymer PICs that have the potential to drive not only 400Gbps aggregate data rate solutions, but also 800Gbps and beyond.

In August 2018 we announced the completion (ahead of schedule) of our fully equipped on-site fabrication facility, where we are expanding our high-speed test and design capabilities. We also announced the continuation of the building of our internal expertise with the hiring of world-class technical personnel with 100Gbps experience.

In February 2019 we announced a major breakthrough in our development of clean technology polymer materials that target the insatiable demand for fast and efficient data communications in the multi-billion-dollar telecom and data markets supporting Internet, 5G and IoT (Internet of Things) webscale services. The improved thermally stable polymer has more than double the electro-optic response of our previous materials, enabling optical device performance of well over 100 GHz with extremely low power requirements. This addition to the family of Perkinamine™ polymers will hold back run-away consumption of resources and energy needed to support ever-growing data consumption demands. We continue to conduct testing of the material and assessment of associated manufacturing processes and device

structures prior to release to full development.

In March 2019 we created an Advisory Board comprised of three world-class leaders in the photonics industry: Dr. Craig Ciesla, Dr. Christoph S. Harder, and Mr. Andreas Umbach. In January 2022 Dr. Ciesla was named to our Board of Directors, and our Advisory Board is currently comprised of Dr. Franky So, Dr. Christoph S. Harder, Mr. Andreas Umbach and Dr. Joseph A. Miller, who is a former member of our Board of Directors. The Advisory Board is working closely with our Company leadership to enhance our Company's product positioning and promote our polymer modulator made on our proprietary *Faster by Design*™ polymer P^2IC™ platform. The mission of the Advisory Board is initially to increase our Company's outreach into the datacenter interconnect market and later to support expansion into other billion-dollar markets. The Advisory Board members have each been chosen for their combination of deep technical expertise, breadth of experience and industry relationships in the fields of fiber optics communications, polymer and semiconductor materials. Each of the Advisory Board members has experience at both innovators like Lightwave Logic and large industry leaders of the type most likely to adopt game-changing polymer-based products. In addition, they possess operational experience with semiconductor and polymer businesses.

Also, in March 2019, our Company received the "Best Achievement in PIC Platform" award for our 100 GHz polymer platform from the PIC International Conference. The award recognizes innovative advances in the development and application of key materials systems driving today's photonic integrated circuits (PICs) and providing a steppingstone to future devices.

During the second quarter of 2019, our Company promoted its polymers at CoInnovate in May and the World Technology Mapping Forum in June. CoInnovate is a meeting of semiconductor industry experts. The World Technology Mapping Forum is a group authoring a photonics roadmap out to 2030.

In September 2019 at the prestigious European Conference on Communications (ECOC) in Dublin, Ireland, we showed measured material response over frequency and the resulting optical data bits stream on our clean technology polymer materials, the newest addition to our family of Perkinamine^{TM} polymers, that meet and exceed of our near-term target speed of 80 GHz. We also released data demonstrating stability under elevated temperatures in the activated (poled to create data carrying capability) state.

In October 2019, we reported that energy-saving polymer technology is highlighted in the recently published Integrated Photonics Systems Roadmap - International (IPSR-I). The roadmap validates the need for low-voltage, high-speed technologies such as ours.

In May 2020, we announced that our latest electro-optic polymer material has exceeded target performance metrics at 1310 nanometers (nm), a wavelength commonly used in high-volume datacenter fiber optics. This material demonstrates an attractive combination at 1310 nm of high electro-optic coefficient, low optical loss and good thermal stability at 85^0 Celsius. The material is expected to enable modulators with 80 GHz bandwidth and low drive power, and has an electro-optic coefficient of 200 pm/V, an industry measure of how responsive a material is to an applied electrical signal. This metric, otherwise known as r33, is very important in lowering power consumption when the material is used in modulator devices. This technology is applicable to shorter reach datacenter operators, for whom decreasing power consumption is imperative to the bottom line of a facility. We considered this a truly historic moment—not only in our Company's history, but in our industry–as we have demonstrated a polymer material that provides the basis for a world-class solution at the 1310 nm wavelength, something which other companies have spent decades attempting to achieve.

In July 2020, we announced the official launch of our new corporate website www.lightwavelogic.com, reflecting ongoing efforts to provide up-to-date information for investors and potential strategic partners. The revamped website offers a clean, modern design integrated with helpful tools and investor relations resources, including a new corporate explainer video, to illustrate the target markets and advantages of Lightwave Logic's proprietary electro-optic polymers.

In August 2020, we announced the addition of Dr. Franky So, a leading authority in the OLED industry, to our Advisory Board. Dr. So is the Walter and Ida Freeman Distinguished Professor in the Department of Materials Science and Engineering at North Carolina State University. Previously, he was the Head of Materials and Device research for OLEDs at OSRAM Opto Semiconductors, as well as Motorola's corporate research lab in the 1990s. Dr. So was an early researcher in electro-optic (EO) polymer modulators at Hoechst Celanese. As a member of the Company's advisory board, Dr. So will work closely with management to enhance Lightwave's product positioning for, as well as the promotion of, its polymer modulators made on its proprietary platform. In addition, he will provide technical support and advisory services to the Lightwave materials and device teams.

On October 7, 2020 we announced the receipt of U.S. Patent number 10,754,093 that improves both the performance and reliability of our high-speed, low-power electro-optic polymer modulators intended for datacenter and telecommunications applications. The patent allows multi-layered electro-optic polymer modulators to perform more efficiently through the design of custom interfaces. These interfaces are designed into the cladding layers that allow optical transmission, electrical conductivity, material integrity, as well as a prevention of solvents affecting adjacent polymer materials. The net impact of all of this allows for our Company's modulators to improve performance across the board, enabling higher reliability in the fiber optic communications environment.

On October 15, 2020, we announced that our proprietary polymer technologies are compatible with currently available integrated photonics platforms. Our proprietary electro-optic materials are currently in the prototyping phase and are fabricated onto standard silicon wafers, and this Polymer Plus™ advancement, driven by the feedback our Company received from potential customers to-date, has allowed our materials to be suitable for additive integration to integrated photonics platforms such as silicon photonics, as well as indium phosphide and other standard platforms – therefore enabling simpler integration by customers. We believe this breakthrough allows a polymer modulator to enhance the performance of existing integrated photonics solutions in the marketplace, enabling higher speed and lower power consumption on foundry-fabricated photonics designs. Since our technology is additive to existing platforms such as silicon photonics, our electro-optic polymers are not actually competing with integrated photonic platforms, but rather enabling them to be more competitive in the marketplace, and it further validates our EO polymer platform as ideally suited to enable optical networking more efficiently than ever.

On October 21, 2020, we announced that we have optimized a robust, photo-stable organic polymer material for use in our next-generation modulators intended to be trialed with potential customers under NDA. Our materials show high tolerance to high-intensity infrared light, common in a fiber optic communications environment and increasingly important as higher density of devices access the network, directly resulting in higher intensity infrared light levels. Our preliminary results suggest that our recently developed electro-optic polymer material, designed based on potential customer input, displays unrivaled light tolerance (also known as photostability) compared to any organic commercial solution in use today. Our results meet both our current internal criteria and address potential customer feedback.

On November 2, 2020, we disclosed results on our polymer material stability testing including further results for electro-optic efficiency for our Company's materials that operate both at 1550nm as well as 1310nm. We demonstrated test materials results for electro-optic efficiency to 4000hrs, improvement in sensitivity to oxygen as part of a broadband exposure test, and stability for polymers exposed to 1310nm light at 100mW.

On November 20, 2020 we announced the receipt of U.S. Patent number 10,591,755 that details an important invention that allows users of electro-optic polymer modulators to not only operate the devices with high speed and low power directly from CMOS IC chips, but gives them the opportunity to avoid the expense, physical footprint and power consumption of high-speed modulator driver ICs. Furthermore, this patent strengthens our freedom of manufacturing, and directly enables our modulators to become more competitive in the marketplace.

On December 16, 2020 we announced the development of a new sealant for our future Chip-on-Board (COB) packaged polymer platform. The sealant, which blocks oxygen and other atmospheric gases, is a key step in our Company's development towards a polymer modulator without a package, an important enabling technology for the industry. We plan to develop the sealant for commercial implementation in our future modulators. Recent results suggest that our electro-optic polymer sealant material displays encouraging barrier properties and is expected to translate to significant improvement in bare chip robustness against atmospheric gases, as compared to existing EO polymer commercial solutions in use today. While the initial measurements are highly promising, our Company plans to continue development work to further optimize the sealant material and barrier performance towards the chip-on-board goal.

On January 13, 2021, we announced the receipt of U.S. Patent number 10,886,694 that details an invention that allows electro-optic polymer modulators to be packaged in a hermetic environment using well-known, high-volume and low-cost fabrication processes that are available in a typical semiconductor fabrication foundry – improving suitability for mass production. Further, the design of this capsule package can improve both the reliability and the coupling interface between fiber optic cables and their laser sources for arrayed photonic integrated circuit solutions. The package can also interpose signals from an underlying circuit board to the polymer modulators, lasers, and other components for data transfer. The hermetic capsule is built from a semiconductor base that contains electrical and optical circuits and components. A hermetic capsule chamber is created by the design of a semiconductor lid that is sealed to the semiconductor base platform by a metallization process. Using standardized fabrication techniques we can now create a package that achieves the performance, reliability, cost, and volume requirements that has been a challenge for the photonics industry for years.

On May 11, 2021, we announced the receipt of U.S. Patent number 10,989,871 that details an invention that allows for improved protective polymer layers in modulators when designed into advanced integrated photonic platforms, better positioning them for high-volume manufacturing processes. The protective layers will enhance electro-optic polymer devices' performance through higher reliability, better optical performance and enable the use of standardized manufacturing processes best suited for mass-production.

On June 7, 2021, we announced that our company's common stock was added to the Solactive EPIC Core Photonics EUR Index NTR as part of the index's semi-annual additions. The index includes global public companies with a common theme of optoelectronics, photonics, and optical technologies in general that range from components, modules, manufacturers, and optical network system companies. This inclusion broadens our exposure to the capital markets community, as well as credibility with potential partners and customers.

On June 16, 2021, we announced test results from new modulators fabricated in 2021, which exceeded bandwidth design targets and achieved triple the data rate as compared to competing devices in use today. The breakthrough new devices demonstrated 3dB electro-optical with electrical bandwidths that exceed 100GHz – with measurements coming close to our Company's state-of-the-art 110GHz test equipment capability. We expect this advancement to have a profound impact on the traffic flow on the internet.

On June 24, 2021, we announced the receipt of U.S. patent number 11,042,051 that details a breakthrough new device design that enables mass-volume manufacturing when designed into advanced integrated photonic platforms. The device design enhances reliability, improves optical mode control and most important, lowers by consumption through the use of direct-drive, low-voltage operation. The patent is entitled, "Direct drive region-less polymer modulator methods of fabricating and materials therefor" and is expected to open the opportunity for low power consumption electro-optic polymers to be developed into large foundry PDKs (process development kits) and be ready for mass volume commercialization. The patent emphasizes our technology platform using fabrication techniques that would naturally fit into foundry PDKs.

On August 4, 2021, we announced that we developed improved thermal design properties for electro-optic polymers used in our Polymer Plus™ and Polymer Slot™ modulators, enabling the speed, flexibility and stability needed for high-volume silicon foundry processes. We successfully created a 2x improvement in r33, while allowing higher stability during poling and post-poling. This provides better thermal performance and enables greater design flexibility in high-volume silicon foundry PDK (process development kit) processes.

On August 9, 2021, we announced the receipt of U.S. patent number 11,067,748 entitled "Guide Transition Device and Method" that covers a new invention that enables enhanced optical routing architectures for polymer-based integrated photonics that can be scaled with partner foundries. This new invention will enable innovative, highly scalable optical routing architectures for integrated photonic platforms. The patent provides novel optical waveguide transition designs using two planes of optical waveguides that are expected to be critical for optical signal routing and optical switching, opening the opportunity for high speed, energy efficient electro-optic polymers to be implemented into foundry PDKs (process development kits) to improve the performance of integrated photonic circuits. This breakthrough technology opens the door for advanced integrated photonics architectural design. We believe the simplicity of the design is ideal for production in foundries and will best position our Company to enable increased data traffic on the internet while using less power.

On September 1, 2021, our Company's common shares began trading on the Nasdaq Capital Market ("Nasdaq"). The Company's Nasdaq listing will help to expand our potential shareholder base, improve liquidity, elevate our public profile within the industry and should ultimately enhance shareholder value.

On September 15, 2021, we announced the receipt of the 2021 Industry Award for Optical Integration from the European Conference on Optical Communications (ECOC), a premier industry exhibition that was held in Bordeaux from September 13-15, 2021. ECOC created the fiber communication industry awards in six categories to put the spotlight on innovation happening within the industry. The awards recognize and highlight key industry achievements in advancing optical components, photonic integration, optical transport and data center innovation. The awards are selected from top industry players, representing significant innovation in photonics integration at our prestigious exhibition.

On September 16, 2021, we announced the achievement of world-record performance for a polymer modulator, as demonstrated in an optical transmission experiment by ETH Zurich, using our Company's proprietary, advanced Perkinamine^{TM} chromophores and Polariton Technologies Ltd.'s newest plasmonic EO modulator, a silicon-photonics-based plasmonic racetrack modulator offering energy-efficient, low-loss, and high-speed modulation in a compact footprint. The groundbreaking results were presented as a post-deadline paper at the prestigious European Conference on Optical Communications (ECOC) industry exhibition and conference in Bordeaux on September 16, 2021. Polariton's plasmonic modulator transmitted 220 Gbit/s OOK and 408 Gbit/s 8PAM. Transmission of an optical signal was conducted over 100 m using a low-voltage electrical drive of 0.6Vp, an on-chip loss of 1 dB, and an optical 3 dB bandwidth of beyond 110 GHz.

On January 3, 2022, we announced the publication of our patent application 20210405504A1 by the United States Patent and Trademark Office (USPTO) – entitled *'Nonlinear Optical Chromophores Having a Diamondoid Group Attached Thereto, Methods of Preparing the Same, and Uses Thereof'* – which significantly improves the overall stability and performance of our electro-optic polymers. The Company's electro-optic chromophores are designed to have one or more diamondiod molecular groups attached to the chromophore. When such chromophores are dispersed in a host polymer matrix, the electro-optic materials result in improved macroscopic electro-optic properties, increased poling efficiency, increased loading as well as increased stability of these materials after poling. The impact of this technology is that it will accelerate the path for very high-speed, low-power electro-optic polymers to be implemented into large foundry process development kits ("**PDKs**") to boost performance of integrated photonic circuits.

On January 3, 2022, we announced that we e nhanced our Company's Foundry Process Development Kit Offering with the addition of Optical Grating Couplers. This expanded design tool kit will enable silicon foundries to implement PDKs and fabricate modulators and optical gratings in a single fab run, further enhancing modulator efficacy. We are continuing to work on additional design tool kit components to enable an expedited commercialization process through a more simplified manufacturing process for our foundry partners.

On January 3, 2022, we announced that we appointed respected industry leader Dr. Craig Ciesla to our Board of Directors and that retired director Dr. Joseph A. Miller transitioned to our Company's Advisory Board. Dr. Ciesla is currently the Vice President, Head of the Advanced Platforms and Devices Group at Illumina, a leading provider of DNA sequencing and array technologies. There he leads a team driving innovation in sequencing platforms, microfluidics, electronics, and nanofabrication. Prior to Illumina, he was Vice President of Engineering at Kaiam, where he was responsible for the development and production of 100G transceivers for the data-center market. He was also the founding CEO of Tactus Technology, an innovator in the user interface industry, where he was the co-inventor of Tactus' polymer morphing screen technology. Before Tactus he had a variety of roles at Intel, JDSU (now Lumentum), Bookham (now Oclaro) and Ignis Optics developing a wide range of products in the fiber-optics market. He started his career at Toshiba Research Europe, where he performed early terahertz images of skin cancer. Dr. Ciesla holds a BSc (Hons.) in Applied Physics and Ph.D. in Physics from Heriot-Watt University in Edinburgh.

On February 10, 2022, we announced breakthrough photostability results on our electro-optic polymer modulators that are compatible with high-volume silicon foundry processes. The improved photostability of our polymers are expected to minimize any optical losses and provide a more robust platform for silicon foundries.

This breakthrough photostability performance is incredibly important as we optimize our polymers for high-volume silicon foundry processes.

On March 7, 2022, we announced the receipt of U.S. patent number 11,262,605 entitled, "Active region-less polymer modulator integrated on a common PIC platform and method." This invention will simplify modulator integration for high-volume foundry manufacturing operations while enhancing polymer reliability to enable a more effective photonic engine. The essence of the invention is a complete optical engine that fits into fiber optic transceivers (either pluggable or co-packaged) that are used in routers, servers and elsewhere in optical networks. The engine is designed for high-volume manufacturing operations using silicon foundry infrastructure. The patent illustrates the use of our polymer modulators as a high speed, low power engine not only for data communication and telecommunication applications, but other new market opportunities as well.

On March 22, 2022 we announced the achievement of world-class results for a polymer modulator, as demonstrated in an enhanced stability and high-speed measurement by Polariton Technologies and ETH Zurich. The results were generated using the Company's proprietary, advanced Perkinamine™ chromophores in Polariton's silicon-photonics-based plasmonic racetrack modulator that offers energy-efficient, low-loss, and high-speed modulation in a compact footprint that is ideal for pluggable and/or co-packaging transceiver modules. The plasmonic modulator performance was compared to that of silicon photonic microring modulators. The plasmonic device, using Lightwave Logic's electro-optic polymer material, was shown to be 250-3000x more stable than the silicon devices relative to operating condition changes. In addition, the plasmonic modulator was tested for 70+ minutes at 100 Gbps NRZ at 80C with no decrease in performance. The world-class results were presented as a contributed peer-reviewed paper at the prestigious 2022 Optical Fiber Conference (OFC2022), the optical communication industry's leading international technical conference and trade show, in San Diego on March 10, 2022.

On April 19, 2022, we announced the publication of our patent application 2022/0113566 A1 entitled "TFP (thin film polymer) optical transition device and method" that illustrates the design of a simpler to fabricate, lower cost hybrid integrated photonics chip using electro-optic polymers which are more advantageous for high-volume production. The invention will simplify polymer modulator fabrication when integrated with silicon photonics for high-volume foundry manufacturing applications. The simplified fabrication approach enables us to simplify the production of very high speed, low power proprietary polymer modulators that will enable significantly faster data rates in the internet environment. The essence of the invention is a hybrid polymer-silicon photonics engine that fits into fiber optic transceivers (either pluggable or co-packaged) that are used in the routers, servers and network equipment that are proliferating with the growth of data centers, cloud computing and optical communications capacity. The hybrid polymer-silicon photonics engine is designed to use high-volume silicon foundry infrastructure.

On May 25, 2022, we announced enhanced photostability results on our Company's proprietary electro-optic polymer modulators – demonstrating the reliability necessary for commercial deployments – all based on a technology which can be ported into high-volume silicon foundries and integrated onto a silicon photonics platform with other optical devices. Photostability is a critical performance metric required both in high volume manufacturing processes (such as photolithography) and in offering the high reliability and network availability required for commercial deployments. In the tests conducted, subjecting the Company's latest polymers to high intensity optical power for over 3000 hours produced no change in device performance. The ability of our proprietary polymers to pass this accelerated photostability aging test provides assurance that they will both tolerate the optical exposures which occur in high-volume manufacturing and support the reliability over the required operating life of optical transceivers and network elements.

On June 21, 2022, we announced the publication of our patent application 2022/0187637A1 entitled "Hybrid electro-optic polymer modulator with silicon photonics" that details a novel fabrication process that allows our Company's proprietary polymers to be fabricated by silicon foundries in a high-volume manufacturing environment. The published patent application also details a more efficient process that allows for high yielding, high stability poling of polymers in a high-volume foundry manufacturing environment. The development of the PDK for this new optical hybrid optical modulator design is now in progress with our Company's foundry partners.

June 23, 2022, we announced the publication of our patent application 2022/0187638A1 entitled " Hybrid electro-optic polymer modulator with atomic layer deposition (ALD) sealant layer" that allows our Company's proprietary polymers to be sealed to moisture and other atmospheric gases in a very low temperature and quasi-hermetic environment through the use of a chip-scale packaging approach that can be applied in parallel at wafer level (i.e. in volume) and that eliminates the need for a separate hermetic enclosure or "gold box." Chip-scale packaging is a technique that has been gathering momentum in the silicon electronics industry for the past decade to reduce device chip packaging costs and increase device performance – enabling high-volume front and back-end manufacturing as well as extremely small sizes in miniaturization. Specifically, our electro-optic polymer modulators are sealed with a low-temperature conformal atomic layer deposition dielectic layers that are supported on a silicon substrate with passive silicon photonics waveguides.

On June 27, 2022 our Company's common stock was added to the Russell 3000 ® Index. We expect that the awareness of being included in one of the most widely followed benchmarks will not only benefit our existing shareholders but will lead to a broader base of institutional investors. The annual Russell index reconstitution captures the 4,000 largest US stocks as of May 6, ranking them by total market capitalization. Our membership in the US all-cap Russell 3000® Index, which remains in place for one year, means automatic inclusion in the small-cap Russell 2000® Index as well as the appropriate growth and value style indexes.

On June 30, 2022, we announced that our CEO, Dr. Michael Lebby, was again invited to co-chair the Photonic Integrated Circuits (PIC) International Conference that took place June 28-29, 2022 in Brussels, Belgium. At the conference, Dr. Lebby led an invited talk entitled, "Enabling lower power consumption optical networking using high speed, low power polymer modulators", focusing on the issue of reducing power consumption in datacenters and optical networks. He also contributed to a panel session, "Hybrid PICs technology challenges and solutions," on the need for hybrid integration addressing the volume production of 3D and 2.5 integrated electronic and photonic integrated circuits (PICs) based on the utilization of large silicon foundries. This included a discussion on the use of silicon photonics with hybrid technologies such as electro-optic polymers, polymer based plasmonics, silicon nitride and III-V laser sources.

On September 22, 2022, we announced the achievement of world record performance for low-power consumption ultra-high-speed 'green' slot modulators in collaboration with Karlsruhe Institute of Technology (KIT) and its spin-off SilOriX as part of a peer-reviewed post-deadline paper presented at the prestigious 2022 European Conference on Optical Communications (ECOC) in Basel, Switzerland on September 22, 2022. The team presented the first sub-1mm Mach Zehnder-type modulators with sub-1V drive voltage that rely on Lightwave's proprietary advanced Perkinamine™ chromophores. The devices rely on the slot-waveguide device concept developed at KIT and commercialized through SilOriX. Further, the material has experimentally proven thermal stability at 85°C and offers extreme energy-efficiency along with high-speed modulation in a compact footprint. Additionally, this shows that our material can perform in a variety of device structures and designs and is positioned to significantly reduce power consumption of optical networking and to become a true 'green photonics' enabler for the industry.

On September 22, 2022, we announced the achievement of a world-record demonstration of a 250GHz super high bandwidth electro-optical-electrical (EOE) link through a collaboration with ETH Zurich. The link was demonstrated by ETH Zurich and uses Polariton's high-speed plasmonic modulators containing Lightwave's proprietary Perkinamine™ chromophores and ETH Zurich's high-speed graphene photodetectors. The link contained a plasmonic modulator using electro-optic polymer material as well as a novel metamaterial enhanced graphene photodetector featuring a 200 nm spectral window and a setup-limited[1] bandwidth of 500 GHz. The EOE link achieved a world record and unprecedented 250 GHz 3dB bandwidth[2]. This is an optical link that utilizes devices with extremely high bandwidths, and the plasmonic demonstration shows that hybrid technologies such as our electro-optic polymers and graphene together form an important technology platform for volume scalability using large silicon foundries for mass commercialization. The groundbreaking results were presented by Stephan Koepfli as part of a peer-reviewed post-deadline paper presented at the prestigious 2022 European Conference on Optical Communications (ECOC) in Basel, Switzerland on September 22, 2022.

On November 15, 2022, we announced the receipt of U.S. patent number 11,435,603 B2 entitled "TFP (thin film polymer) optical transition device and method," which illustrates the design of a simpler to fabricate, lower cost hybrid integrated photonics chip using electro-optic polymers which are more advantageous for high-volume production. The simplified fabrication approach enables streamlined production of very high speed, low power proprietary polymer modulators that will enable significantly faster data rates in the internet environment. The essence of the invention is a hybrid polymer-silicon photonics engine that fits into fiber optic transceivers (either pluggable or co-packaged) that are used in the routers, servers and network equipment that are proliferating with the growth of data centers, cloud computing and optical communications capacity.

On November 17, 2022, we announced the receipt of U.S. patent number 11,435,604 B2 entitled "Hybrid electro-optic polymer modulator with silicon

photonics," which allows Lightwave Logic's proprietary polymers to be fabricated by silicon foundries in a high-volume manufacturing environment. The patent also details a more efficient process that allows for high yielding, high stability poling of polymers in a high-volume foundry manufacturing environment. From a commercial standpoint, this patent enables our polymers to be mass-produced using existing silicon foundry equipment, simplifying production for the foundry's we are working with.

On November 29, 2022, we announced our acquisition of the polymer technology and intellectual property assets of Chromosol Ltd (UK). The acquisition significantly strengthened our Company's design capabilities with foundry PDKs with extremely low temperature atomic layer deposition (ALD) processes that effectively hermetically seal polymer devices that have been prepared for high volume manufacturing. The advanced fabrication processes of ALD with temperatures below 100C will solidify our Company's market position with both the Company's manufacturing foundry partners as well as end-users as we prepare to enter the 800Gbps integrated photonics marketplace. The acquisition also advanced our Company's patent portfolio of electro-optic polymer technology with an innovative polymer chemistry device patent that has potential to increase the performance of integrated modulators through optical amplification in a photonic integrated circuit (PIC) and enhance the functionality of the PIC by integrating laser light sources made using the polymer-based gain and a laser optical cavity defined on the Silicon photonic platform, with our Company's high speed, high efficiency modulators. Having access to extremely low temperature ALD allows our Company's polymer modulators to be protected from the environment without the need for expensive and large footprint gold box packaging, propelling our Company forward with chip-scale packaging as required by major hyper-scaler end-users. The patent opens a new class of PICs which expands our variety of devices. The Patent is US patent number 9837794, EU patent number 3017489, China registration number 201480048236 & 201910230856, and is entitled, "Optoelectronic devices, methods of fabrication thereof and materials therefor."

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[1] Set-up limited' indicates that the measurement was limited by the testing equipment.

[2] University of Kiel, Germany supported the digital signal processor (DSP), and ETHZ supported the photodetector.

On December 12, 2022, we announced the receipt of U.S. patent number 11,506,918 B2 entitled "Hybrid electro-optic polymer modulator with atomic layer deposition (ALD) sealant layer," which allows our proprietary polymers to be sealed to moisture and atmospheric gases in a very low temperature and quasi-hermetic environment through the use of a chip-scale packaging approach that can be applied in parallel at wafer level (i.e. in volume) and that eliminates the need for a separate hermetic enclosure or "gold box." Specifically, our electro-optic polymer modulators will be sealed with low-temperature conformal atomic layer deposition dielectric layers that are supported on a silicon substrate with passive silicon photonics waveguides. The sealant process will enable lower cost system implementation in a high-volume foundry environment.

On December 13, 2022, we provided a world-class figure-of merit performance for modulators using electro-optical polymers and a plasmonic device design in conjunction with Polariton Technologies. Building from the world record performance and demonstration of a 250 GHz super high bandwidth electro-optical-electrical (EOE) link that was presented at the 2022 European Conference on Optical Communications (ECOC)[3] through a collaboration with ETH Zurich, these latest figure of merit results show the potential for extreme power savings for optical network equipment and demonstrated clearly that polymer-based technology platforms are positioned well for general implementation. These results were achieved using Polariton's electro-optic polymer-based plasmonic devices with Lightwave's electro-optic materials, with a bandwidth greater than 250 GHz. While these high-speed results have been reported previously, here Lightwave Logic reported for the first time that the voltage-length product Figure of Merit (FoM) for this modulator is just 60 Vum, which is approximately 10X better than the performance of the optical semiconductor modulators that are incumbent in the optical network and internet today. This figure of merit will allow ultra-low voltage operation and, enabled by Polariton's plasmonic modulator, the ability to carry significantly more data per modulator while consuming much less power. The net positive effect on system level equipment is expected not only to be significant, but perhaps more importantly, also a strong driver of a "green photonics" platform. These results position our Company extremely well for next generation ultra-high-capacity interconnects for the hyper-scale market. The combination of electro-optic polymers and plasmonics is becoming an ideal sunrise technology platform to address the 'Achilles heel' of the data industry: high power consumption. As the industry contemplates the implementation of PAM4 200G lanes for 2023 and 2024, these optical devices already have shown capability for at least 2X these lane speeds.

On January 12, 2023, our Chief Executive Officer, Dr. Michael Lebby, hosted a presentation and participated in an industry panel discussion at the 2023 Photonics Spectra Conference, a prominent virtual conference within the photonics industry. In the panel discussion, Dr. Lebby and a panel of industry experts from the entire photonics integrated chip (PIC) value chain, discussed lessons learned when scaling PIC production for volume applications. In his presentation, Dr. Lebby reviewed the potential solutions that electro-optical polymer modulators offer to integrated and hybrid photonics integrated chips (PICs), discussing their relevance to PIC packaging operations as well as how electro-optic polymers boost PIC speed and power efficiency.

On January 30, 2023, our Chief Executive Officer, Dr. Michael Lebby, participated in an industry panel discussion at the 2023 Laser Focus World Executive Forum. The Laser Focus World Executive Forum is one of the industry's premier events for senior-level executives, technology directors, and business managers from technology companies around the world, delivering an in-depth analysis of the global laser and photonics market. In this discussion, Dr. Lebby joined a panel of industry experts to discuss how the success of Silicon Photonics is based on the premise that it is a semiconductor technology, and hence it can be manufactured in volume by semiconductor fabs. The panel addressed the manufacturing plans of photonic integrated circuits (PICs) by semiconductor fabs and how the photonic industry can transfer their processes to the semiconductor industry.

On March 22, 2023, we announced that our latest commercial-class electro-optic polymer material achieved breakthrough performance metrics at 1310 nanometers (nm), a wavelength popular in hyperscale datacenter applications. These commercial-class improvements include a significantly higher electro-optic coefficient exceeding 200 pm/V, which allows for very low drive power of 1 volt or less. Other characteristics include optimized chromophore loading, superior low optical loss, excellent temporal stability at 85^0 Celsius, and extremely high thermal and photo stability. The breakthrough commercial-class electro-optic material is expected to enable ultra-small footprint modulators with at least 100 GHz bandwidth as well as meeting all critical requirements for pluggable transceivers, on-board optics and co-packaging solutions. Additionally, the achievement of these results at the 1310nm bandwidth positions us for potential near-term licensing opportunities in datacenter applications.

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[3] The groundbreaking results were presented by Stefan Koepfli (ETH Zurich) as part of a peer-reviewed post-deadline paper presented at the prestigious 2022 European Conference on Optical Communications (ECOC) in Basel, Switzerland on September 22, 2022. The post-deadline paper is titled ">500 GHz Bandwidth Graphene Photodetector Enabling Highest-Capacity Plasmonic-to-Plasmonic Links."

In April 2023, our Chief Executive Officer, Dr. Michael Lebby, co-chaired the Photonic Integrated Circuits (PIC) International Conference in Brussels, Belgium. Industry-leading insiders delivered more than 30 presentations spanning six sectors at the conference. The conference provided attendees with an up-to-date overview of the status of the global photonics industry as well as the opportunity to meet many other key players within the community. In addition to serving as co-chair of the event, Dr. Lebby hosted a presentation for in-person attendees within the "Scaling PICs in Volume Using Foundries" track, focusing on the industry's consideration of electro-optic polymer modulators due to their increased modulation speed, lower power consumption, and potential for future multi-Tbps aggregated data-rates in the next decade. Additionally, Dr. Lebby discussed the latest results on foundry fabricated EO polymers, as well as the latest work in photonics roadmaps on both the integrated photonics (PIC) level as well as PIC packaging level.

On May 4, 2023, we announced, that in conjunction with our research partners at the Karlsruhe Institute of Technology and Solarix, the achievement of record optical modulator performance using our Company's latest Perkinamine® Series 5 material at extremely low cryogenic temperatures, delivering the potential to revolutionize applications in supercomputers, quantum circuits and advanced computing systems. Building from the world record performance and demonstration of super high bandwidth, and super low voltage electro-optic modulators with Karlsruhe Institute of Technology and Silorix over the past year, the results have the potential to enable supercomputing and quantum systems to be more competitive than standard computational systems given its faster speeds at low temperatures. This achievement opens huge opportunities to our Company in the areas of supercomputing and quantum systems by giving access to very high data rate, low power optical modulators.

On May 18, 2023, we announced the receipt of U.S. patent number 11,614,670 B2 entitled "Electro-optic polymer devices having high performance claddings

and methods of preparing the same," which is a cutting-edge design technique, enhancing the performance of polymer modulators through the use of innovative polymer cladding design that is amenable for high-volume foundry fabrication when integrated with silicon photonics. The patent details a novel fabrication process that allows our proprietary polymers to perform more effectively and to be fabricated by silicon foundries in a high-volume manufacturing environment. It also introduces a more efficient process for improving the performance of the polymer claddings, leading to increased poling efficiency and lower losses in both optical and RF aspects. This patent is helping us move forward with our commercial discussions through the enabling of enhanced performance and simplified manufacturing of our polymer modulators with silicon photonics.

On May 25, 2023, we announced our Company's first commercial material supply license agreement for our Perkinamine ® chromophore materials. This agreement is to provide Perkinamine® chromophore materials for polymer based photonic devices and photonic integrated circuits (PICs). Supplying licensed materials is one prong of our Company's three-prong revenue model and business strategy that includes polymer modulator products as well as technology transfer. This agreement recognizes market acceptance and competitive advantage of our technology and validates the first prong of our business model. Further, it represents tangible commercial progress for electro-optic polymers as part of our business plan.

On May 31, 2023, we announced the receipt of U.S. patent number 11,661,428 entitled "Nonlinear Optical Chromophores, Nonlinear Optical Materials Containing the Same, and Uses Thereof in Optical Devices," which details an innovative organic chromophore design using a novel 'thiophene bridge' to significantly improve material performance in a production environment. This is accomplished by designing thiophene-containing bridging groups that are positioned between the electron-donating and electron-accepting ends of the chromophore. These designs provide nonlinear optical chromophores with significantly improved optical properties and improved stability. We expect this patent will help us progress our commercial discussions with potential customers.

In June 2023, we announced the publication of World International Property Organization (WIPO) PCT Patent Publication - PCT Patent No. WO 2023/102066 entitled “Nonlinear Optical Materials Containing High Boiling Point Solvents, and Methods of Efficiently Poling The Same,” which illustrates novel organic chemical structural designs that offer increased poling efficiency, as well as thermal stability for electro-optic materials. These designs provide non-linear optical chromophores with significantly improved material properties and stability for processing and fabrication by commercial foundries. Specifically, the patent teaches material processing and poling methods that directly leads to significantly enhanced electro-optic efficiency (r33) as compared to previous poling techniques. We consider this WIPO PCT Patent Publication to be a strong step forward in the scaling and volume commercialization of our polymer technology platform.

On August 1, 2023, we appointed respected industry executive Laila Partridge to our Board of Directors. Ms. Partridge brings over 30 years of executive experience in technology, corporate innovation and finance to our Board – having worked with a wide range of technologies, including telecommunications, internet infrastructure, AI, internet of things and more. She was named by Boston Business Journal as one of the ten "2017 Women to Watch in Science and Technology". She currently serves as Founder and Chief Executive Officer of The HardTech Project, a new venture with a novel approach to early-stage hardware investing. Previously, she was Managing Director of the STANLEY + Techstars Accelerator where she directed a global effort for Stanley Black & Decker's Chief Technology Officer to identify and invest in innovative technologies for industrial applications with an emphasis on electrification, sustainability and advanced manufacturing. Prior to that, she began her technology career at Intel Capital, serving as a Director of Strategic Investments. Ms. Partridge began her career at Wells Fargo, where she ultimately achieved the role of VP of Corporate Banking, having led complex corporate finance transactions for the company's senior secured debt agencies in the Midwest. Ms. Partridge brings significant board experience to the Board of Directors, including at Intel Capital serving privately-held technology companies, and in her current role as an independent Director at Cambridge Trust (NASDAQ: CATC). She holds a Bachelor's degree with Honors from Wellesley College.

On August 21, 2023, we announced the completion of new laboratory production facilities, expanding our corporate headquarters by over 65%, nearly 10,000 square feet, for a total of approximately 23,500 square feet to support new commercial activity, including enabling commercial device testing and evaluation, production reliability testing, laser characterization, SEM analysis and the expansion of our Company's chemical synthesis production line.

On October 3, 2023, we announced our receipt of the 2023 Industry Award for Most Innovative Hybrid PIC/Optical Integration Platform from the European Conference on Optical Communications (ECOC) – a premier industry exhibition – held in Glasgow, Scotland from October 2-4, 2023. ECOC is one of the leading conferences on optical communication and attracts top industry minds from across the world. The ECOC awards emphasize technology and product commercialization, highlighting significant achievements in advancing the business of optical communications, transport, networking, fiber-based products, photonic integration circuits and related developments. The Innovative Product category with 5 subcategories looks across the industry at new products driving change in their respective market segment, and what is timely and helping to increase the use of optics. Metrics include design features that are photonics, electronics, thermal, mechanical, chemical, environmental and carbon footprint based.

As we move forward to diligently meet our goals, we continue to work closely with our packaging and foundry partners for 112Gbaud prototypes, and we are advancing our reliability and characterization efforts to support our prototyping. Depending on electrical encoding schemes such as PAM4, or PAM8, or wavelength optical multiplexing, these Gigabaud rates roughly translate to 200Gbps and 300Gbps per lane, and are the key speed rates for emerging 800Gbps to future possible 1200Gbps applications. Our partnership with silicon-based foundries will allow us to scale commercial volumes of electro-optic polymer modulator devices using large silicon wafers, and we are currently working to have our fabrication processes accepted into foundry PDKs (process development kits). These are the recipes that foundries use to manufacture devices in their fabrication plants.

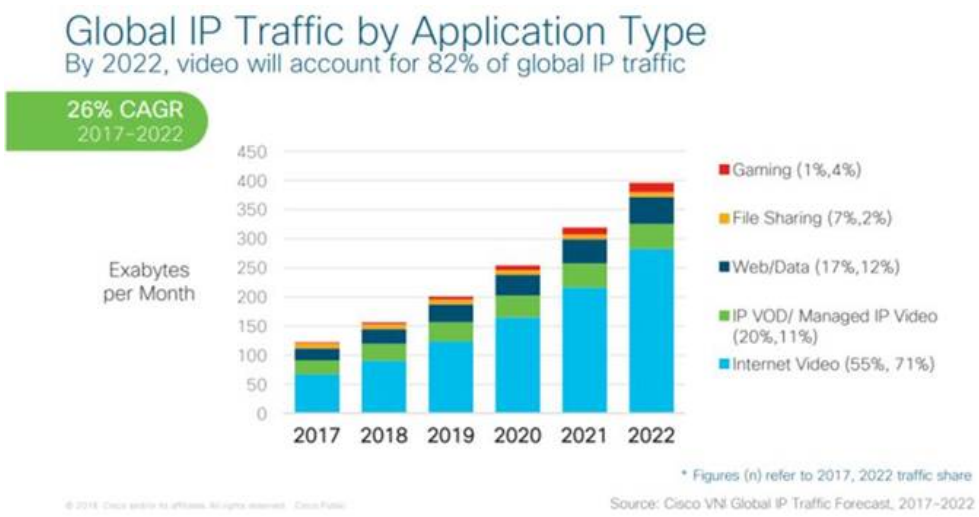
We are actively engaged with test equipment manufacturers of the most advanced test equipment to test our state-of-the-art polymer devices. We continue to engage with multiple industry bodies to promote our roadmap. We continue to fine tune our business model with target markets, customers, and technical specifications. Our business model includes the licensing of our strong IP and Patent portfolio, as well as technology transfer to entities such as foundries. Discussions with prospective customers are validating that our modulators are ideally suited for the datacenter and telecommunications markets that are over 10km in length. Details and feedback of what these prospective customers are seeking from a prototype are delivered to our technical team.

The Global Photonic Device Market

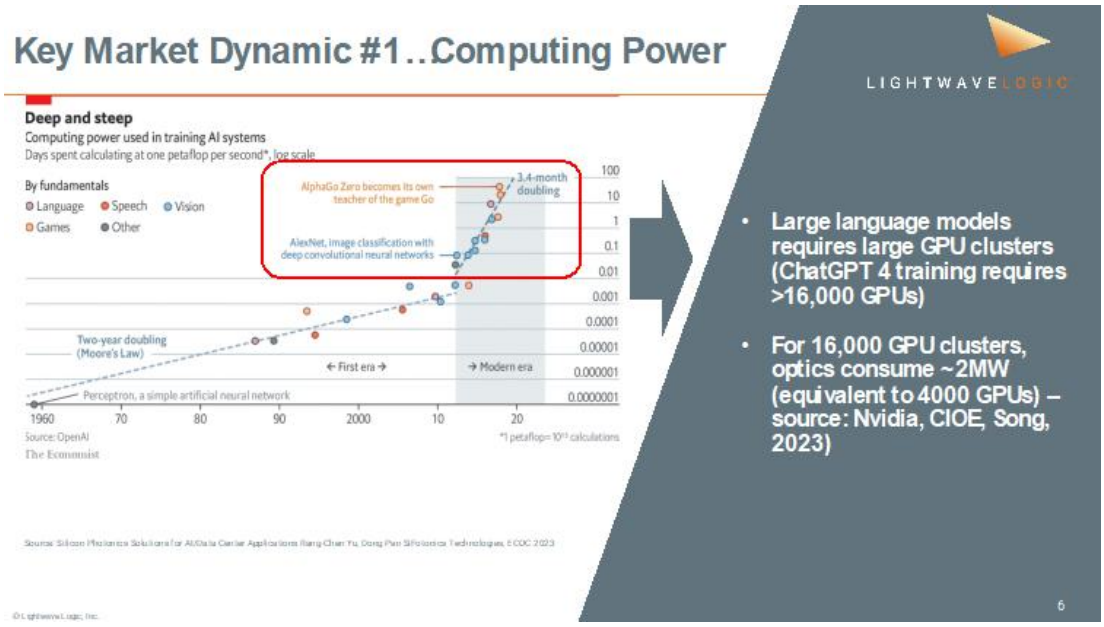
General Overview

Lightwave Logic has been reviewing the latest market data as well as its own internal data for its business strategy, and below we detail the global market dynamics both in terms of data traffic as well as how co-packaged optical solutions which will require optimized modulators will grow in the fiber communications segment of the market.

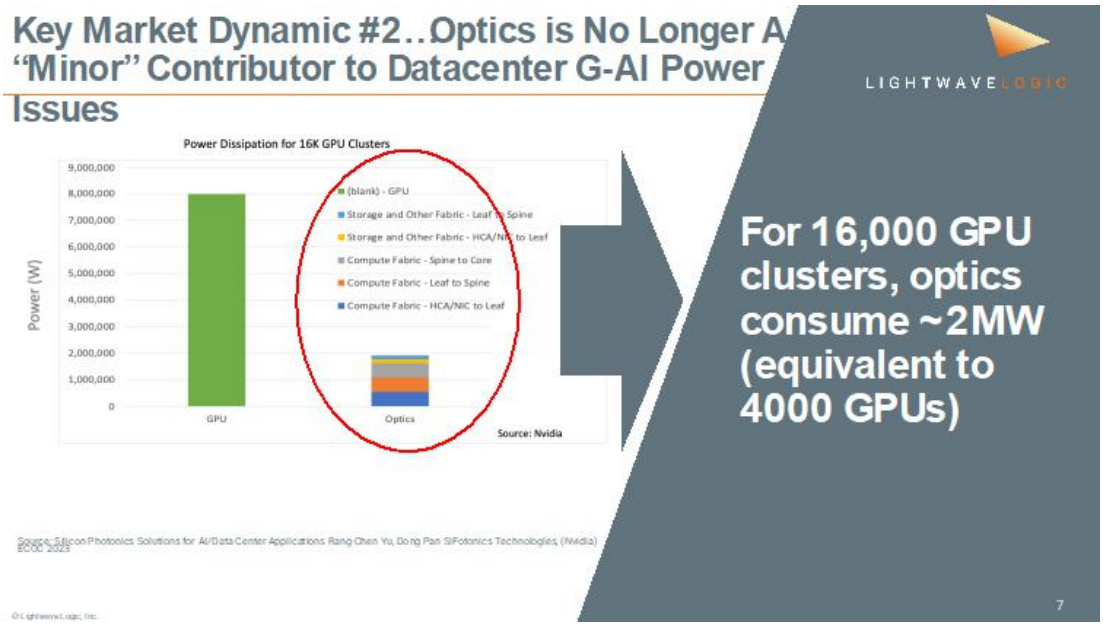
As we have already seen with products such as smart phones, lap top computers, and personal digital assistants (PDAs), Internet traffic, and especially mobile internet traffic is one of the important metrics that is being used to show activity in fiber communications, and particularly telecommunications as well as data communications (which includes datacenters and high-performance computing). Internet Protocol (IP) traffic has typically been used to gauge the amount of data that is being used on the internet as shown in the graph below (sourced from Cisco VNI in 2022). The metric is Exabytes per month. An Exabyte is 1E18 which is 1000 Petabytes, or 1000,000 Terabytes or a billion Gigabytes of data. As seen from the graph which has a strong growth of 26% CAGR (2017-2022) of global IP traffic, with the majority traffic being driven by internet video. The traffic rates are fast approaching the metric of Zetta which is 1E21 bytes of data. Some estimates are discussing the further metric of Yotta which is 1E24 bytes of data over the next decade, which is also expected to be driven for the most part by internet video.



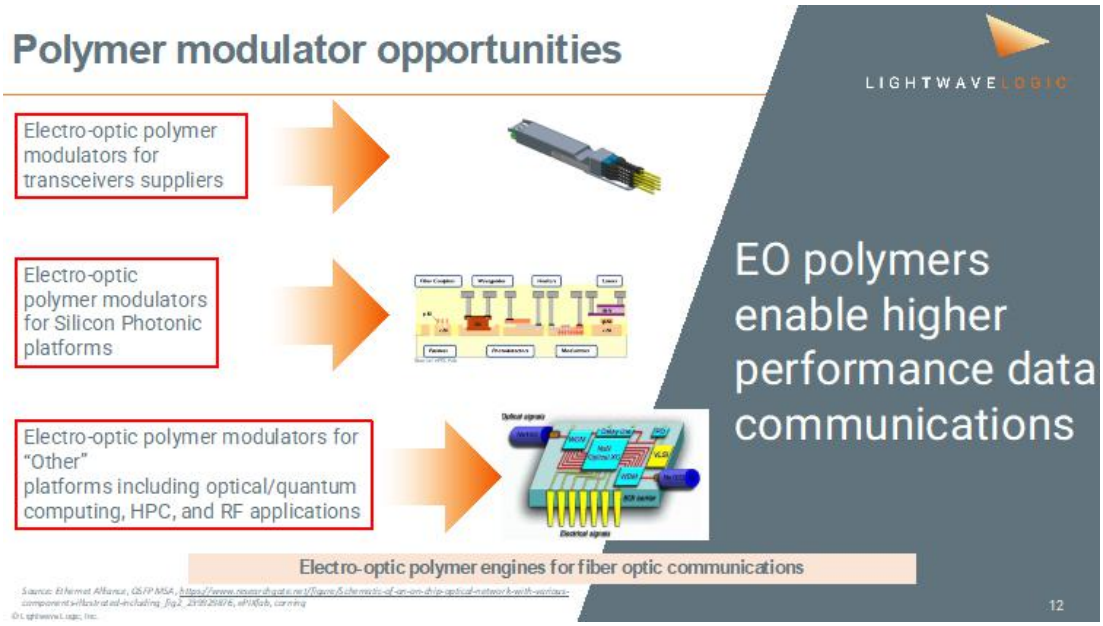
Within the overall market trends of IP traffic growth and in particular mobile video, the internet will need to be able to support high volumes of data traffic. To do this, the fiber-optic infrastructure that allows data to be communicated between network nodes such as datacenters, within datacenters, and optical network switches etc., needs to be upgraded. Today, fiber-optic networks are a combination of long, medium and short optical interconnects that range from 3 meters (or 1yard) to over 1000km depending on application in the optical network. Optical components, typically known as photonics components are used to build the fiber-optic infrastructure and consist of things such as: laser diodes, photodetectors, multipliers, modulators, transceivers etc. These are known as discrete components, while a mix of these components that are integrated or connected on a single substrate (such as silicon, InP, GaAs etc.) are called PICs (Photonic Integrated Components). All of these components are packaged and put into transceivers.



Computing power is increasing significantly in part due to Generative Artificial Intelligenc (G-AI). In the graph above, large language models are requiring large GPU clusters, which is driving more information on the internet. This coupled with the heavy power consumption becomes a driving factor to reduce power in data centers and other nodes that utilize computational processing. The leverage of low power, high speed polymer modulators will alleviate these issues in the near future.

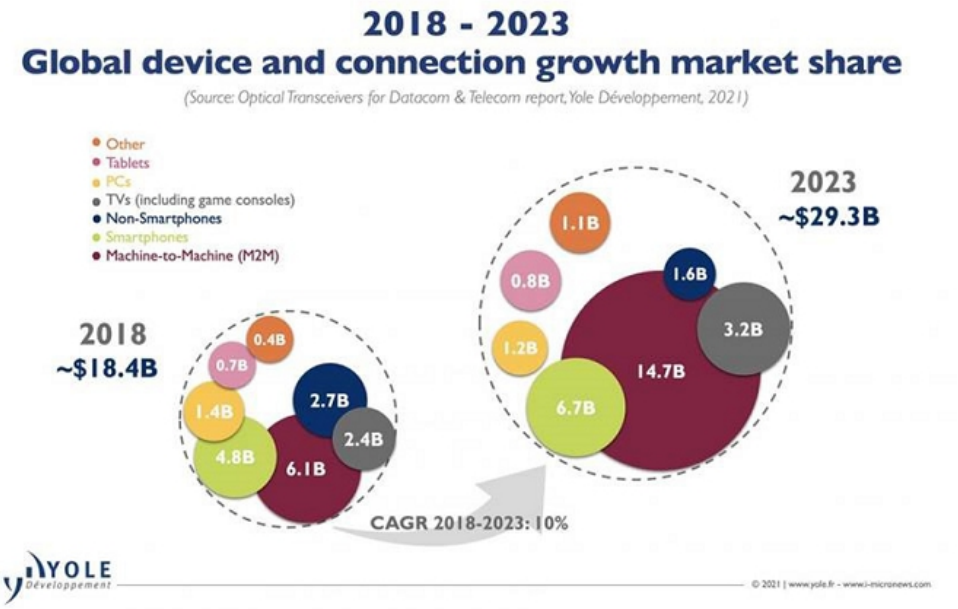


The above graphic shows that for large Graphical Processing Units (GPUs), power consumption is a key metric to be addressed. The graphic also shows that the role of optics is now becoming significant, and lower power optical components and PICs such as polymer modulators have the potential to address and mitigate the growing trend of increased power consumption in G-AI datacenter applications.

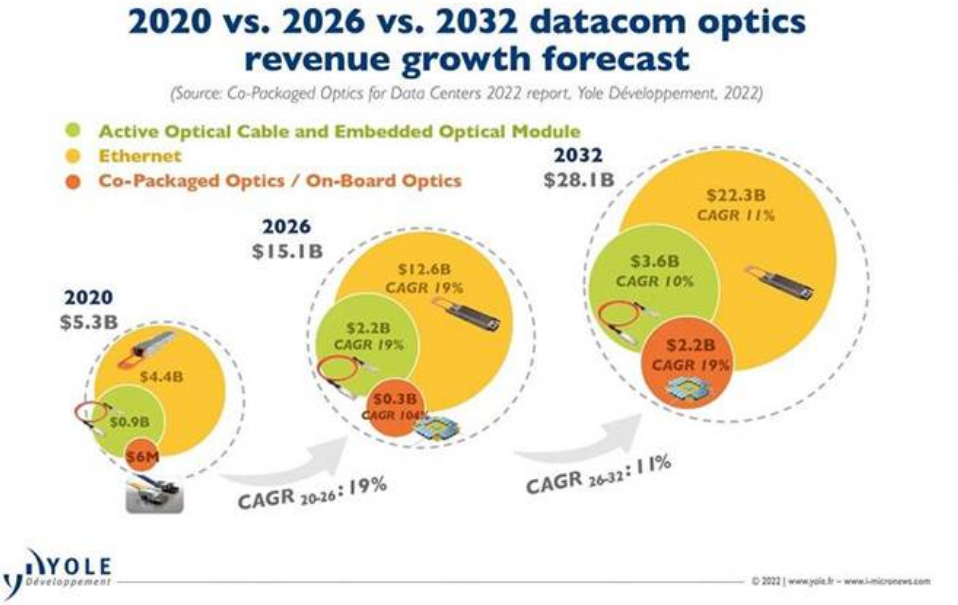


Within the datacenter environment, the power contribution of incumbent modulators is very high and needs to be reduced, especially at the new network nodes of 800Gbps, and more so at 1600Gbps. The role of polymer PIC based electro-optic modulators will be to reduce power consumption at these higher data rates, and provide power competitive fiber optic transceivers at 800Gbps, 1600Gbps and even 3200Gbps in the near future. In the graphic above, there are huge polymer modulator opportunities that include fiber optic transceivers, silicon photonics, and other platforms such as high-performance computing, RF, quantum computing etc. Electro-optic polymers enable higher performance data communcations in a number of fiber optic market verticals.

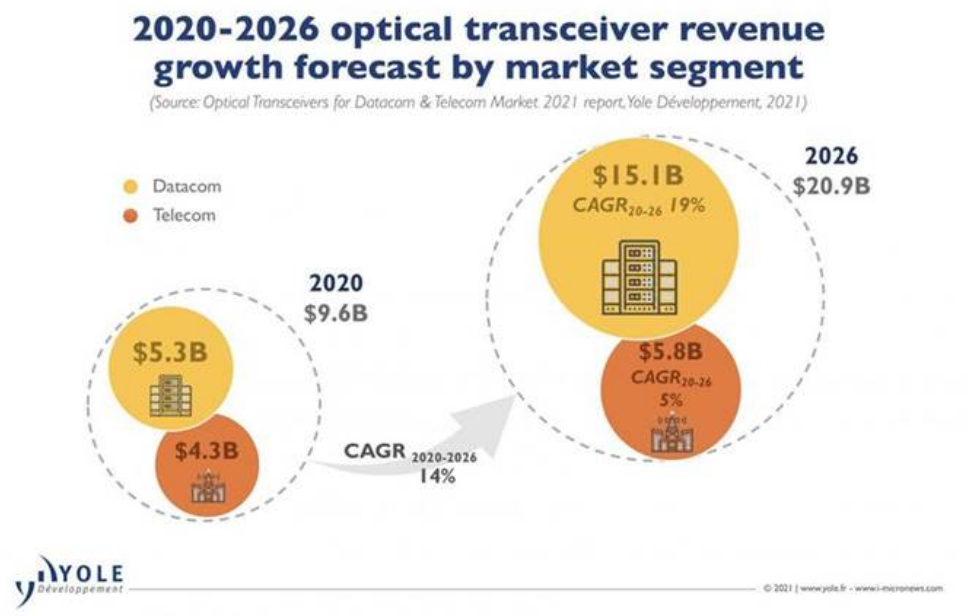
The global device and connection growth market share as forecasted by Yole Developpment (see below) in their optical transceivers for datacom and telecom report (2021) is expected to grow from $18B in 2018 to approximately $30B in 2023 as can be seen by the figure below (Source: Yole Developpment). The compound annual growth is expected to reach a healthy 10% for the period 2018 to 2023. This market has machine to machine market vertical at nearly 50% of the market share by 2023, followed by smartphones, TVs and game consoles, non-smartphones, Personal computers, other, and tablets.



The datacom optics revenue forecast ranging from 2020 through 2026, and onto 2032 is shown in the graphic below. This data is also sourced from Yole Developpment and is reported in their co-packaged optics for data centers report in 2022. The data shows that the datacom optics revenues have grown from nearly $6B in 2020 to a forecast that exceeds $15B in 2026, and over $28B by 2032. The respective compound annual growth rates are a very healthy 19% for 2020-2026, and a healthy 11% for the period 2026-2032. The market is segmented into three major categories that include: Active optical cable and embed optical modules, ethernet, and co-packaged optics/on-board optics. In all of these categories the growth of PIC based engines for optical transceivers being utilized in datacom optics is expected to grow quickly. In all of these segments today, many of the optical engines are either indium phosphide or silicon photonics based. These optical engines are expected to be upgraded with hybrid PIC solutions that improve the overall performance of the PIC.

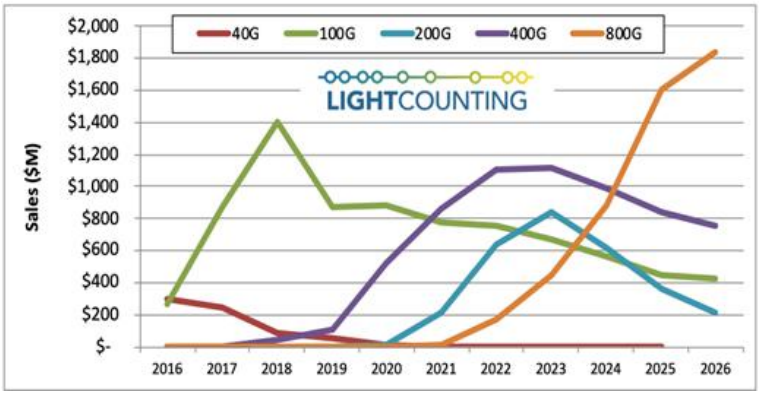


The optical transceiver revenue forecast ranging from 2020 through 2026 by market segment is shown in the figure below. This data is also sourced from Yole Development, and is reported in their optical transceivers for datacom and telecom market report published in 2021. The data shows that the optical transceiver revenues have grown from nearly $10B in 2020 to forecast that approaches $21B in 2026. The respective compound annual growth rates are a healthy 14% for the period 2020-2026. The market is segmented into two major categories that include: Datacom and telecom. In these categories the growth of PIC based engines for optical transceivers being utilized in both datacom and telecom is expected to grow quickly using hybrid solutions that are expected to incorporate electro-optic polymer technologies.



A large driver of the growth of the optical transceiver market is the corresponding growth of - and the "need for speed" by - the large data center operators lead by Amazon. Data sourced from Lightcounting shows the rapid adoption and growth of each generation of speed. As noted earlier, our unique polymer technology platform has inherent advantages for the requirements of 800Gbps. While this graphic does not show market revenue for 1600Gbps and 3200Gbps, these higher performing datarates are being planned on roadmaps today.

Figure: Sales of Ethernet Transceivers to the Top 5 Cloud Companies



As the Company is developing polymer based photonic devices such as fiber-optic modulators, these devices translate electric signals into optical signals and allow laser-based technology to operate effectively at, 100G, 200G, and beyond. Lasers with modulators are used in fiber communication systems to transfer data over fiber-optic networks today and are expected to be a key driver in photonics components for PIC based technological solutions over the next decade. Optical data transfer using lasers and modulators is significantly faster and more efficient than transfer technologies using only electric signals, permitting more cost-effective use of bandwidth for broadband Internet and voice services.

Our Target Markets

Cloud computing and data centers

Big data is a general term used to describe the voluminous amount of unstructured and semi-structured data a Company creates – data that would take too much time and cost too much money to load into a relational database for analysis. Companies are looking to cloud computing in their data centers to access all the data. Inherent speed and bandwidth limits of traditional solutions and the potential of organic polymer devices offer an opportunity to increase the bandwidth, reduce costs, improve speed of access, and to reduce power consumption both at the device as well as the system level.

Datacenters have grown to enormous sizes with hundreds of thousands and even millions of servers in a single datacenter. The number of so-called "hyperscale" datacenters are expected to continue to increase in number. Due to their size, a single "datacenter" may consist of multiple large warehouse-size buildings on a campus or even several locations distributed around a metropolitan area. Data centers are confronted with the problem of moving vast amounts of data not only around a single data center building, but also between buildings in distributed data center architecture. Links within a single datacenter building may be shorter than 500 meters, though some will require optics capable of 2 km. Between datacenter buildings, there is an increasing need for high performance interconnects over 10km in reach.

Our modulators are suitable for single-mode fiber optic links. We believe that our single mode modulator solutions will be competitive at 500m to 10km link distance lengths, with inherent advantages for 800Gbps applications.

Telecommunications/Data Communications

The telecommunications industry has evolved from transporting traditional analogue voice data over copper wire into the movement of digital voice and data. Telecommunication companies are faced with the enormous increasing challenges to keep up with the resulting tremendous explosion in demand for bandwidth. The

metropolitan network is especially under stress now and into the near future. Telecommunications companies provide services to some data center customers for the inter-data center connections discussed above. 5G mobile upgrade, autonomous driving and IoT are expected to increase the need for data stored and processed close to the end user in edge data centers. This application similarly requires optics capable of very high speeds and greater than 10 km reach.

Industry issues of scaling

The key issues facing the fiber-optic communications industry are the economic progress and scalability of any PIC based technological platform. Our polymer platform is unique in that it is truly scalable and is expected to become a high-performance engine for transceiver modules. Scalable means being able to scale up for high-speed data rates, while simultaneously being able to scale down in cost, and lower power consumption. This allows a competitive cost per data rate or cost per Gbps metric to be achieved.

Fiber optic datacenter and high-performance computing customers want to achieve the metric of $1/Gbps @ 800Gbps (this essentially means a single mode fiber optic link that has a total cost of $800 and operates with a data rate of 800Gbps). Equally importantly, the datacenter industry would like to reduce the power consumption of optical ports for 400Gbps, 800Gbps, etc., significantly. As industry tries to match this target, it needs scalable PIC platforms to achieve this goal, of which our polymer platform is uniquely suited.

An article by Dr, Michael Lebby that was recently published in broadband communities (BBC) magazine in early February 2023 discusses the virtues of polymer-based technologies as part of an industry technology roadmap. The article is entitled “The internet is the brick wall Nostradamus did not see coming.” In this article cost/performance metrics are discussed that show the trend to higher and higher data rates using PIC platforms that include very high speed, low power modulator devices.

The article also shows that electro-optic polymers play an important role in PICs over the next decade as they can reduce or close the gap between customer expectations and technical performance through effective scaling increase of high performance with low cost for short distance transceiver optical links.

Some of the things needed to achieve the scaling performance of polymers in integrated photonics platforms is within sight today:

1. Increased r33 (which leads to very low Vpi in modulator devices) and we are currently optimizing our polymers for this. With Vpi levels of 1V or less will enable direct from associated electronics and potentially save network architects the cost of individual driver ICs.

2. Increase temperature stability so that the polymers can operate at broader temperature ranges effective, where we have made significant progress over the past few years.

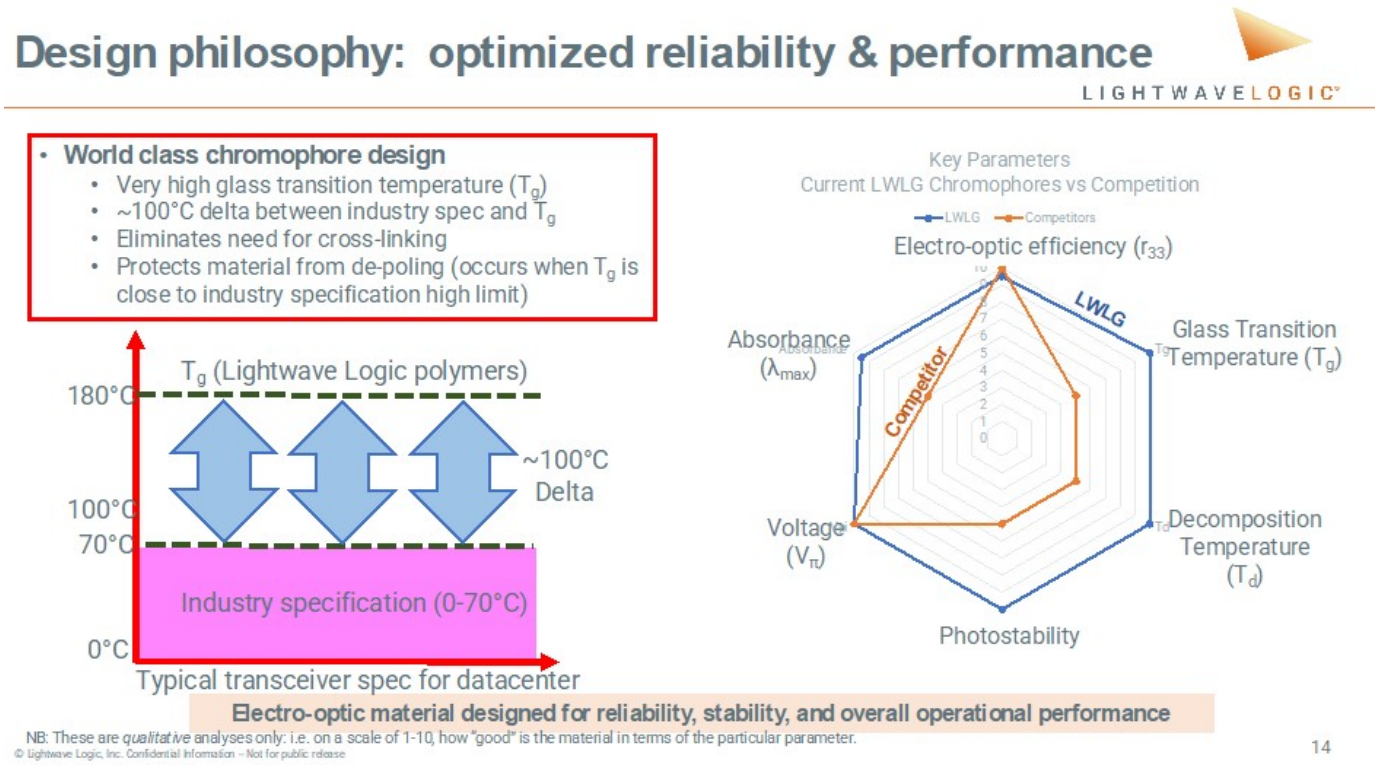
3. Low optical loss in waveguides and active/passive devices for improved optical budget metrics which is currently an ongoing development program at our Company.

4. Higher levels of hermeticity for lower cost packaging of optical sub-assemblies within a transceiver module, where our advanced designs are being implemented into polymer-based packages that utilize atomic layer deposition (ALD) that is being developed in-house.

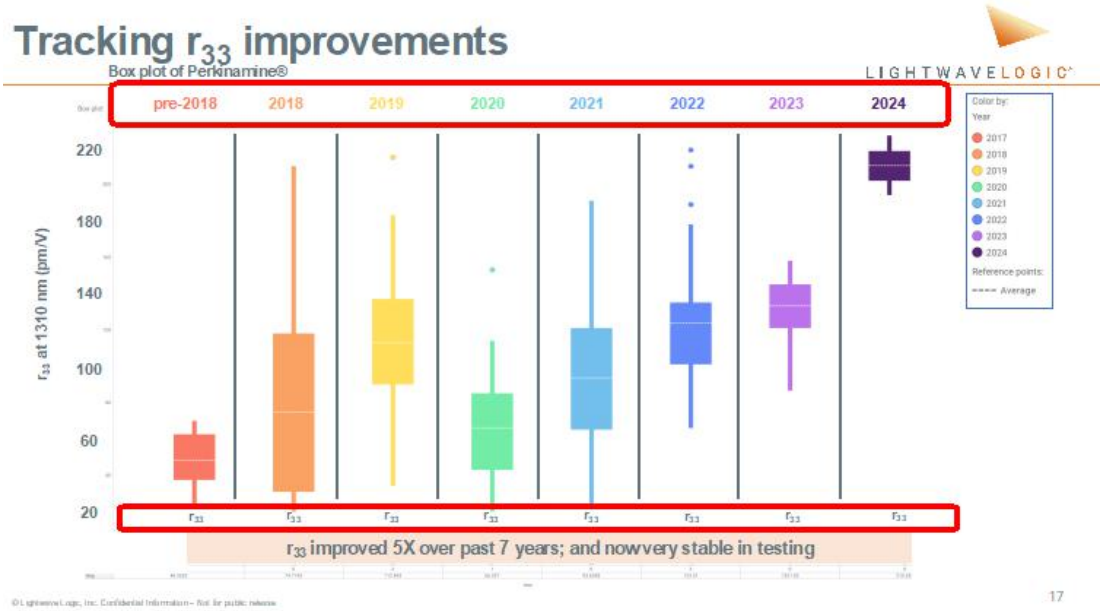
Scalability in terms of cost reduction and high-volume manufacturing can be enhanced by:

1. Leverage of commercial silicon photonics manufacturing capacity through the use of silicon-based foundries. Our Polymer Plus™ platform seeks to be additive to standard silicon photonics circuits.

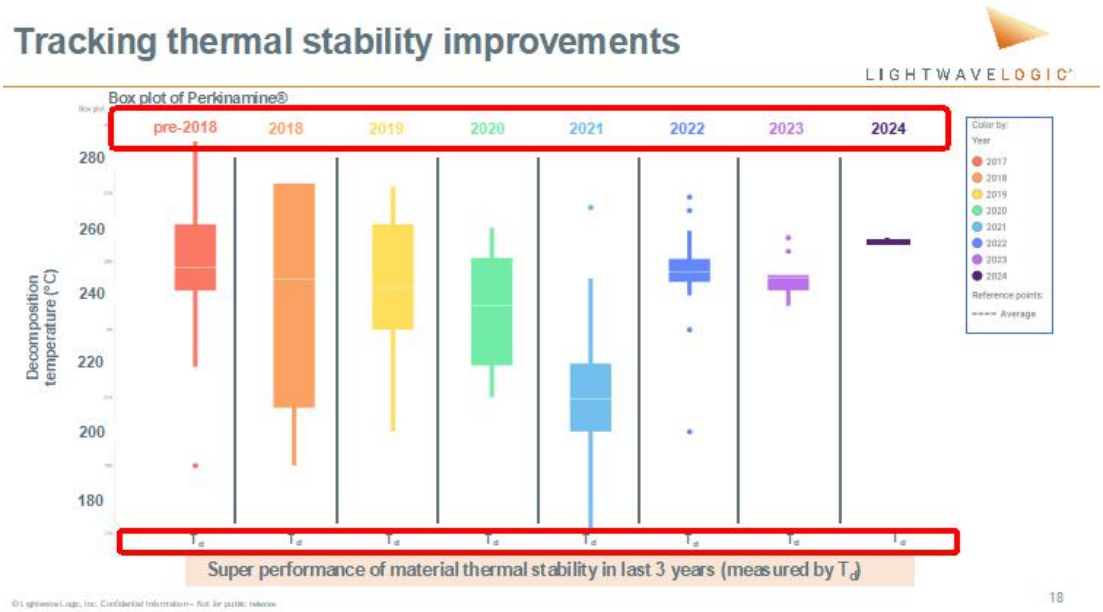
   Reduction of optical packaging costs by integration at the chip level of multiple modulators and also with other optical devices. Our P2IC™ platform seeks to address device integration



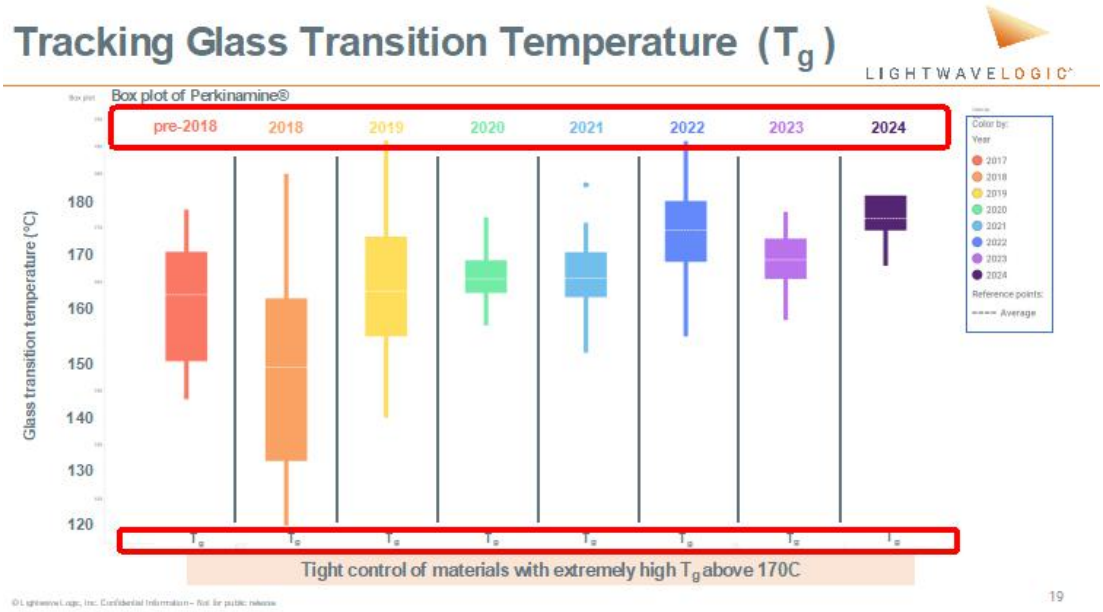
The above graphic shows the Company electro-optic material design philosophy of increased glass transition temperature. When the materials are designed with Tg above 170C, this equates to approximately 100C above the normal operating temperatures in a data center environment. This feature increases the material reliability significantly. Further, as the spider chart on the right of the above graphic indicates that key performance metrics of the Company’s electro-optic chromophores perform well against competition in parameters such as photostability, decomposition temperature, voltage, absorbance, glass transition temperature, and r33 (electro-optic efficiency). This positions the Company’s materials very well in the marketplace and eliminates the need to cross-link the polymers which jeopardizes stability and reliability.



The above graphic shows the increasing trend of improved electro-optic chromophores that have been developed by the Company. The graphic details improvements in r33, a measure of electro-optic efficiency of Perkinamine® electro-optic material. The r33 has improved using a box plot, approximately over 5X during the past 7 years, and is now very stable in testing.



The above graphic shows the increasing trend of improved electro-optic chromophores that have been developed by the Company in respect to decomposition temperature. The graphic details improvements in Td showing through the box plot extremely tight and improved material thermal stability over the past 3 years, and excellent results over the past year.



The above graphic shows the increasing trend of improved electro-optic chromophores that have been developed by the Company in respect to glass transition temperature. The graphic details improvements in Tg showing through the box plot extremely tight and improved material with Tg's above 170C with tight control of the materials performance as measured in thin films.

Business Strategy

Our first revenue stream was obtained from our entry into a material supply license agreement to provide Perkinamine ® chromophore materials for polymer based photonic devices and photonic integrated circuits (PICs). Our Company is also in various stages of photonic device and materials development and evaluation with potential customers and strategic partners. We expect to continue to obtain a revenue stream from technology licensing agreements, and to obtain additional revenue streams from technology transfer agreements and direct sale of our electro-optic device components.

Specifically, our business strategy provides that our revenue stream will be derived from one or some combination of the following: (i) technology licensing for specific product application; (ii) joint venture relationships with significant industry leaders; and (iii) the production and direct sale of our own electro-optic device components. Our objective is to be a leading provider of proprietary technology and know-how in the electro-optic device market. In order to meet this objective, we intend to continue to:

- Further the development of proprietary organic electro-optic polymer material systems
- Develop photonic devices based on our P ^{2}ICTM technology
- Develop proprietary intellectual property
- Grow our commercial device development capabilities
- Partner with silicon-based foundries who can scale volume quickly
- Grow our product reliability and quality assurance capabilities
- Grow our optoelectronic packaging and testing capabilities
- Grow our commercial material manufacturing capabilities
- Maintain/develop strategic relationships with major telecommunications and data communications companies to further the awareness and commercialization of our technology platform
- Add high-level personnel with industrial and manufacturing experience in key areas of our materials and device development programs.

Create Organic Polymer-Enabled Electro-Optic Modulators

We intend to utilize our proprietary optical polymer technology to create an initial portfolio of commercial electro-optic polymer product devices with applications for various markets, including telecommunications, data communications and data centers. These product devices will be part of our proprietary photonics integrated circuit (PIC) technology platform.

We expect our initial modulator products will operate at symbol rates at least 112 Gigabaud which is roughly 200Gbps when utilized with PAM4 encoding schemes. Our devices are highly linear, and can also enable the performance required to take advantage of more advance complex encoding schemes if required.

Our Research and Development Process

Our research and development process consist of the following steps:

- We develop novel polymer materials utilizing our patented and patent pending technology to meet certain performance specifications. We then develop methods to synthesize larger quantities of such material.
- We conduct a full battery of tests at the completion of the synthesis of each new polymer material to evaluate its characteristics. We also create development strategies to optimize materials to meet specifications for specific applications. We model and simulate each new polymer material so that we can further understand how to optimize the material for device operation.
- We integrate data from the material characterization and test results to fabricate devices. We analyze device-testing results to refine and improve fabrication processes and methods. In addition, we investigate alternative material and design variations to possibly create more efficient fabrication processes.
- We create an initial device design using simulation software. Following device fabrication, we run a series of optical and electronic tests on the device.
- We are developing PDKs with commercial silicon-based foundries so that our technology can transfer seamlessly to larger silicon wafer fabrication plants, and scale in volume quickly.

We have and expect to continue to make significant operating and capital expenditures for research and development. Our research and development expenses were $15,903,689, $12,805,374, and $12,476,040 for the years ended December 31, 2023, 2022 and 2021, respectively.

Our Proprietary Products in Development

As part of a tactical marketing strategy, our Company is developing several optical devices using our proprietary electro-optical polymer material, which are in various stages of development. These include:

Ridge Waveguide Modulator, Polymer Stack ™

Our ridge electro-optic waveguide modulator was designed and fabricated in our in-house laboratory. The fabrication of our first in-house device is significant to our entire device program and is an important starting point for modulators that are being developed for target markets. We have multiple generations of new materials that we will soon be optimizing for this specific design. In September 2017 we announced that our initial alpha prototype ridge waveguide modulator, enabled by our P^2IC™ polymer system, demonstrated bandwidth performance levels that will enable 112 Gbaud modulation in fiber-optic communications. This device demonstrated true amplitude (intensity) modulation in a Mach-Zehnder modulator structure incorporating our polymer waveguides. This important achievement will allow users to utilize arrays of 4 x 112 Gbaud symbol rate (4x 200 Gbps data rate) polymer modulators using PAM-4 encoding to enable 800 Gbps data rate systems. These ridge waveguide modulators are currently being packaged with our partner into prototype packages.

These prototype packages will enable potential customers to evaluate the performance at 112 Gbaud. Once a potential customer generates technical feedback on our prototype, we expect to be asked to optimize the performance to their specifications. Assuming this is successful, we expect to enter a qualification phase where our prototypes will be evaluated more fully.

In parallel, we are developing modulators for scalability to higher symbol rates above 112 Gbaud. In September 2018, we showed in conference presentations the potential of our polymer modulator platform to operate at over 100 GHz bandwidth. This preliminary result corresponds to 100 Gbps data rates using a simple NRZ data encoding scheme or 200 Gbps with PAM-4 encoding. With 4 channel arrays in our P^2IC™ platform, the Company thus has the potential to address both 400 Gbps and 800 Gbps markets. While customers may start the engagement at 112 Gbaud, we believe potential customers recognize that scalability to higher speeds is an important differentiator of the polymer technology.

We believe the ridge waveguide modulator Polymer Stack™ represents our first commercially viable device and targets the fiber optics communications market. We have completed internal market analysis and are initially targeting interconnect reach distances of less than 1km. In these markets, the system network companies are looking to implement modulator-based transceivers that can handle aggregated data rates 800 Gbps and above. The market opportunity for less than 10km is worth over $2B over the next decade.

Polymer Plus™

Using our novel waveguide design, we are developing a more compact modulator to be implemented directly with existing integrated photonics platforms such as silicon photonics and Indium Phosphide. As our electro-optic polymers are applied in liquid form, they can be deposited as a thin film coating in a fabrication clean room such as may be found in semiconductor foundries. This approach we call Polymer Plus™. The advantage of this approach is that it allows existing semiconductor integrated photonics platforms such as silicon photonics and indium phosphide to be upgraded with higher speed modulation functionality with the use of polymers in a straight-forward and simple approach. Further, our polymers are unique in that they are stable enough to seamlessly integrate into existing CMOS, Indium Phosphide (InP), Gallium Arsenide (GaAs), and other semiconductor manufacturing lines.

A large majority of commercial silicon photonics platforms utilize large silicon photonics foundries such as those that manufacture IC products for a number of applications such as communications, computing, consumer, etc. In order to seamlessly integrate our polymer materials to upgrade for example, silicon photonics designs, partnering with a silicon foundry is necessary.

Polymer Slot™

As part of supporting further improvement and scalability of our platform, we continue to develop more advanced device structures that include the Polymer Slot™. Our high performance, low power, extremely small footprint polymer photonics slot waveguide modulator utilizes a slot design that is part of PIC platform such as silicon photonics with one of our proprietary electro-optic polymer material systems as the enabling material layer. Performance results in 2023 from commercial foundries achieved key design specifications for the slot modulator.

Preliminary testing and initial data on our polymer photonics slot waveguide modulators fabricated at commercial foundries demonstrated extremely high performance suitable for the hyperscaler and fiber optics markets. The tested polymer photonic slot chip had less than 1-millimeter square footprint, enabling the possibility of sophisticated PIC architecture designs on a single silicon substrate. In addition, the waveguide structure was a fraction of the length of a typical inorganic-based silicon photonics modulator waveguide and is suitable to be used as an engine for state-of-the-art pluggable transceiver modules such as the OSFP and the QSFP-DD.

With the combination of our proprietary electro-optic polymer material and the extremely high optical field concentration in the slot waveguide, the test modulators demonstrated very low operating voltage. Initial speeds exceeded 70GHz in the telecom, 1310nm, and 1550 nanometer frequency bands, and there were devices that exceeded over 100GHz 3dB bandwidth.

We are also continuing our collaborative development of our polymer photonic slot waveguide modulators (Polymer Slot™) with a partner that has advanced device design capabilities using Plasmonic technologies. Some of these devices demonstrated performance levels that exceeded 250GHz in 2022 with our partners.

Our Long-Term Device Development Goal - Multichannel Polymer Photonic Integrated Circuit (P^2IC™)

Our P^2IC™ platform is positioned to address markets with aggregated data rates of 100 Gbps, 400 Gbps, 800 Gbps and beyond. Our P^2IC™ platform will contain several photonic devices that may include, over and above polymer-based modulators, photonic devices such as lasers, multiplexers, demultiplexers, detectors, fiber couplers.

While our polymer-based ridge waveguide and slot modulators are currently under development to be commercially viable products, our long-term device development goal is to produce a platform for the 400 Gbps, 800 Gbps, 1600Gbps and beyond fiber optic transceiver market. This has been stated in our photonics product roadmap that is publicly available on our website. The roadmap shows a progression in speed from 50 Gbaud based modulators to 100 Gbaud based modulators. The roadmap shows a progression in integration in which the modulators are arrayed to create a flexible, multichannel P^2IC™ platform that spans 100 Gbps, 400 Gbps, 800 Gbps, 1.6Tbps (or 1600Gbps), and a scaling philosophy that will grow to 3.2Tbps line rates.

We showed bandwidths of polymer-based modulator devices at a major international conference (ECOC – European Conference on Optical Communications 2018) with bandwidths that exceeded 100GHz. We noted that to achieve 100Gbaud, the polymer-based modulator only needs to achieve 80GHz bandwidth. During ECOC 2019, we showed environmental stability. We continue to develop our polymer materials and device designs to optimize additional metrics. We are now optimizing the device parameters for very low voltage operation. At the ECOC 2022 conference we demonstrated two different world record performances using polymer slot-based modulators.

Other Potential Applications for Our Products

We believe that there are myriad potential applications for our organic polymer materials and devices outside of our initial focus of data communications, telecommunications and data centers. These potential applications encompass areas as diverse as military, space, optical computing, and life sciences. We believe that as viable organic polymer materials gain acceptance, their increased flexibility, functionality and low cost will create new applications that may not yet be technically

feasible. Two such future applications with revolutionary potential are:

All-Optical Switches

An all-optical switch is one that enables signals in optical fibers or networks to be selectively switched from one fiber or circuit to another. Many device designs have been developed and commercialized in today's telecom networks to effect optical switching by using mechanical or electrical control elements to accomplish the switching event. Future networks will require all-optical switches that can be more rapidly activated with a low energy and short duration optical (light) control pulse.

Multi-Channel Optical Modem

The availability of low-cost electro-optic modulators will enable low-cost multichannel optical modems that will use many wavelengths in parallel and employ high efficiency modulation techniques such as QAM (quadrature amplitude modulation). Such modems would enable an order of magnitude increase in the Internet capacity of legacy fiber. Our Company is in the early feasibility stage of such a multichannel optical modem.

Our Past Government Program Participation

Our Company has been a participant in several vital government sponsored research and development programs with various government agencies that protect the interests of our country. The following is a list of some of the various divisions of government agencies that have provided us with advisory, financial and/or materials support in the pursuit of high-speed electro-optic materials. Our previous relationships included:

- National Reconnaissance Office (NRO)
- Properties Branch of the Army Research Laboratory on the Aberdeen Proving Grounds in Aberdeen, Maryland
- Defense Advance Research Project Agency (DARPA)
- Naval Air Warfare Center Weapons Division in China Lake, California
- Air Force Research Laboratory at Wright-Patterson Air Force Base in Dayton, Ohio

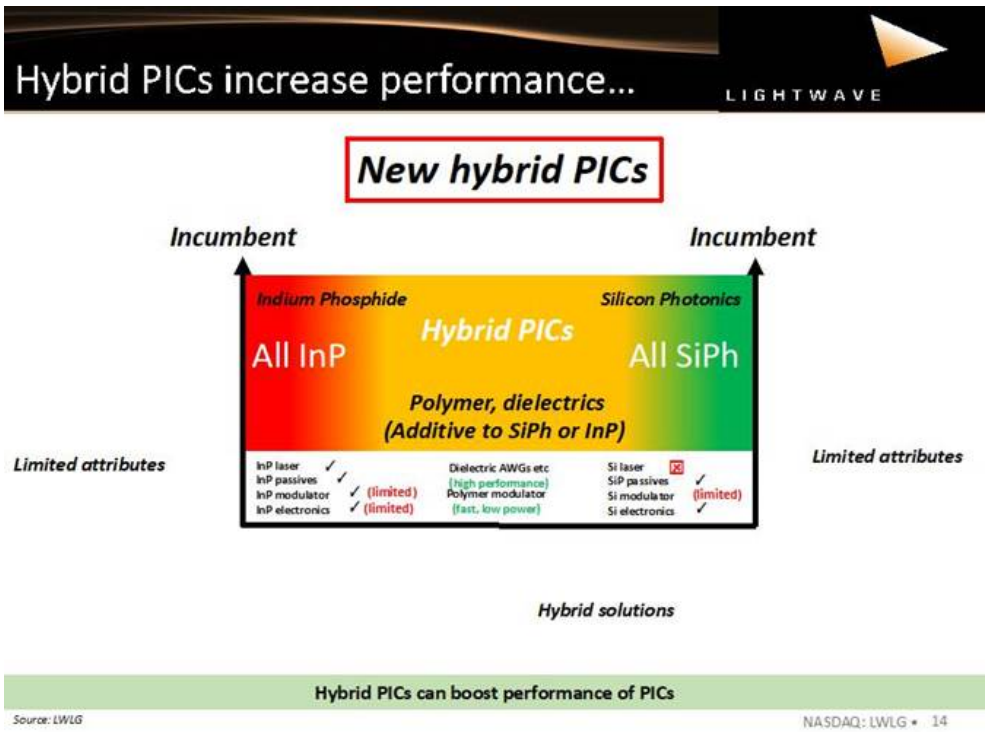
We are aware of a multitude of government programs that include for example the Chips and Science Act amongst others. As noted above, we are not currently partnered with or financially supported by any governmental agency at this time, however, we are exploring future opportunities as our Company grows and gains the additional resources and personnel necessary to support these efforts.

Our Competition

Competitive Technologies - PIC Based Technologies

PIC technologies have historically been driven using III-V compound semiconductors, namely InP, although GaAs remains a strong PIC platform, and is expected to strengthen via the VCSEL based 3D sensing applications. Indium Phosphide has been used since the 1980s as the first PIC platform with laser modulator chips where both the laser and modulator were fabricated monolithically. Since the 1980s, there have been InP based transmitters, receivers, and other functional elements that all support the fiber-communications industry. In fact, over the past 3 decades, the fiber communications industry has driven the increased performance, miniaturization and simplicity in packaging for PIC based technologies. Also, back in the 1980s, 'optoelectronics' was the key word to describe having both electronic and photonic functions or devices on a single chip. This was known in early publications as an optoelectronics integrated circuit (OEIC). Today optoelectronics is synonymous with 'photonics', and hence the common-place use of 'photonics integrated circuits' for PICs.

In the below figure that discusses hybrid PICs, it can be seen in red that the incumbent technology for PICs is InP. InP can provide a number of devices and opportunities in both electronics as well as photonics. InP main weakness from a function standpoint is that although it can provide HFETs, JFETs, bipolar electronic devices, it has not been able to successfully penetrate LSI, VLSI, or ULSI etc., with digital IC circuitry. Chips such as ASICs and DSPs are not practically available with the InP platform – mostly due to advancement in electronic transistor design, and also through limited maturity in large format wafer manufacturing. Today the majority of InP fabrication is based on 4" or 100mm wafers, and only in the past two years have folks been seriously looking at 6" or 150mm InP wafer infrastructure. From the photonics standpoint, there are very good reasons why InP is the incumbent technology – it provides world class performance in lasers, modulators, simple electronics such as drivers and TIAs (transimpedance amplifiers), as well as highly performing active and passive devices such as SOAs, waveguides, spot-size converters, and mux/demux blocks such as AWG and Eschelle gratings.



Over the past decade, the rise of silicon-based photonics has accelerated quickly (as can be seen in green in the Figure). Silicon has a huge history in electronics, and it's been said by many that if the existing infrastructure could be utilized effectively, then the cost of producing photonics with similar fabrication, design, testing, and simulation tools, would become competitive with the current incumbent technology: InP. As can be seen by the figure, silicon is capable of handling many photonics devices in addition to all electronic functionality with CMOS and BiCMOS based technologies. The only photonic device that remains impossible (at least for the time being) is the emitter or laser where light is generated. This has spawned a new segment for silicon photonics (SiPh) where engineers and scientists have developed creative ways to implement InP into device, wafer, and epi-designs that are silicon based. These solutions are typically referred to as heterogeneous solutions or Hybrid PICs where both InP and silicon are utilized to create PIC platforms with emitter or laser-based functionality.

While the red area of the Figure represents the incumbent technology InP, the green areas, Silicon Photonics, the middle areas that are shaded yellow represent PIC based technologies that can utilize either III-V compound semiconductor platforms such as InP, GaAs, even GaN, as well as silicon platforms such as silicon wafers, and various combinations of silicon-based materials such as SOI (silicon on insulator), SiGe etc. The yellow areas are represented by both polymers and dielectric materials that can be deposited onto either silicon or III-V material wafers. These combinations of technology allow flexibility in PIC designs where both polymers and dielectrics can provide a multitude of active and passive photonic devices such as: waveguides (W/G), spot size converters (SSC), modulators (such as Mach Zehnder and slot types), multipliers and demultipliers (Mux/Demux variants such as AWGs, MMI, and Echelle gratings). The interesting part of the polymer and dielectric technology is that combinations of active and passive devices can be mixed and matched with either III-V compound devices as well as silicon based, heterogeneous based devices to design more effective and efficient PICs. For polymers, very low voltage can be utilized for low cost, low power consumption, very high-speed modulators that can be deposited onto a semiconductor platform. For dielectric photonics, very low temperature sensitivity mux/demux devices (such as athermal designs) can be deposited onto a semiconductor platform. As can be seen from the Figure, polymer and dielectric technology suffers from that the fact that high density ICs and laser-based emitters are not available but could be integrated with the appropriate designs for the PIC with III-V compound semiconductors and/or silicon-based technology that have both DSP/ASIC type circuits and laser emitters.

PIC technologies have a number various and broad applications as can be seen by the Figure below and highlighted in green. In this Figure applications range from fiber optic communications (green lines), to other market verticals such as: display/ projection display, automotive/LIDAR for self-driving vehicles, optical sensing/3D, bio-photonic sensing, medical, instrumentation etc. .Market TAMs are forecasted over the next decade with estimations for the opportunities for PICs.

PIC technologies are based upon semiconductor wafers (such as III-V compound semiconductors – InP, GaAs etc.) as well as silicon wafers (which can be tailored to become SiGe heterogeneous, SOI, etc.). As these platforms are semiconductor based, the wafers are processed in fabs or fabrication facilities to produce devices. As a general rule, silicon has the largest wafers with 8" (200mm) and 12" (300mm) format discs. GaAs typically is running 3" (75mm), 4" (100mm) and 6" (150mm) wafers in production fabs or fabrication plants around the world. There is an expectation that GaAs will eventually move to 8" (200mm) wafers in the next 5 years. InP is in production today on 2" (50mm), 3" (75mm) and 4" (100mm) wafers with an expectation to move to 6" (150mm) in the next 5 years. Heterogeneous solutions with silicon photonics that utilize materials such as SiGe and InP are typically 8" (200mm) and 12" (300mm) format wafers. Polymer photonics can be deposited on either III-V compound semiconductor wafers as well as silicon wafers which makes it suitable for the next generation of PIC based technological platforms for the fiber communications industry.

The supply chain for the PIC industry starts with the wafer development and continues through epitaxial growth, device fabrication, optical sub-assembly, module or transceiver builds, and sub-systems which are implemented into optical networking applications. Within these supply chain segments, several combinations of technology can be utilized. For example, CMOS IC circuits can be fabricated onto silicon wafers together with silicon photonics, heterogeneous solutions, that could have the advantage of polymer active devices, and dielectric passive devices on board. InP may be combined with polymer photonics to house on-board or on-wafer emitters to source light for the optical signaling with modulators. Included in the wafers can be combinations of electrical and optical circuitry. Electrical circuitry is usually set up as both as single as well as multilevel interconnects. Optical circuitry is usually set up as a waveguide or optical layer as part of the device fabrication design. PICs can interconnect electrical devices with photonic devices, and also increase chip functionality through the use of electrical and optical active and passive device solutions. Polymer technologies can provide active device function through for example Mach Zehnder modulators, as well as providing passive device function with waveguides, multipliers, and demultipliers.

Competitors

The markets we are targeting for our electro-optic polymer technology are intensely competitive. While there are no major multi-national companies that compete directly with us on electro-polymers, there are other companies that do manufacture optical modulators. These companies that have incumbent optical modulators using semiconductors include: Lumentum, Broadcom, Intel, Ciena, Fujitsu, and Coherent. These companies are heavily invested in the production of crystalline-based semiconductor electro-optic modulator technologies, as well as the development of novel manufacturing techniques and modulator designs.

Smaller companies that compete with us on optical modulators using new and novel technologies include: Hyperlite (who are developing thin film lithium niobate

(TFLN) and Lumiphase (who are developing Barium Titanate or BTO).

Our Plan to Compete

We believe that as our organic polymer technology gains industry acceptance, we will be poised to obtain a significant portion of the component manufacturing market and have our technology become ubiquitous. Electro-optic polymers demonstrate several advantages over other technologies, such as inorganic-based technologies, due to their reduced manufacturing and processing costs, higher performance, and lower power requirements. Our patented organic polymers and future electro-optic photonic devices have demonstrated significant stability advantages over our known competitor's materials.

We believe the principal competitive factors in our target markets are:

- The ability to develop and commercialize highly stable optical polymer-based materials and optical devices in commercial quantities.
- The ability to obtain appropriate patent and proprietary rights protection.
- The ability to create commercial silicon-based PDKs for our electro-optic polymers
- Lower cost, high production yield for these products.
- The ability to enable integration and implement advanced technologies.
- Strong sales and marketing, and distribution channels for access to products.

We believe that our current business planning will position our Company to compete adequately with respect to these factors. Our future success is difficult to predict because we are an early-stage company with most of products still in development.

Many of our existing and potential competitors have substantially greater research and product development capabilities and financial, scientific, marketing and human resources than we do. As a result, these competitors may:

- Succeed in developing products that are equal to or superior to our products and future products or that achieve greater market acceptance than our products and future products.
- Devote greater resources to developing, marketing or selling their products.
- Respond quickly to new or emerging technologies or scientific advances and changes in customer requirements, which could render our technologies or products obsolete.
- Introduce products that make the continued development of our products and/or future products uneconomical.
- Obtain patents that block or otherwise inhibit our ability to develop and commercialize our future products.
- Withstand price competition more successfully than we can.
- Establish cooperative relationships among themselves or with third parties that enhance their ability to address the needs of our prospective customers.
- Take advantage of acquisition or other opportunities more readily than we can.

Employees and Human Capital

We currently have 33 full-time employees, and we retain several independent contractors on an as-needed basis. Based on our current development plan we expect to add 2 additional full-time employees in 2024.

People

As a technology and innovation-driven company, we depend on a highly skilled workforce. Attracting, developing, advancing and retaining the best talent is critical for us to execute our strategy and grow our business. Individuals with technical, engineering, chemistry and other science backgrounds, experience, or interests are particularly important for us to succeed. We strive to advance a diverse, equitable and inclusive work environment.

Technical Team

Our team is composed of world-class technologists, including materials scientists, design engineers, device engineers, synthetic organic chemists, test and material engineers and technicians.

Diversity, Inclusion and Equity

We recognize and view equity as key to our success. We work to create a culture of diversity and inclusion so that all of our employees feel they are respected and treated equally, regardless of gender, race, ethnicity, age, disability, sexual orientation, gender identity, cultural background or religious belief. We strive to provide our employees a diverse, equitable, and inclusive work environment.

Compensation and benefits

Our total rewards package includes market-competitive pay, stock option grants and bonuses, healthcare benefits, retirement savings plans, life insurance, disability insurance, paid time off and family leave, and flexible work schedules.

The principal purposes of our equity incentive plan is to attract and retain employees who will contribute to our Company's long range success, to provide incentives that align the interests of our employees with those of our shareholders, and to promote the success of our Company's business.

Health and Safety

We are committed to providing a healthy environment and safe workplace by operating in accordance with established health and safety protocols within our facility and maintaining a strong health and safety compliance program. We prioritize, manage, and carefully track safety performance at our facility and integrate sound safety practices in every aspect of our operations. We regularly conduct self-assessments to examine our safety culture and processes.

Available Information

We maintain a website at www.lightwavelogic.com. We make available on our website under "Investors" – "Financial & Filings," free of charge, our annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K, and amendments to those reports as soon as reasonably practicable after we electronically file or furnish such material with the SEC. References to our website in this report are provided as a convenience, and the information on our website is not, and shall not be deemed to be a part of this Annual Report on Form 10-K or incorporated into any other filings we make with the SEC. The SEC maintains an Internet site (www.sec.gov) that contains reports, proxy and information statements, and other information regarding issuers that file electronically with the SEC. In addition, we make available on our website under "Investors" – "Corporate Governance", free of charge, our Audit Committee Charter, Compensation Committee Charter, Nominating And Corporate Governance Committee Charter, Operations Committee Charter and Code of Ethics and Business Conduct. In addition, the foregoing information is available in print, without charge, to any stockholder who requests these materials from us.

Item 1A. Risk Factors.

Investing in our common stock is risky. In addition to the other information contained in this Annual Report on Form 10-K, you should consider carefully the

following risk factors in evaluating our business and us. If any of the following events actually occur, our business, operating results, prospects or financial condition could be materially and adversely affected. This could cause the trading price of our common stock to decline and you may lose all or part of your investment. The risks described below are not the only ones that we face. Additional risks not presently known to us or that we currently deem immaterial may also significantly impair our business operations and could result in a complete loss of your investment.

We have incurred substantial operating losses since our inception and will continue to incur substantial operating losses for the foreseeable future.

Since our inception, we have been engaged primarily in the research and development of our electro-optic polymer materials technologies and products. As a result of these activities, we incurred significant losses and experienced negative cash flow since our inception. We incurred a net loss of $21,038,032 for the year ended December 31, 2023, $17,230,480 for the year ended December 31, 2022, and $18,631,381 for the year ended December 31, 2021. We anticipate that we will continue to incur operating losses through at least 2024.

We may not be able to generate significant revenue either through customer contracts for our existing or future products or technologies or through development contracts from the U.S. government or government subcontractors. We expect to continue to make significant operating and capital expenditures for research and development and to improve and expand production, sales, marketing and administrative systems and processes. As a result, we will need to generate significant revenue to achieve profitability. We cannot assure you that we will ever achieve profitability.

We are subject to the risks frequently experienced by early-stage companies.

The likelihood of our success must be considered in light of the risks frequently encountered by early-stage companies, especially those formed to develop and market new technologies. These risks include our potential inability to:

- Establish significant product sales and marketing capabilities;
- Establish and maintain significant markets for our products and future products;
- Identify, attract, retain and motivate qualified personnel;
- Continue to develop and upgrade our technologies to keep pace with changes in technology and the growth of markets using polymer based materials;
- Develop expanded product production facilities, along with silicon-based foundry and other outside contractor relationships;
- Maintain our reputation and build trust with customers;
- Scale up from small pilot or prototype quantities to large quantities of product on a consistent basis;
- Contract for or develop the internal skills needed to master large volume production of our products; and
- Fund the capital expenditures required to develop volume production due to the limits of our available financial resources.

If we fail to effectively manage our growth, and effectively transition from our focus on research and development activities to commercially successful products, our business could suffer.

Failure to manage growth of operations could harm our business. To date, a large number of our activities and resources have been directed at the research and development of our technologies and development of potential related products including work in association with external partners. The transition from a focus on research and development to being a vendor of products requires effective planning and management. Additionally, growth arising from expected synergies from any future acquisitions will require effective planning and management. Future expansion will be expensive and will likely strain management and other resources.

In order to effectively manage growth, we must:

- Continue to develop an effective planning and management process to implement our business strategy;
- Hire, train and integrate new personnel in all areas of our business;
- Expand our facilities and increase capital investments; and
- Continue to successfully partner with silicon-based foundries.

We cannot assure you that we will be able to accomplish these tasks effectively or otherwise effectively manage our growth.

We will require additional capital to continue to fund our operations and if we do not obtain additional capital, we may be required to substantially limit our operations.

Our business does not presently generate the cash needed to finance our current and anticipated operations. Based on our current operating plan and budgeted cash requirements, we believe that we have sufficient funds to finance our operations through July 2025; however, we will need to obtain additional future financing after that time to finance our operations until such time that we can conduct profitable revenue-generating activities. We expect that we will need to seek additional funding through public or private financings, including equity financings, and through other arrangements, including collaborative arrangements. Poor financial results, unanticipated expenses or unanticipated opportunities could require additional financing sooner than we expect. Other than with respect to (i) the purchase agreement for up to $30 million we entered into with Lincoln Park on February 28, 2023 (the "**2023 Purchase Agreement**"); and (ii) the sales agreement for up to $35 million we entered into with Roth Capital Partners, LLC ("**Roth Capital**") on December 9, 2022 (the "**Roth Sales Agreement**"); we have no plans or arrangements with respect to the possible acquisition of additional financing, and such financing may be unavailable when we need it or may not be available on acceptable terms. We currently have a remaining amount of $10.5 million that is available to our Company pursuant to the 2023 Purchase Agreement with Lincoln Park, and $33.4 million that is available to our Company pursuant to the Roth Sales Agreement with Roth Capital.

Our forecast of the period of time through which our financial resources will be adequate to support our operations is a forward-looking statement and involves risks and uncertainties, and actual results could vary as a result of a number of factors, including the factors discussed elsewhere in this Annual Report on Form 10-K. We have based this estimate on assumptions that may prove to be wrong, and we could use our available capital resources sooner than we currently expect.

Additional financing may not be available to us, due to, among other things, our Company not having a sufficient credit history, income stream, profit level, asset base eligible to be collateralized, or market for its securities. If we raise additional funds by issuing equity or convertible debt securities, the percentage ownership of our existing shareholders may be reduced, and these securities may have rights superior to those of our common stock. If adequate funds are not available to satisfy our long-term capital requirements, or if planned revenues are not generated, we may be required to substantially limit our operations.

We are entering new markets, and if we fail to accurately predict growth in these new markets, we may suffer substantial losses.

We are devoting significant resources to develop next generation proprietary photonic devices that are based on our advanced electro-optical polymer material systems for future applications in data communications and telecommunications markets and we are exploring other applications that include automotive/LIDAR, sensing, displays etc. We expect to continue to develop products for these markets and to seek to identify new markets. These markets change rapidly, and we cannot assure you that they will grow or that we will be able to accurately forecast market demand, or lack thereof, in time to respond appropriately. Our investment of resources to develop products for these markets may either be insufficient to meet actual demand or result in expenses that are excessive in light of actual sales volumes. Failure to predict growth and demand accurately in new markets may cause us to suffer substantial losses. In addition, as we enter new markets, there is a significant risk that:

- The market may not accept the price and/or performance of our products;
- There may be issued patents we are not aware of that could block our entry into the market or could result in excessive litigation; and
- The time required for us to achieve market acceptance of our products may exceed our capital resources that would require additional investment.

Our plan to develop relationships with strategic partners may not be successful.

Part of our business strategy is to maintain and develop strategic relationships with private firms, such as packaging companies and silicone-based foundries, and to a lesser extent, government agencies and academic institutions, to conduct research and development and testing of our products and technologies. For these efforts to be successful, we must identify partners whose competencies complement ours. We must also successfully enter into agreements with them on terms attractive to us, and integrate and coordinate their resources and capabilities with our own. We may be unsuccessful in entering into agreements with acceptable

partners or negotiating favorable terms in these agreements. Also, we may be unsuccessful in integrating the resources or capabilities of these partners. In addition, our strategic partners may prove difficult to work with or less skilled than we originally expected. If we are unsuccessful in our collaborative efforts, our ability to develop and market products could be severely limited.

The failure to establish and maintain collaborative relationships may have a materially adverse affect on our business.

We are initially targeting applications in data communications and telecommunications markets and are exploring other applications that include automotive/LIDAR, sensing, displays etc. Our ability to generate significant revenues depends significantly on the extent to which potential customers and other potential industry partners develop, promote and sell systems that incorporate our products, which, of course, we cannot control. Any failure by potential customers and other potential industry partners to successfully develop and market systems that incorporate our products could adversely affect our sales. The extent to which potential customers and other industry partners develop, promote and sell systems incorporating our products is based on a number of factors that are largely beyond our ability to control.

We may participate in joint ventures that expose us to operational and financial risk.

We may participate in one or more joint ventures for the purpose of assisting us in carrying out our business expansion, especially with respect to new product and/or market development. We may experience with our joint venture partner(s) issues relating to disparate communication, culture, strategy, and resources. Further, our joint venture partner(s) may have economic or business interests or goals that are inconsistent with ours, exercise their rights in a way that prohibits us from acting in a manner which we would like, or they may be unable or unwilling to fulfill their obligations under the joint venture or other agreements. We cannot assure you that the actions or decisions of our joint venture partners will not affect our operations in a way that hinders our corporate objectives or reduces any anticipated cost savings or revenue enhancement resulting from these ventures.

If we fail to develop and introduce new or enhanced products on a timely basis, our ability to attract and retain customers could be impaired and our competitive position could be harmed.

We plan to operate in a dynamic environment characterized by rapidly changing technologies and industry standards and technological obsolescence. To compete successfully, we must design, develop, market and sell products that provide increasingly higher levels of performance and reliability and meet the cost expectations of our customers. The introduction of new products by our competitors, the market acceptance of products based on new or alternative technologies, or the emergence of new industry standards could render our anticipated products obsolete. Our failure to anticipate or timely develop products or technologies in response to technological shifts could adversely affect our operations. In particular, we may experience difficulties with product design, manufacturing, marketing or certification that could delay or prevent our development, introduction or marketing of products. If we fail to introduce products that meet the needs of our customers or penetrate new markets in a timely fashion our Company will be adversely affected.

Our future growth will suffer if we do not achieve sufficient market acceptance of our organic nonlinear optical material products or our proprietary photonic devices.

We expect our patented and patent-pending optical materials along with trade secrets and licensed materials, to be the core of and the enabling technology for future generations of optical devices, modules, sub-systems and systems that we will develop or potentially out-license to electro-optic device manufacturers. Most of our products are still in the development stage, and we do not know when a market for these products will develop, if at all. Our success depends, in part, upon our ability to gain market acceptance of our products. To be accepted, our products must meet the technical and performance requirements of our potential customers. OEMs, suppliers or government agencies may not accept polymer-based products. In addition, even if we achieve some degree of market acceptance for our products in one industry, we may not achieve market acceptance in other industries for which we are developing products.

Achieving widespread market acceptance for our products will require marketing efforts and the expenditure of financial and other resources to create product awareness and demand by customers. We may be unable to offer products that compete effectively due to our limited resources and operating history. Also, certain large corporations may be predisposed against doing business with a company of our limited size and operating history. Failure to achieve broad acceptance of our products by customers and to compete effectively would harm our operating results.

Our potential customers require our products to undergo a lengthy and expensive qualification process, which does not assure product sales.

Prior to purchasing our products, our potential customers will require that our products undergo extensive qualification processes. These qualification processes may continue for several months or more. However, qualification of a product by a customer does not assure any sales of the product to that customer. Even after successful qualification and sales of a product to a customer, a subsequent revision to the product, changes in our customer's manufacturing process or our selection of a new supplier may require a new qualification process, which may result in additional delays. Also, once one of our products is qualified, it could take several additional months or more before a customer commences volume production of components or devices that incorporate our products. Despite these uncertainties, we are devoting substantial resources, including design, engineering, sales, marketing and management efforts, to qualifying our products with customers in anticipation of sales. If we are unsuccessful or delayed in qualifying any of our products with a customer, sales of our products to a customer may be precluded or delayed, which may impede our growth and cause our business to suffer.

Obtaining a sales contract with a potential customer does not guarantee that a potential customer will not decide to cancel or change its product plans, which could cause us to generate no revenue from a product and adversely affect our results of operations.

Even after we secure a sales contract with a potential customer, we may experience delays in generating revenue from our products as a result of a lengthy development cycle that may be required. Potential customers will likely take a considerable amount of time to evaluate our products; it could take 12 to 24 months from early engagement by our sales team to actual product sales. The delays inherent in these lengthy sales cycles increase the risk that a customer will decide to cancel, curtail, reduce or delay its product plans, causing us to lose anticipated sales. In addition, any delay or cancellation of a customer's plans could materially and adversely affect our financial results, as we may have incurred significant expense and generated no revenue. Finally, our customers' failure to successfully market and sell their products could reduce demand for our products and materially and adversely affect our business, financial condition and results of operations. If we were unable to generate revenue after incurring substantial expenses to develop any of our products, our business would suffer.

Many of our products will have long sales cycles, which may cause us to expend resources without an acceptable financial return and which makes it difficult to plan our expenses and forecast our revenue.

Many of our products will have long sales cycles that involve numerous steps, including initial customer contacts, specification writing, engineering design, prototype fabrication, pilot testing, regulatory approvals (if needed), sales and marketing and commercial manufacture. During this time, we may expend substantial financial resources and management time and effort without any assurance that product sales will result. The anticipated long sales cycle for some of our products makes it difficult to predict the quarter in which sales may occur. Delays in sales may cause us to expend resources without an acceptable financial return and make it difficult to plan expenses and forecast revenues.

Successful commercialization of our current and future products will require us to maintain a high level of technical expertise.

Technology in our target markets is undergoing rapid change. To succeed in our target markets, we will have to establish and maintain a leadership position in the technology supporting those markets. Accordingly, our success will depend on our ability to:

- Accurately predict the needs of our target customers and develop, in a timely manner, the technology required to support those needs;

- Provide products that are not only technologically sophisticated but are also available at a price acceptable to customers and competitive with comparable products;
- Establish and effectively defend our intellectual property; and
- Enter into relationships with other companies that have developed complementary technology into which our products may be integrated.

We cannot assure you that we will be able to achieve any of these objectives.

One of our significant target markets is the telecommunications market, which historically has not accepted polymer modulators.

One of our significant target markets is the telecommunications market, which demands high reliability optical components. Historically, polymer modulators have not been accepted into this market even though polymer modulators have achieved Telcordia™ based specifications. It is clear that the telecommunications market is demanding higher and higher data rates for its optical components, and may again decide that polymer based modulators are not suitable even if higher data rates, high reliability, and low power consumption are demonstrated.

Another of our significant target markets is the data communications (datacenter and/or high performance computing) market, which may be subject to heavy competition from other PIC based technologies such as silicon photonics and Indium Phosphide.

Another of our significant target markets is the data communications (datacenter and/or high performance computing) market, which may be subject to heavy competition from other PIC based technologies such as silicon photonics and Indium Phosphide. As the demands for high performance, low cost ($/Gbps) is implemented into next generation architectures, polymer modulators and polymer based PIC products may be subject to significant competition. Furthermore, there is a potential that technologies such as silicon photonics and Indium Phosphide might reach the metric of $1/Gbps at 400Gbps before ours . Customers may then be less willing to purchase new technology such as ours or invest in new technology development such as ours for next generation systems.

Our inability to successfully acquire and integrate other businesses, assets, products or technologies could harm our business and cause us to fail at achieving our anticipated growth.

We may grow our business through strategic acquisitions and investments, and we are actively evaluating acquisitions and strategic investments in businesses, products or technologies that we believe could complement or expand our product offering, create and/or expand a client base, enhance our technical capabilities or otherwise offer growth or cost-saving opportunities. From time to time, we may enter into letters of intent with companies with which we are negotiating potential acquisitions or investments or as to which we are conducting due diligence. Although we are currently not a party to any binding material definitive agreement with respect to potential investments in, or acquisitions of, complementary businesses, products or technologies, we may enter into these types of arrangements in the future, which could materially decrease the amount of our available cash or require us to seek additional equity or debt financing. We have limited experience in successfully acquiring and integrating businesses, products and technologies. We may not be successful in negotiating the terms of any potential acquisition, conducting thorough due diligence, financing the acquisition or effectively integrating the acquired business, product or technology into our existing business and operations. Our due diligence may fail to identify all of the problems, liabilities or other shortcomings or challenges of an acquired business, product or technology, including issues related to intellectual property, product quality or product architecture, regulatory compliance practices, revenue recognition or other accounting practices, or employee or customer issues.

Additionally, in connection with any acquisitions we complete, we may not achieve the synergies or other benefits we expected to achieve, and we may incur write-downs, impairment charges or unforeseen liabilities that could negatively affect our operating results or financial position or could otherwise harm our business. If we finance acquisitions using existing cash, the reduction of our available cash could cause us to face liquidity issues or cause other unanticipated problems in the future. If we finance acquisitions by issuing convertible debt or equity securities, the ownership interest of our existing stockholders may be diluted, which could adversely affect the market price of our stock. Further, contemplating or completing an acquisition and integrating an acquired business, product or technology could divert management and employee time and resources from other matters, which could harm our business, financial condition and operating results.

Public health emergencies or outbreaks of epidemics, pandemics, or contagious diseases have disrupted, and could in the future disrupt, our operations and materially and adversely affect our business, financial condition, and results of operations.

Widespread public health emergencies or outbreaks of epidemics, pandemics, or contagious diseases, such as the COVID-19 pandemic, have had, and could in the future have, a material adverse effect on our business, financial condition, and results of operations. The full extent to which a global health crisis may impact our business and operating results would depend on future developments that are highly uncertain and cannot be accurately predicted, including new medical and other information that may emerge as a result and the actions by governmental entities or others to contain it or treat its impact.

The impacts of a severe health crisis could pose the risk that we or our employees, suppliers, customers and others may be restricted or prevented from conducting, or adversely modify, our business activities for indefinite or intermittent periods of time, including as a result of employee health and safety concerns, shutdowns, shelter in place orders, travel restrictions and other actions and restrictions that may be prudent or required by governmental authorities. A global health crisis could also impact our customers' purchasing behavior or decisions, including reduced demand for our products that could continue for an extended period of time.

Any or all of the foregoing in jurisdictions where we or our customers, suppliers, or operations are located have had and could in the future have a material adverse effect on our business, results of operations, cash flows, and financial condition. In addition, fluctuations in demand and other implications associated with public health emergencies have resulted in, and could in the future result in, certain supply chain constraints and challenges.

We may incur debt in the future that might be secured with our intellectual property as collateral, which could subject our Company to the risk of loss of all of our intellectual property.

We currently have no debt to service. If we incur debt in the future, we may be required to secure the debt with our intellectual property, including all of our patents and patents pending. In the event we default on the debt, we could incur the loss of all of our intellectual property, which would materially and adversely affect our Company and cause you to lose your entire investment in our Company.

Our failure to compete successfully could harm our business.

The markets that we are targeting for our proprietary electro-optic polymer systems and photonic devices are intensely competitive. Most of our present and potential competitors have or may have substantially greater research and product development capabilities, financial, scientific, marketing, manufacturing and human resources, name recognition and experience than we have. As a result, these competitors may:

- succeed in developing products that are equal to or superior to our products and future products or that will achieve greater market acceptance than our products and future products;
- devote greater resources to developing, marketing or selling their products;
- respond more quickly to new or emerging technologies or scientific advances and changes in customer requirements, which could render our technologies or products obsolete;
- introduce products that make the continued development of our products and future products uneconomical;
- obtain patents that block or otherwise inhibit our ability to develop and commercialize our products and future products;
- withstand price competition more successfully than we can;
- establish cooperative relationships among themselves or with third parties that enhance their ability to address the needs of our prospective customers.

Our failure to compete successfully against these existing or future competitors could harm our business.

We may be unable to obtain effective intellectual property protection for our products and technology.

Our intellectual property, or any intellectual property that we have or may acquire, license or develop in the future, may not provide meaningful competitive advantages. Our patents and patent applications, including those we license, may be challenged by competitors, and the rights granted under such patents or patent applications may not provide meaningful proprietary protection. For example, numerous patents held by third parties relate to polymer materials and electro-optic devices. These patents could be used as a basis to challenge the validity or limit the scope of our patents or patent applications. A successful challenge to the validity or limitation of the scope of our patents or patent applications could limit our ability to commercialize our polymer materials technology and, consequently, reduce our revenues.

Moreover, competitors may infringe our patents or those that we license, or successfully avoid these patents through design innovation. To combat infringement or unauthorized use, we may need to resort to litigation, which can be expensive and time-consuming and may not succeed in protecting our proprietary rights. In addition, in an infringement proceeding a court may decide that our patents or other intellectual property rights are not valid or are unenforceable, or may refuse to stop the other party from using the intellectual property at issue on the ground that it is non-infringing. Policing unauthorized use of our intellectual property is difficult and expensive, and we may not be able to, or have the resources to, prevent misappropriation of our proprietary rights, particularly in countries where the laws may not protect these rights as fully as the laws of the United States.

We also rely on the law of trade secrets to protect unpatented technology and know-how. We try to protect this technology and know-how by limiting access to those employees, contractors and strategic partners with a need to know this information and by entering into confidentiality agreements with these parties. Any of these parties could breach the agreements and disclose our trade secrets or confidential information to our competitors, or these competitors might learn of the information in other ways. Disclosure of any trade secret not protected by a patent could materially harm our business.

We may be subject to patent infringement claims, which could result in substantial costs and liability and prevent us from selling our products.

Third parties may claim that our products or related technologies infringe their patents. Any patent infringement claims brought against us may cause us to incur significant expenses, divert the attention of our management and key personnel from other business concerns and, if successfully asserted against us, require us to pay substantial damages. In addition, as a result of a patent infringement suit, we may be forced to stop or delay developing, manufacturing or selling products that are claimed to infringe a patent covering a third party's intellectual property unless that party grants us rights to use its intellectual property. We may be unable to obtain these rights on terms acceptable to us, if at all. Even if we are able to obtain rights to a third party's patented intellectual property, these rights may be non-exclusive, and therefore our competitors may obtain access to the same intellectual property. Ultimately, we may be unable to sell our products or may have to cease some of our business operations as a result of patent infringement claims, which could severely harm our business.

If our products infringe the intellectual property rights of others, we may be required to indemnify customers for any damages they suffer. Third parties may assert infringement claims against our current or potential customers. These claims may require us to initiate or defend protracted and costly litigation on behalf of customers, regardless of the merits of these claims. If any of these claims succeed, we may be forced to pay damages on behalf of these customers or may be required to obtain licenses for the products they use. If we cannot obtain all necessary licenses on commercially reasonable terms, we may be unable to continue selling such products.

Our technology may be subject to government rights.

We may have obligations to government agencies in connection with the technology that we have developed, including the right to require that a compulsory license be granted to one or more third parties selected by certain government agencies. It may be difficult to monitor whether these third parties will limit their use of our technology to these licensed uses, and we could incur substantial expenses to enforce our rights to our licensed technology in the event of misuse.

The loss of certain of our key personnel, or any inability to attract and retain additional personnel, could impair our ability to attain our business objectives.

Our future success depends to a significant extent on the continued service of our key management personnel, particularly Dr. Michael Lebby, our Chief Executive Officer and James S. Marcelli our President, Chief Operating Officer, Secretary and Principal Financial Officer. Accordingly, the loss of the services of either of these persons would adversely affect our business and our ability to continue to commercialize our products, and impede the attainment of our business objectives.

Our future success will also depend on our ability to attract, retain and motivate highly skilled personnel to assist us with product development and commercialization. Competition for highly educated qualified personnel in the polymer industry is intense. If we fail to hire and retain a sufficient number of qualified management, engineering, sales and technical personnel, we will not be able to attain our business objectives.

If we fail to develop and maintain the quality of our manufacturing processes, our operating results would be harmed.

The manufacture of our products is a multi-stage process that requires the use of high-quality materials and advanced manufacturing technologies. Also, polymer-related device development and manufacturing must occur in a highly controlled, clean environment to minimize particles and other yield and quality-limiting contaminants. In spite of stringent quality controls, weaknesses in process control or minute impurities in materials may cause a substantial percentage of a product in a lot to be defective. If we are not able to develop and continue to improve on our manufacturing processes or to maintain stringent quality controls, or if contamination problems arise, our operating results would be harmed.

The complexity of our products may lead to errors, defects and bugs, which could result in the necessity to redesign products and could negatively, impact our reputation with customers.

Products as complex as those we market and intend to market might contain errors, defects and bugs when first introduced or as new versions are released. Delivery of products with production defects or reliability, quality or compatibility problems could significantly delay or hinder market acceptance of our products or result in a costly recall and could damage our reputation and adversely affect our ability to sell our products. If our products experience defects, we may need to undertake a redesign of the product, a process that may result in significant additional expenses.

We may also be required to make significant expenditures of capital and resources to resolve such problems. There is no assurance that problems will not be found in new products after commencement of commercial production, despite testing by our suppliers, our customers and us.

If we decide to make commercial quantities of products at our facilities, we will be required to make significant capital expenditures to increase capacity.

We lack the internal ability to manufacture products at a level beyond the stage of early commercial introduction. To the extent we do not have an outside vendor to manufacture our products, we will have to increase our internal production capacity and we will be required to expand our existing facilities or to lease new facilities or to acquire entities with additional production capacities. These activities would require us to make significant capital investments and may require us to seek additional equity or debt financing. We cannot assure you that such financing would be available to us when needed on acceptable terms, or at all. Further, we cannot assure you that any increased demand for our products would continue for a sufficient period of time to recoup our capital investments associated with increasing our internal production capacity.

In addition, we do not have experience manufacturing our products in large quantities. In the event of significant demand for our products, large-scale production might prove more difficult or costly than we anticipate and lead to quality control issues and production delays.

We may not be able to manufacture products at competitive prices.

To date, we have produced limited quantities of materials for license and sale and materials and devices for research, development, demonstration and prototype purposes. The cost per unit for these products currently exceeds the price at which we could expect to profitably sell them. If we cannot substantially lower our cost of production as we move into sales of products in significant commercial quantities, our financial results will be harmed.

We may be unable to export our products or technology to other countries, convey information about our technology to citizens of other countries or sell certain products commercially, if the products or technology are subject to United States export or other regulations.

We develop certain polymer-based products that we believe the United States government and other governments may be interested in using for military and information gathering or antiterrorism activities. United States government export regulations may restrict us from selling or exporting certain products into other countries, exporting our technology to those countries, conveying information about our technology to citizens of other countries or selling certain products to commercial customers. We may be unable to obtain export licenses for products or technology, if they become necessary. We currently cannot assess whether national security concerns would affect our future products and, if so, what procedures and policies we would have to adopt to comply with applicable existing or future regulations.

We are subject to regulatory compliance related to our operations.

We are subject to various U.S. governmental regulations related to occupational safety and health, labor and business practices. Failure to comply with current or future regulations could result in the imposition of substantial fines, suspension of production, alterations of our production processes, cessation of operations, or other actions, which could harm our business.

We may incur liability arising from the use of hazardous materials.

Our business and our facilities are subject to a number of federal, state and local laws and regulations relating to the generation, handling, treatment, storage and disposal of certain toxic or hazardous materials and waste products that we use or generate in our operations. Many of these environmental laws and regulations subject current or previous owners or occupiers of land to liability for the costs of investigation, removal or remediation of hazardous materials. In addition, these laws and regulations typically impose liability regardless of whether the owner or occupier knew of, or was responsible for, the presence of any hazardous materials and regardless of whether the actions that led to the presence were taken in compliance with the law. In our business, we use hazardous materials that are stored on site. We use various chemicals in our manufacturing process that may be toxic and covered by various environmental controls. An unaffiliated waste hauler transports the waste created by use of these materials off-site. Many environmental laws and regulations require generators of waste to take remedial actions at an off-site disposal location even if the disposal was conducted lawfully. The requirements of these laws and regulations are complex, change frequently and could become more stringent in the future. Failure to comply with current or future environmental laws and regulations could result in the imposition of substantial fines, suspension of production, alteration of our production processes, cessation of operations or other actions, which could severely harm our business.

Our data and information systems and network infrastructure may be subject to hacking or other cybersecurity threats. If our security measures are breached and an unauthorized party obtains access to our proprietary business information, our information systems may be perceived as being unsecure, which could harm our business and reputation, and our proprietary business information could be misappropriated which could have an adverse effect on our business and results of operations.

Our Company stores and transmits its proprietary information on its computer systems. Despite our security measures, our information systems and network infrastructure may be vulnerable to cyber-attacks or could be breached due to an employee error or other disruption that could result in unauthorized disclosure of sensitive information that has the potential to significantly interfere with our business operations. Breaches of our security measures could expose us to a risk of loss or misuse of this information, litigation and potential liability. Since techniques used to obtain unauthorized access or to sabotage information systems change frequently and generally are not recognized until launched against a target, we may be unable to anticipate these techniques or to implement adequate preventive measures in advance of such an attack on our systems. In addition, we use third party vendors to store our proprietary information who use cyber or “Cloud” storage of information as part of their service or product offerings, and despite our attempts to validate the security of such services, our proprietary information may be misappropriated by other parties. In the event of an actual or perceived breach of our security, or the security of one of our vendors, the market perception of the effectiveness of our security measures could be harmed and we could suffer damage to our reputation or our business. Additionally, misappropriation of our proprietary business information could prove competitively harmful to our business.

We conduct significantly all of our research and development activities at our Englewood, CO facility, and circumstances beyond our control may result in considerable business interruptions.

We conduct significantly all of our research and development activities at our Englewood, CO facility. Our operations are vulnerable to interruption by fire, earthquake, floods or other natural disaster, quarantines or other disruptions associated with infectious diseases, national catastrophe, terrorist activities, war, disruptions in our computing and communications infrastructure due to power loss, telecommunications failure, human error, physical or electronic security breaches and computer viruses, and other events beyond our control. We do not have a detailed disaster recovery plan.

We could be negatively affected as a result of a proxy contest and the actions of activist stockholders.

A proxy contest with respect to election of our directors, or other activist stockholder activities, could adversely affect our business because: (1) responding to a proxy contest and other actions by activist stockholders can be costly and time-consuming, disruptive to our operations and divert the attention of management and our employees; (2) perceived uncertainties as to our future direction caused by activist activities may result in the loss of potential business opportunities, and may make it more difficult to attract and retain qualified personnel and business partners; and (3) if individuals are elected to our Board of Directors with a specific agenda, it may adversely affect our ability to effectively and timely implement our strategic plans.

The requirements of being a public company are a strain on our systems and resources, are a diversion to management’s attention and are costly.

As a public company, we are subject to the reporting requirements of the Securities Exchange Act of 1934 (“ **Exchange Act**”) the Sarbanes-Oxley Act of 2002 (“**Sarbanes-Oxley Act**”), the Dodd-Frank Wall Street Reform and Consumer Protection Act (“ **Dodd-Frank Act**”), and the rules and regulations of The NASDAQ Stock Market. The requirements of these rules and regulations increase our legal, accounting and financial compliance costs, make some activities more difficult, time-consuming and costly and may also place undue strain on our personnel, systems and resources.

The Exchange Act requires, among other things, that we file annual, quarterly and current reports with respect to our business and operating results. The Sarbanes-Oxley Act requires, among other things, that we maintain effective disclosure controls and procedures and internal control over financial reporting. We are continuing the costly process of implementing and testing our systems to report our results as a public company, to continue to manage our growth and to implement internal controls. We are and will continue to be required to implement and maintain various other control and business systems related to our equity, finance, treasury, information technology, other recordkeeping systems and other operations. As a result of this implementation and maintenance, management's attention may be diverted from other business concerns, which could adversely affect our business. Furthermore, we rely on third-party software and system providers for ensuring our reporting obligations and effective internal controls, and to the extent these third parties fail to provide adequate service including as a result of any inability to scale to handle our growth and the imposition of these increased reporting and internal controls and procedures, we could incur material costs for upgrading or switching systems and our business could be materially affected.

In addition, changing laws, regulations and standards relating to corporate governance and public disclosure are creating uncertainty for public companies, increasing legal and financial compliance costs and making some activities more time consuming. These laws, regulations and standards are subject to varying

interpretations, in many cases due to their lack of specificity, and, as a result, their application in practice may evolve over time as new guidance is provided by regulatory and governing bodies. This could result in continuing uncertainty regarding compliance matters and higher costs necessitated by ongoing revisions to disclosure and governance practices. We intend to invest resources to comply with evolving laws, regulations and standards, and this investment may result in increased general and administrative expenses and a diversion of management's time and attention from revenue-generating activities to compliance activities. If our efforts to comply with new laws, regulations and standards differ from the activities intended by regulatory or governing bodies due to ambiguities related to their application and practice, regulatory authorities may initiate legal proceedings against us and our business may be adversely affected.

In addition, we expect these laws, rules and regulations to make it more difficult and more expensive for us to obtain director and officer liability insurance, and we may be required to incur substantial costs to maintain appropriate levels of coverage. These factors could also make it more difficult for us to attract and retain qualified members of our board of directors, particularly to serve on our audit committee, and qualified executive officers.

As a result of being a public company, our business and financial condition are more visible, which we believe may result in threatened or actual litigation, including by competitors and other third parties. If such claims are successful, our business and operating results could be adversely affected, and even if the claims do not result in litigation or are resolved in our favor, these claims, and the time and resources necessary to resolve them, could divert the time and resources of our management and adversely affect our business and operating results.

If we fail to maintain an effective system of disclosure controls and internal control over financial reporting, our ability to produce timely and accurate financial statements or comply with applicable regulations could be impaired.

As a public company, we are subject to the reporting requirements of the Securities Exchange Act of 1934 (Exchange Act) the Sarbanes-Oxley Act of 2002 (Sarbanes-Oxley Act), the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act), and the rules and regulations of The NASDAQ Stock Market. We expect that compliance with these rules and regulations will continue to increase our legal, accounting and financial compliance costs, make some activities more difficult, time consuming and costly, and place significant strain on our personnel, systems and resources.

The Sarbanes-Oxley Act requires, among other things, that we assess the effectiveness of our internal control over financial reporting annually and the effectiveness of our disclosure controls and procedures quarterly. In particular, Section 404 of the Sarbanes-Oxley Act, (Section 404), requires us to perform system and process evaluation and testing of our internal control over financial reporting to allow management to report on, and our independent registered public accounting firm to attest to, the effectiveness of our internal control over financial reporting. Our compliance with applicable provisions of Section 404 requires that we incur substantial accounting expense and expend significant management time on compliance-related issues as we implement additional corporate governance practices and comply with reporting requirements. Moreover, if we are not able to comply with the requirements of Section 404 applicable to us in a timely manner, or if we or our independent registered public accounting firm identifies deficiencies in our internal control over financial reporting that are deemed to be material weaknesses, the market price of our stock could decline and we could be subject to sanctions or investigations by the SEC or other regulatory authorities, stockholder or other third-party litigation, all of which would require additional financial and management resources.

Furthermore, investor perceptions of our Company may suffer if deficiencies are found, and this could cause a decline in the market price of our stock or hinder our ability to raise capital. Irrespective of compliance with Section 404, any failure of our internal control over financial reporting could have a material adverse effect on our stated operating results and harm our reputation. If we are unable to continue to implement and maintain these requirements effectively or efficiently, it could harm our operations, financial reporting, or financial results and could result in an adverse opinion on our internal controls from our independent registered public accounting firm.

The exercise of options and warrants and other issuances of shares of common stock or securities convertible into common stock will dilute your interest.

Our Board may determine from time to time that it needs to raise additional capital by issuing additional shares of our common stock or other securities and we are not restricted from issuing additional common stock, including securities that are convertible into or exchangeable for, or that represent the right to receive, shares of our common stock. Because our decision to issue securities in any future offering will depend on market conditions and other factors beyond our control, we cannot predict or estimate the amount, timing, or nature of any future offerings, or the prices at which such offerings may be affected. Additional equity offerings may dilute the holdings of existing stockholders or reduce the market price of our common stock.

As of December 31, 2023, we have outstanding options and warrants to purchase an aggregate of 7,967,605 shares of our common stock at exercise prices ranging from $0.51 to 16.81 per share with a weighted average exercise price of $2.49 per share. The exercise of options and warrants at prices below the market price of our common stock could adversely affect the price of shares of our common stock. Additional dilution may result from the issuance of shares of our capital stock in connection with any collaboration (although none are contemplated at this time) or in connection with other financing efforts, including pursuant to the 2023 Purchase Agreement with Lincoln Park, and the Roth Sales Agreement with Roth Capital. Any issuance of our common stock that is not made solely to then-existing stockholders proportionate to their interests, such as in the case of a stock dividend or stock split, will result in dilution to each stockholder by reducing his, her or its percentage ownership of the total outstanding shares. Moreover, if we issue options or warrants to purchase our common stock in the future and those options or warrants are exercised or we issue restricted stock, stockholders may experience further dilution. Holders of shares of our common stock have no preemptive rights that entitle them to purchase their pro rata share of any offering of shares of any class or series.

The trading price of our common stock has been, and may continue to be, volatile, and the value of our common stock may decline. This volatility, as well as general market conditions, may cause our stock price to fluctuate greatly and even potentially expose us to litigation.

Our common stock may be subject to continued volatility. During the past 52 weeks, the share price for our common stock ranged from a low of $3.79 to a high of $9.18. We cannot assure you that the market price for our common stock will be less volatile or will remain at its current level. A decrease in the market price for our shares could result in substantial losses for investors. The market price of our common stock may be significantly affected by one or more of the following factors, many of which are beyond our control, including:

- our Company’s ability to execute on its business plan;
- the status of particular development programs and the timing of performance under specific development agreements;
- actual or anticipated demand for our products and future products and technologies;
- amount and timing of our costs related to our development and marketing efforts or other initiatives and expansion of our operations;
- changes in anticipated commercial deployment of certain products and financial results;
- our ability to enter into, renegotiate or renew key agreements or strategic relationships,
- our ability to develop expanded product production facilities, along with silicon-based foundry and other outside contractor relationships;
- issuance of new or updated research or reports by securities analysts;
- the use by investors or analysts of third-party data regarding our business that may not reflect our operations;
- fluctuations in the valuation of companies perceived by investors to be comparable to us;
- share price and volume fluctuations attributable to inconsistent trading volume levels of our shares;
- large trades, block trades or short selling of our common stock,
- actual or anticipated changes in our competitive position relative to our industry competitors;
- announcements or implementation by our competitors of technological innovations or new products;
- changes in laws or regulations applicable to our products or industry;
- additions or departures of key personnel;
- capital-raising activities or commitments;
- product shortages requiring suppliers to allocate minimum quantities;
- the commencement or conclusion of legal proceedings that involve us;

- costs related to possible future acquisitions of technologies or businesses;
- economic conditions specific to our industry, as well as general economic and market conditions; or
- other events or factors, including those resulting from civil unrest, war, foreign invasions, terrorism, or public health crises or responses to such events.

Furthermore, the stock markets frequently experience extreme price and volume fluctuations that affect the market prices of equity securities of many companies. These fluctuations often have been unrelated or disproportionate to the operating performance of those companies. These broad market and industry fluctuations, as well as general economic, political, and market conditions such as recessions, elections, interest rate changes, or international currency fluctuations, may negatively impact the market price of our common stock. As a result of such fluctuations, you may not realize any return on your investment in us and may lose some or all of your investment. In the past, companies that have experienced volatility in the market price of their stock have been subject to securities class action litigation or derivative litigation.

A sale of a substantial number of shares of our common stock may cause the price of our common stock to decline and may impair our ability to raise capital in the future.

Our common stock is traded on The NASDAQ Capital Market and, despite certain increases of trading volume from time to time, there have been periods when the market for our common stock could be considered "thinly-traded," meaning that the number of persons interested in purchasing our common stock at or near bid prices at any given time may be relatively small. Finance transactions or option/warrant exercises resulting in a large amount of newly issued shares that become readily tradable, or other events that cause current stockholders to sell shares, could place downward pressure on the trading price of our stock the trading price of our stock could decline. Additionally, we believe a significant portion of our shares are held by shareholders that accumulated their shares during a time when our shares prices were significantly less than our current share prices. If these shareholders, some of which hold a substantial number of shares of our common stock, decide to sell some or all of their shares at once without regard to the impact of their sales on the market price of our stock, the trading price of our stock could decline. In addition, the lack of a robust resale market may require a stockholder who desires to sell a large number of shares of common stock to sell the shares in increments over time to mitigate any adverse impact of the sales on the market price of our stock.

If our existing stockholders sell, or the market perceives that our stockholders intend to sell, substantial amounts of our common stock in the public market, including shares issued upon the exercise of outstanding options or warrants or pursuant to the 2023 Purchase Agreement with Lincoln Park, and the Roth Sales Agreement with Roth Capital, the market price of our common stock could decline. Sales of a substantial number of shares of our common stock may make it more difficult for us to sell equity or equity-related securities in the future at a time and price that we deem reasonable or appropriate. We may become involved in securities class action litigation that could divert management's attention and harm our business.

Our common stock will be subject to potential delisting if we do not maintain the listing requirements of the Nasdaq Capital Market.

Our common stock commenced trading on The NASDAQ Capital Market on September 1, 2021. We cannot assure you that that an active trading market for our common stock will continue to be sustained. Nasdaq has rules for continued listing, including, without limitation, minimum market capitalization and other requirements. Failure to maintain our listing, or de-listing from Nasdaq, would make it more difficult for stockholders to dispose of our securities and more difficult to obtain accurate price quotations on our securities. This could have an adverse effect on the price of our common stock. Our ability to issue additional securities for financing or other purposes, or otherwise to arrange for any financing we may need in the future, may also be materially and adversely affected if our common stock and/or other securities are not traded on a national securities exchange.

If securities or industry analysts do not publish research or reports about our business, or if they change their recommendations regarding our stock adversely, our stock price and trading volume could decline.

The trading market for most listed companies' securities depends in part on the research and reports that securities or industry analysts publish about them or their business. We currently have no independent research analysts that cover our stock and we may not obtain research coverage by securities and industry analysts until our products are commercialized and we obtain revenues, and there is no assurances that we will ever obtain independent research analysts coverage. If no securities or industry analysts commence coverage of us, the trading price for our common stock could be negatively affected. In the event any analyst who covers us downgrades our securities, the price of our securities would likely decline. If one or more of these analysts ceases to cover us or fails to publish regular reports on us, interest in the purchase of our securities could decrease, which could cause the price of our common stock and its trading volume to decline.

Our board of directors has the authority, without stockholder approval, to issue preferred stock with terms that may not be beneficial to existing common stockholders and with the ability to affect adversely stockholder voting power and perpetuate their control over us.

Our articles of incorporation, as amended, allow us to issue shares of preferred stock without any vote or further action by our stockholders. Our board of directors has the authority to fix and determine the relative rights and preferences of preferred stock. Our board of directors also has the authority to issue preferred stock without further stockholder approval, including large blocks of preferred stock. As a result, our board of directors could authorize the issuance of a series of preferred stock that would grant to holders thereof the preferred right to our assets upon liquidation, the right to receive dividend payments before dividends are distributed to the holders of common stock or other preferred stockholders and the right to the redemption of the shares, together with a premium, prior to the redemption of our common stock or existing preferred stock, if any.

Preferred stock could be used to dilute a potential hostile acquirer. Accordingly, any future issuance of preferred stock or any rights to purchase preferred stock may have the effect of making it more difficult for a third party to acquire control of us. This may delay, defer or prevent a change of control or an unsolicited acquisition proposal. The issuance of preferred stock also could decrease the amount of earnings attributable to, and assets available for distribution to, the holders of our common stock and could adversely affect the rights and powers, including voting rights, of the holders of our common stock and preferred stock.

Our articles of incorporation and amended and restated bylaws, and certain provisions of Nevada corporate law, as well as certain of our contracts, contain provisions that could delay or prevent a change in control even if the change in control would be beneficial to our stockholders.

Nevada law, as well as our articles of incorporation, as amended, and amended and restated bylaws, contain anti-takeover provisions that could delay or prevent a change in control of our Company, even if the change in control would be beneficial to our stockholders. These provisions could lower the price that future investors might be willing to pay for shares of our common stock. These anti-takeover provisions:

- authorize our board of directors to create and issue, without stockholder approval, preferred stock, thereby increasing the number of outstanding shares, which can deter or prevent a takeover attempt;
- prohibit cumulative voting in the election of directors, which would otherwise allow less than a majority of stockholders to elect director candidates;
- empower our board of directors to fill any vacancy on our board of directors, whether such vacancy occurs as a result of an increase in the number of directors or otherwise;
- provide that our board of directors be divided into three classes, with approximately one-third of the directors to be elected each year;
- provide that special meetings of our stockholders may only be called by t he chairperson, president or chief executive officer, or by resolution of the board of directors or at the request in writing of stockholders owning 66 2/3% in amount of the entire capital stock of the Company issued and outstanding and entitled to vote;
- establish advance notice procedures with regard to stockholder proposals relating to stockholder nominees for director and other stockholder proposals;
- provide that our board of directors is expressly authorized to adopt, amend or repeal our bylaws; and
- provide that our directors will be elected by a plurality of the votes cast in the election of directors.

Nevada Revised Statutes, the terms of our employee stock option agreements and other contractual provisions may also discourage, delay or prevent a change in control of our Company. Nevada Revised Statutes sections 78.378 to 78.3793 provide state regulation over the acquisition of a controlling interest in certain Nevada corporations unless the articles of incorporation or bylaws of the corporation provide that the provisions of these sections do not apply. Our articles of incorporation, as amended, and amended and restated bylaws do not state that these provisions do not apply. The statute creates a number of restrictions on the ability of a person or entity to acquire control of a Nevada company by setting down certain rules of conduct and voting restrictions in any acquisition attempt, among other things. The statute contains certain limitations and it may not apply to our Company. Our 2016 Equity Incentive Plan includes change-in-control provisions that allow us to grant options that may become vested immediately upon a change in control. Our board of directors also has the power to adopt a stockholder rights plan that could delay or prevent a change in control of our Company even if the change in control is generally beneficial to our stockholders. These plans, sometimes called “poison pills,” are oftentimes criticized by institutional investors or their advisors and could affect our rating by such investors or advisors. If our board of directors adopts such a plan, it might have the effect of reducing the price that new investors are willing to pay for shares of our common stock.

Together, these charter, statutory and contractual provisions could make the removal of our management and directors more difficult and may discourage transactions that otherwise could involve payment of a premium over prevailing market prices for our common stock. Furthermore, the existence of the foregoing provisions, as well as the significant common stock beneficially owned by our founders, executive officers, and members of our board of directors, could limit the price that investors might be willing to pay in the future for shares of our common stock. They could also deter potential acquirers of our Company, thereby reducing the likelihood that you could receive a premium for your common stock in an acquisition.

Item 1B. Unresolved Staff Comments.

None.

Item 1C. Cybersecurity.

Cybersecurity Risk Management and Strategy. We depend on software applications, information technology systems, computing infrastructure and cloud service providers to operate our business. Certain of these systems are managed, hosted, provided or used by third parties, to assist in conducting our business and which have their own cyber security measures in place. We implement generally applicable industry standards and best practices processes for the assessment, identification, and management of material risks from cybersecurity threats to our information technology systems. We have an Information Security Coordinator who oversees our information security policies and procedures. Our Information Security Coordinator maintains a cyber incident reporting and response process and provides management notifications based on the seriousness of any incident. Our information security policies and procedures are required to be reviewed on a regular basis.

We have not experienced a cybersecurity incident that resulted in a material adverse impact to our business or operations; however, there can be no guarantee that we will not experience such an incident in the future. For a description of the risks from cybersecurity threats that may materially affect our Company and how they may do so, please see “Risk Factors” included in Part I, Item 1A of this Annual Report on Form 10-K, including “Our data and information systems and network infrastructure may be subject to hacking or other cyber security threats. If our security measures are breached and an unauthorized party obtains access to our proprietary business information, our information systems may be perceived as being unsecure, which could harm our business and reputation, and our proprietary business information could be misappropriated which could have an adverse effect on our business and results of operations."

Cybersecurity Governance. Our Audit Committee has primary responsibility for overseeing our risk-management program relating to cybersecurity, although our Board of Directors participates in periodic reviews and discussion dedicated to cyber risks, threats, and protections.

Item 2. Properties.

Our principal executive office and research and development facility is located at 369 Inverness Parkway, Suite 350, Englewood, Colorado. The 23,104 square feet facility includes fully functional 1,000 square feet of class 1,000 cleanroom, 500 square feet of class 10,000 cleanroom, chemistry laboratories, and analytic laboratories, and serves as our office, laboratory and research and development space. Our total annual base rent during 2024 is expected to be approximately $376,364.

Item 3. Legal Proceedings.

We are not a party to any litigation of a material nature, nor are we aware of any threatened litigation of a material nature.

Item 4. Mine Safety Disclosures.

Not Applicable.

PART II

Item 5. Market For Registrant’s Common Equity, Related Stockholder Matters and Issuer Purchases Of Equity Securities.

Market Information

Our common stock trades on the Nasdaq Capital Market under the symbol LWLG.

Holders of Common Stock

On February 28, 2024, we had approximately 70 holders of our common stock, not including persons who hold our common stock in nominee or "street name” accounts through brokers or banks.

Dividend Policy

Our Company has never paid a cash dividend and has no present plans to pay cash dividends .

Securities Authorized for Issuance under Equity Compensation Plans

Equity Compensation Plans as of December 31, 2023.

Equity Compensation Plan Information

Plan category	Number of securities to be issued upon exercise of outstanding options, warrants and rights (a)	Weighted-average exercise price of outstanding options, warrants and rights (b)	Number of securities remaining available for future issuance under equity compensation plans (excluding securities reflected in column (a)) (c)
Equity compensation plans approved by security holders [1]	8,290,807	$2.90	5,291,784
Equity compensation plans not approved by security holders [2]	519,000	$0.64	0
Total	8,809,807	$2.76	5,291,784

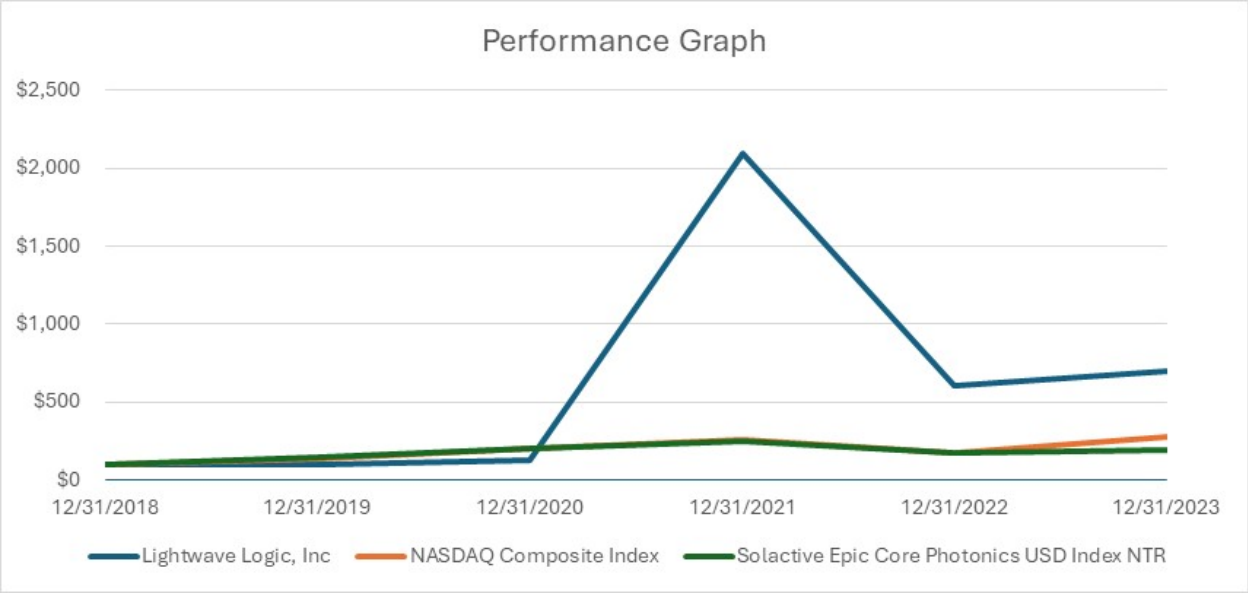
1. Reflects shares of common stock to be issued pursuant to our 2016 Equity Incentive Plan and our 2007 Employee Stock Plan, both of which are for the benefit of our directors, officers, employees and consultants. We have reserved 13,000,000 shares of common stock for such persons pursuant to our 2016 Equity Incentive Plan. We terminated our 2007 Employee Stock Plan in June 2016 and no additional awards are made under that plan.

2. Comprised of common stock purchase warrants we issued for services.

Stock Performance Graph

The graph set forth below compares the cumulative total stockholder return on our common stock between December 31, 2018 and December 31, 2023, with the cumulative total return of (a) the NASDAQ Composite Index and (b) Solactive EPIC Core Photonics USD Index NTR, over the same period. This graph assumes the investment of $100 on December 31, 2018 in our common stock, the NASDAQ Composite Index and the Solactive EPIC Core Photonics USD Index NTR and assumes the reinvestment of dividends, if any. The graph assumes our closing sales price on December 31, 2018 of $.71 per share as the initial value of our common stock.

The comparisons shown in the graph below are based upon historical data. The stock price performance shown in the graph below is not necessarily indicative of, nor is it intended to forecast, the potential future performance of our common stock. Information used in the graph was obtained from the NASDAQ Stock Market LLC and Solactive AG, financial data providers and sources believed to be reliable.



The above graph and related information shall not be deemed “soliciting material” or to be “filed” with the Securities and Exchange Commission, nor shall such information be incorporated by reference into any future filing under the Securities Act or the Exchange Act except to the extent we specifically incorporate it by reference into such filing. Our stock price performance shown in the graph below is not indicative of future stock price performance.

Recent Sales of Unregistered Securities

During the period covered by this report, our Company has sold the following securities without registering the securities under the Securities Act:

Date	Security
Jan 5, 2023	Common Stock — 25,000 shares of Common Stock at $.75 per share pursuant to a warrant exercise.
June 5, 2023	Common Stock — 100,000 shares of Common Stock at $1.15 per share pursuant to a warrant exercise.
June 20, 2023	Common Stock — 25,000 shares of Common Stock at $.67 per share pursuant to a warrant exercise.
July 18, 2023	Common Stock —19,000 shares of Common Stock at $.75 per share pursuant to a warrant exercise.
Dec 14, 2023	Common Stock —100,000 shares of Common Stock at $.72 per share pursuant to a warrant exercise.

No underwriters were utilized, and no commissions or fees were paid with respect to any of the above transactions. These persons were the only offerees in connection with these transactions. We relied on Section 4(a)(2) and Rule 506 of Regulation D of the Securities Act since the transaction does not involve any public offering.

Purchases of Equity Securities by the Issuer or Affiliated Purchasers

None.

Item 6. RESERVED.

Item 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS.

The following management's discussion and analysis of financial condition and results of operations provides information that management believes is relevant to an assessment and understanding of our plans and financial condition. The following selected financial information is derived from our historical financial statements and should be read in conjunction with such financial statements and notes thereto set forth elsewhere within this Annual Report on Form 10-K and the "Forward-Looking Statements" explanation included elsewhere herein.

Overview

Lightwave Logic, Inc. is a technology company focused on the development of next generation electro-optic photonic devices made on its P ^{2}IC™ technology platform which we have detailed as: 1) Polymer Stack™, 2) Polymer Plus™, and 3) Polymer Slot™. Our unique polymer technology platform uses in-house proprietary high-activity and high-stability organic polymers. Electro-optical devices called modulators convert data from electric signals into optical signals for multiple applications.

Our differentiation at the modulator device level is in higher speed, lower power consumption, simplicity of manufacturing, small footprint (size), and reliability. We have demonstrated higher speed and lower power consumption in packaged devices, and during 2022 and 2023, we continued to make advances in techniques to translate material properties to efficient, reliable modulator devices with commercial foundries. We are currently focused on testing and demonstrating the simplicity of manufacturability and reliability of our devices, including in conjunction with the silicon photonics manufacturing ecosystem. In 2022 we discussed the addition of several silicon-based foundry partners to help scale in volume our polymer modulator devices and we started to receive working modulator chips from the foundries. We have advanced our interactions with our foundries, and we continue to receive working modulator chips for prototyping. Silicon-based foundries are large semiconductor fabrication plants developed for the electronics IC business, that are now engaging with silicon photonics to increase their wafer throughput. Partnering with silicon-based foundries not only demonstrates that our polymer technology can be transferred into standard production lines using standard equipment, it also allows us to efficiently utilize our capital. The foundry partnerships will allow us to scale our high-performance polymer optical engines quickly and efficiently.

Our extremely strong and broad patent portfolio allows us to optimize our business model in three areas: 1) Traditional focus on product development, 2) Patent licensing and 3) Technology transfer to foundries. We are continually looking to strengthen our patent portfolio both by internal inventions and acquisition of intellectual property.

We are initially targeting applications in fiber optic data communications and telecommunications markets and are exploring other applications that include automotive/LIDAR, sensing, displays etc., for our polymer technology platform. Our goal is to have our unique polymer technology platform become ubiquitous.

Artificial Intelligence (AI) has been integrating deeper within our daily activities with applications to make us more efficient and possibly smarter. The impact on the internet is huge, and the internet is based on an optical network that utilizes data centers to route and switch traffic or information to and from destinations. Data centers are being upgraded today in a fashion that the industry has not seen before. The expected demands of increased traffic, information, and data driven by AI is changing the way the internet is being operated. AI is now creating new and interesting market opportunities to upgrade the internet. Three of these are important today: density, speed, and low power and these are very well aligned with our high performance electro-optic polymers. We are designing high performance polymer modulator optical engines to support the rise and growth of AI as it generates more information that will travel through the internet and optical network.

Commencement of Commercial Operations

We commenced commercial operations in May 2023. Presently, our commercial operations consist of a material supply license agreement to provide Perkinamine® chromophore materials for polymer based photonic devices and photonic integrated circuits (PICs). The license agreement represents tangible commercial progress for electro-optic polymers as part of our Company's business plan. Our Company is also in various stages of photonic device and materials development and evaluation with potential customers and strategic partners. We expect to continue to obtain a revenue stream from technology licensing agreements, and to obtain additional revenue streams from technology transfer agreements and direct sale of our electro-optic device components.

Business Strategy

Our first revenue stream was obtained from our entry into a material supply license agreement to provide Perkinamine ® chromophore materials for polymer based photonic devices and photonic integrated circuits (PICs). Our Company is also in various stages of photonic device and materials development and evaluation with potential customers and strategic partners. We expect to continue to obtain a revenue stream from technology licensing agreements, and to obtain additional revenue streams from technology transfer agreements and direct sale of our electro-optic device components.

Specifically, our business strategy provides that our revenue stream will be derived from one or some combination of the following: (i) technology licensing for specific product application; (ii) joint venture relationships with significant industry leaders; and (iii) the production and direct sale of our own electro-optic device components. Our objective is to be a leading provider of proprietary technology and know-how in the electro-optic device market. In order to meet this objective, we intend to continue to:

- Further the development of proprietary organic electro-optic polymer material systems
- Develop photonic devices based on our P ^{2}IC™ technology
- Develop proprietary intellectual property
- Grow our commercial device development capabilities
- Partner with silicon-based foundries who can scale volume quickly
- Grow our product reliability and quality assurance capabilities
- Grow our optoelectronic packaging and testing capabilities
- Grow our commercial material manufacturing capabilities
- Maintain/develop strategic relationships with major telecommunications and data communications companies to further the awareness and commercialization of our technology platform
- Add high-level personnel with industrial and manufacturing experience in key areas of our materials and device development programs.

Create Organic Polymer-Enabled Electro-Optic Modulators

We intend to utilize our proprietary optical polymer technology to create an initial portfolio of commercial electro-optic polymer product devices with applications for various markets, including telecommunications, data communications and data centers. These product devices will be part of our proprietary photonics integrated circuit (PIC) technology platform.

We expect our initial modulator products will operate at symbol rates at least 112 Gigabaud which is roughly 200Gbps when utilized with PAM4 encoding schemes. Our devices are highly linear and can also enable the performance required to take advantage of more advance complex encoding schemes if required.

Capital Requirements

We commenced commercial operations in May 2023, and we do not generate sufficient revenues to pay for our operating expenses. We have incurred substantial net losses since inception. We have satisfied our capital requirements since inception primarily through the issuance and sale of our common stock.

Results of Operations

Comparison of year ended December 31, 2023 to year ended December 31, 2022 and year ended December 31, 2022 to year ended December 31, 2021

Revenues

During the year ended December 31, 2023, we recognized $40,502 of licensing and royalty revenue. As a development stage company during the years ended December 31, 2022 and December 31, 2021, we had no revenues. The Company is in various stages of photonic device and materials development and evaluation with potential customers and strategic partners, and commercialization. The Company expects to continue obtaining a revenue stream from technology licensing agreements, to obtain additional revenue streams from technology transfer agreements and direct sale of its own electro-optic device components.

Cost of Sales

During the year ended December 31, 2023, we recognized $2,513 in Cost of Sales, and $0 in Cost of Sales during the years ended December 31, 2022 and 2021.

Operating Expenses

	For the Year Ending December 31, 2023	For the Year Ending December 31, 2022	Change from Prior Year	Percent Change from Prior Year
Research and development	15,903,689	$ 12,805,374	$ 3,098,315	24%
General and administrative	5,359,565	4,334,290	1,025,275	24%
	$ 21,263,254	$ 17,139,664	$ 4,123,590	24%

	For the Year Ending December 31, 2022	For the Year Ending December 31, 2021	Change from Prior Year	Percent Change from Prior Year
Research and development	$ 12,805,374	$ 12,476,040	$ 329,334	3%
General and administrative	4,334,290	4,520,403	(186,113)	-4%
	$ 17,139,664	$ 16,996,443	$ 143,221	1%

Research and development expenses increased for the year ended December 31, 2023, as compared to the year ended December 31, 2022, primarily due to increases in research and development salary and bonus expenses, research and development non-cash stock option and RSA amortization, recruiting fees, employee relocation expenses, rent expense, chemistry and wafer fabrication materials and supplies, testing expenses, software expenses, research and development consulting expenses, and travel expenses, offset by a decrease in prototype expenses.

Research and development salary and bonus expenses increased by $1,636,577 in the year ended December 31, 2023, compared to the same period in 2022. Research and development non-cash stock option and RSA amortization expenses increased by $690,879 in the year ended December 31, 2023, compared to the same period in 2022. Recruiting fees increased by $195,697 in the year ended December 31, 2023, compared to the same period in 2022. Employee relocation expenses increased by $178,626 in the year ended December 31, 2023, compared to the same period in 2022. Rent expense increased by $153,949 in the year ended December 31, 2023, compared to the same period in 2022. Chemistry and wafer fabrication materials and supplies increased by $143,581 in the year ended December 31, 2023, compared to the same period in 2022. Research and development testing expenses increased by $129,593 in the year ended December 31, 2023 compared to the same period in 2022. Software expenses increased by $126,854 in the year ended December 31, 2023, compared to the same period in 2022. Research and development consulting expenses increased by $112,261 in the year ended December 31, 2023, compared to the same period in 2022. Research and development travel expenses increased by $96,923 in the year ended December 31, 2023, compared to the same period in 2022. These increases were offset by a $483,617 decrease in prototype expenses in the year ended December 31, 2023, compared to the same period in 2022.

Research and development expenses increased for the year ended December 31, 2022, as compared to the year ended December 31, 2021, primarily due to increases in research and development non-cash stock option amortization, prototype device development expenses, research and development salary expenses, laboratory and wafer fabrication materials and supplies, research and development consulting expenses, depreciation and research and development travel expenses offset by a decrease in expense for cashless option exercises and research and development bonus expenses.

Research and development non-cash stock option amortization expenses increased by $3,732,646 in the year ended December 31, 2022, compared to the same period in 2021. Prototype device development expenses increased by $1,460,419 in the year ended December 31, 2022, compared to the same period in 2021. Research and development salary expenses increased by $617,627 in the year ended December 31, 2022, compared to the same period in 2021. Laboratory and wafer fabrication materials and supplies increased by $242,737 in the year ended December 31, 2022, compared to the same period in 2021. Research and development consulting expenses increased by $224,435 in the year ended December 31, 2022, compared to the same period in 2021. Depreciation expenses increased by $173,206 in the year ended December 31, 2022, compared to the same period in 2021. Research and development travel expenses increased by $147,136 in the year ended December 31, 2022, compared to the same period in 2021. The expense for research and development cashless option exercises decreased by $3,382,582 in the year ended December 31, 2022, compared to the same period in 2021. Research and development bonus expenses decreased by $3,003,169 in the year ended December 31, 2022, compared to the same period in 2021.

We expect to continue to incur substantial research and development expense developing and commercializing our photonic devices, and electro-optic materials platform. These expenses will increase as a result of accelerated development effort to support commercialization of our non-linear optical polymer materials technology; to build photonic device prototypes; working with semiconductor foundries; hiring additional technical and support personnel; engaging senior technical advisors; pursuing other potential business opportunities and collaborations; customer testing and evaluation; and incurring related operating expenses.

General and administrative expenses increased for the year ended December 31, 2023, as compared to the year ended December 31, 2022, primarily due to increases in general and administrative salary and bonus expenses, accounting fees, general and administrative consulting fees, general and administrative non-cash stock option and RSA amortization, D&O insurance expenses, investor relations expenses, travel expenses, office expenses, rent expense, general and administrative recruiting fees, and software expenses, offset by a decrease in legal fees.

General and administrative salary and bonus expenses increased by $172,690 in the year ended December 31, 2023, compared to the same period in 2022. Accounting fees increased by $191,803 in the year ended December 31, 2023, compared to the same period in 2022. General and administrative consulting fees increased by $144,600 in the year ended December 31, 2023, compared to the same period in 2022. General and administrative non-cash stock option and RSA amortization expenses increased by $125,863 in the year ended December 31, 2023, compared to the same period in 2022. D&O insurance expenses increased by $99,555 in the year ended December 31, 2023, compared to the same period in 2022. Investor relations expenses increased by $67,670 in the year ended December 31, 2023, compared to the same period in 2022. Travel expenses increased by $58,999 in the year ended December 31, 2023, compared to the same period in 2022. Office expenses increased by $53,949 in the year ended December 31, 2023, compared to the same period in 2022. Rent expense increased by $48,350 in the year ended December 31, 2023, compared to the same period in 2022. General and administrative recruiting fees increased by $43,255 in the year ended December 31, 2023, compared to the same period in 2022. Software expenses increased by $33,222 in the year ended December 31, 2023, compared to the same period in 2022. These increases were offset by a $38,374 decrease in legal fees in the year ended December 31, 2023, compared to the same period in 2022.

General and administrative expenses decreased for the year ended December 31, 2022, as compared to the year ended December 31, 2021, primarily due to decreases in general and administrative bonus and salary expenses and general and administrative expense for cashless option exercises offset by increases general and administrative non-cash stock option amortization, legal expenses, director fees, insurance and general and administrative travel expenses.

General and administrative bonus and salary expenses decreased by $2,054,916 in the year ended December 31, 2022, compared to the same period in 2021 primarily for bonus expenses in the year ended December 31, 2021. The expense for general and administrative cashless option exercises decreased by $170,137 in

the year ended December 31, 2022, compared to the same period in 2021. General and administrative non-cash stock option amortization increased by $1,138,708 in the year ended December 31, 2022, compared to the same period in 2021. Legal expenses increased by $417,624 in the year ended December 31, 2022, compared to the same period in 2021. Director fees increased by $149,750 in the year ended December 31, 2022, compared to the same period in 2021. Insurance expenses increased by $136,771 in the year ended December 31, 2022, compared to the same period in 2021. General and administrative travel expenses increased by $75,652 in the year ended December 31, 2022, compared to the same period in 2021.

Other Income (Expense)

	For the Year Ending December 31, 2023	For the Year Ending December 31, 2022	Change from Prior Year	Percent Change from Prior Year
Other Income (Expense)	$ 187,233	$ (90,816)	$ 278,049	-306%

	For the Year Ending December 31, 2022	For the Year Ending December 31, 2021	Change from Prior Year	Percent Change from Prior Year
Other Expense	$ (90,816)	$ (1,634,938)	$ 1,544,122	-94%

Other income increased for the year ended December 31, 2023, as compared to the year ended December 31, 2022, primarily due to an increase in interest income earned on money market account of $568,137 and a gain on disposal of fixed assets of $215,509, offset by an increase in commitment fee associated with the purchase of shares by an institutional investor for sale under a stock purchase agreement in the amount of $463,869.

Other expenses decreased for the year ended December 31, 2022, as compared to the year ended December 31, 2021, primarily due to a decrease in commitment fee associated with the purchase of shares by an institutional investor for sale under a stock purchase agreement in the amount of $1,849,755 offset by the forgiveness by the Small Business Administration during 2021 of a loan funding from the Paycheck Protection Program in the amount of $410,700.

Net Loss

	For the Year Ending December 31, 2023	For the Year Ending December 31, 2022	Change from Prior Year	Percent Change from Prior Year
Net Loss	$ 21,038,032	$ 17,230,480	$ 3,807,552	22%

	For the Year Ending December 31, 2022	For the Year Ending December 31, 2021	Change from Prior Year	Percent Change from Prior Year
Net Loss	$ 17,230,480	$ 18,631,381	$ (1,400,901)	-8%

Net loss was $21,038,032 and $17,230,480 for the year ended December 31, 2023 and 2022, respectively, for an increase of $3,807,552 due primarily to increases in salary and bonus expense, non-cash stock option and RSA amortization, commitment fee associated with the purchase of shares by an institutional investor for sale under a stock purchase agreement, consulting fees, recruiting fees, rent expense, accounting fees, research and development employee relocation costs, software costs, research and development travel expenses, chemistry and wafer fabrication materials and supplies, testing expenses, D&O insurance, investor relations fees, and office expenses, offset by decrease primarily related to prototype and legal expenses, a higher interest income earned on money market account, and a gain on property and equipment disposal.

Net loss was $17,230,480 and $18,631,381 for the year ended December 31, 2022 and 2021, respectively, for a decrease of $1,400,901 due primarily to decreases in expense for cashless option exercises, bonus expenses and commitment fee associated with the purchase of shares by an institutional investor for sale under a stock purchase agreement offset by increases in non-cash stock option amortization, prototype device development expenses, research and development salary expenses, legal expenses, the forgiveness by the Small Business Administration during 2021 of a loan funding from the Paycheck Protection Program, laboratory and wafer fabrication materials and supplies, research and development consulting fees, travel expenses, depreciation, director fees and insurance expenses.

Significant Accounting Policies

Our Company's accounting policies are more fully described in Note 1 of Notes to Financial Statements. As disclosed in Note 1 of Notes to Financial Statements, the preparation of financial statements in conformity with accounting principles generally accepted in the United States requires management to make estimates and assumptions that affect the amounts reported in the financial statements and accompanying disclosures. Although these estimates are based on our management's best knowledge of current events and actions our Company may undertake in the future, actual results could differ from the estimates.

Liquidity and Capital Resources

Our primary source of operating cash inflows was proceeds from the sale of common stock to Lincoln Park (institutional investor) pursuant to purchase agreements with Lincoln Park and proceeds from sale of common stock by Roth Capital (investment banking company) pursuant to the at the market sale agreement with Roth Capital as described in Note 11 to the Financial Statements and below, proceeds received pursuant to the exercise of options and warrants and a proceed received under a material supply and license agreement of which $39,875 is recorded as deferred revenue as of December 31, 2023.

All of the registered shares under the January 21, 2019 purchase agreement with Lincoln Park have been issued as of June 30, 2021. On July 2, 2021, the Company filed a $100 million universal shelf registration statement which became effective on July 9, 2021. On October 4, 2021, our Company entered into the 2021 purchase agreement with Lincoln Park to sell up to $33 million of common stock over a 36-month period. All of the registered shares under the October 4, 2021 purchase agreement with Lincoln Park have been issued as of June 30, 2023. On February 28, 2023, our Company entered into the 2023 purchase agreement with Lincoln Park to sell up to $30 million of common stock over a 36-month period, with $10.5 million remaining on the 2023 purchase agreement as of the date of this filing. On December 9, 2022, our Company entered into the at the market sale agreement with Roth Capital, as sales agent, whereby pursuant to the at the market sale agreement, our Company may offer and sell up to $35,000,000 in shares of our common stock, from time to time through Roth Capital. As of the date of this filing $33.4 million remains available to our Company pursuant to the at the market sale agreement.

During the year ended December 31, 2023, the Company received $19,993,359 in proceeds pursuant to the 2021 purchase agreement and 2023 purchase agreement with Lincoln Park, $1,515,878 in proceeds pursuant to the at the market sale agreement with Roth Capital, $1,013,924 in proceeds pursuant to the exercise of options and warrants and $50,000 in a proceed received under a material supply and license agreement of which $39,875 is recorded as deferred revenue as of December 31, 2023. During the year ended December 31, 2022, the Company received $12,775,268 in proceeds pursuant to the 2021 purchase agreement with Lincoln Park and $653,895 in proceeds pursuant to the exercise of options and warrants. During the year ended December 31, 2021, the Company received $30,350,674 in proceeds pursuant to purchase agreements with Lincoln Park and $2,379,225 in proceeds pursuant to the exercise of options and warrants.

During the year ended December 31, 2023, our primary sources of cash outflows from operations included payroll, rent, utilities, payments to vendors including

prototypes development and foundries expenses and third-party service providers. During the year ended December 31, 2022, our primary sources of cash outflows from operations included payroll, rent, utilities, payments to vendors including prototypes development and foundries expenses, third-party service providers and payroll taxes related to cashless option exercise. During the year ended December 31, 2021, our primary sources of cash outflows from operations included payroll and bonus, payroll taxes related to cashless option exercise, rent, utilities, payments to vendors including prototypes development and foundries expenses and third-party service providers.

Sources and Uses of Cash

Our future expenditures and capital requirements will depend on numerous factors, including: the progress of our research and development efforts; the rate at which we can, directly or through arrangements with original equipment manufacturers, continue to introduce and sell products incorporating our polymer materials technology; the costs of filing, prosecuting, defending and enforcing any patent claims and other intellectual property rights; market acceptance of our products and competing technological developments; and our ability to establish or continue to establish cooperative development, joint venture and licensing arrangements. We expect that we will incur approximately $1,830,000 of expenditures per month over the next 12 months.

We expect the proceeds received pursuant to the 2023 purchase agreement and future purchase agreements with Lincoln Park, the at the market sale agreement with Roth Capital, the exercise of options and warrants and commercial operations to provide us with sufficient funds to maintain our operations over the next 12 months. Our current cash position enables us to finance our operations through July 2025 before we will be required to replenish our cash reserves pursuant to the 2023 Purchase Agreement or the Roth Sales Agreement. Our cash requirements are expected to increase at a rate consistent with our Company's revenue growth as we expand our activities and operations with the objective of increasing our revenue stream from the commercialization of our electro-optic polymer technology. We currently have no debt to service.

We expect that our cash used in operations will continue to increase during 2024 and beyond as a result of the following planned activities:

- The addition of management, sales, marketing, technical and other staff to our workforce;
- Increased spending for the expansion of our research and development efforts, including purchases of additional laboratory and production equipment;
- Increased spending in marketing as our products are introduced into the marketplace;
- Partnering with commercial foundries to implement our electro-optic polymers into accepted PDKs by the foundries;
- Developing and maintaining collaborative relationships with strategic partners;
- Developing and improving our manufacturing processes and quality controls; and
- Increases in our general and administrative activities related to our operations as a reporting public company and related corporate compliance requirements.

2023 Purchase Agreement with Lincoln Park

On February 28, 2023, our Company entered into the 2023 purchase agreement with Lincoln Park, pursuant to which Lincoln Park agreed to purchase from us up to $30 million of our common stock (subject to certain limitations) from time to time over a 36-month period. Pursuant to the 2023 purchase agreement, Lincoln Park is obligated to make purchases as the Company directs in accordance with the purchase agreement, which may be terminated by the Company at any time, without cost or penalty. Sales of shares will be made in specified amounts and at prices that are based upon the market prices of our common stock immediately preceding the sales to Lincoln Park. We expect this and any future purchase agreements with Lincoln Park to provide us with sufficient funds to maintain our operations for the foreseeable future. With the additional capital, we expect to achieve a level of revenues attractive enough to fulfill our development activities and adequate enough to support our business model for the foreseeable future.

There are no trading volume requirements or restrictions under the 2023 purchase agreement, and we will control the timing and amount of any sales of our common stock to Lincoln Park. Lincoln Park has no right to require any sales by us, but is obligated to make purchases from us as we direct in accordance with each of the 2023 purchase agreement. We can also accelerate the amount of common stock to be purchased under certain circumstances. There are no limitations on the use of proceeds, financial or business covenants, restrictions on future financings (other than restrictions on the Company's ability to enter into a similar type of agreement or equity line of credit during the term, excluding an at-the-market transaction with a registered broker-dealer), rights of first refusal, participation rights, penalties or liquidated damages under the 2023 purchase agreement.

At the Market Sale Agreement – Roth Capital

On December 9, 2022, we entered into the at the market sale agreement with Roth Capital, as sales agent. Pursuant to the at the market sale agreement, our Company may offer and sell up to $35,000,000 in shares of our common stock, from time to time through Roth Capital. Upon delivery of a placement notice based on our Company's instructions and subject to the terms and conditions of the at the market sale agreement, Roth Capital may sell the shares by methods deemed to be an "at the market offering" as defined in Rule 415(a)(4) promulgated under the Securities Act, including sales made directly on or through The Nasdaq Capital Market, on any other existing trading market for the Company's common stock, in negotiated transactions at market prices prevailing at the time of sale or at prices related to such prevailing market prices, or by any other method permitted by law, including negotiated transactions, subject to the prior written consent of our Company. We are not obligated to make any sales of shares under this agreement. The Company or Roth Capital may suspend or terminate the offering of shares upon notice to the other party, subject to certain conditions. Roth Capital will act as sales agent on a commercially reasonable efforts basis consistent with its normal trading and sales practices and applicable state and federal law, rules and regulations and the rules of Nasdaq. We have agreed to pay Roth Capital commissions for its services of acting as agent of 3.0% of the gross proceeds from the sale of the shares pursuant to the at the market sale agreement.

The amount of proceeds we receive from the at the market sale agreement, if any, will depend upon the number of shares of our common stock sold and the market price at which they are sold. There can be no assurance that we will be able to sell any shares under or fully utilize this agreement. Roth Capital is not required to sell any specific number of shares of our common stock under the agreement. We intend to use net proceeds from the at the market sale agreement for general corporate purposes, including, without limitation, sales and marketing activities, product development, making acquisitions of assets, businesses, companies or securities, capital expenditures, and for working capital needs.

We cannot assure you that we will meet the conditions of the 2023 purchase agreements with Lincoln Park in order to obligate Lincoln Park to purchase our shares of common stock, and we cannot assure you that we will be able to sell any shares under or fully utilize the at the market sale agreement with Roth Capital. In the event we fail to do so, and other adequate funds are not available to satisfy long-term capital requirements, or if planned revenues are not generated, we may be required to substantially limit our operations. This limitation of operations may include reductions in capital expenditures and reductions in staff and discretionary costs.

Analysis of Cash Flows

For the year ended December 31, 2023

Net cash used in operating activities was $12,236,024 for the year ended December 31, 2023, primarily attributable to the net loss of $21,038,032 adjusted by $6,459,387 in options issued for services, $262,697 amortization of deferred compensation, $673,578 in common stock issued for services, $1,119,141 in depreciation expenses and patent amortization expenses, $184,835 amortization of right of use asset, $215,509 gain on disposal of property and equipment, ($587,540) in prepaid expenses, $935,795 in accounts receivable, accounts payable, accrued bonuses, accrued expenses, deferred revenue and other liabilities. Net cash used in operating activities consisted of payments for research and development, legal, professional and consulting expenses, rent and other expenditures necessary to develop our business infrastructure.

Net cash used by investing activities was $2,957,201 for the year ended December 31, 2023, consisting of $307,687 in cost for intangibles, $3,292,224 in asset

additions for the Colorado headquarter facility and labs offset by $642,120 in a loan repayment and $590 in proceeds on sale of property and equipment.

Net cash provided by financing activities was $22,523,161 for the year ended December 31, 2023, and consisted of $1,013,924 in proceeds from exercise of options and warrants, $19,993,359 in proceeds from resale of common stock to an institutional investor and $1,515,878 in proceeds from at the market sale of common stock by an investment banking company.

On December 31, 2023, our cash and cash equivalents totaled $31,432,087, our assets totaled $41,783,585, our liabilities totaled $5,349,771 and we had stockholders' equity of $36,433,814.

For the year ended December 31, 2022

Net cash used in operating activities was $10,465,880 for the year ended December 31, 2022, primarily attributable to the net loss of $17,230,480 adjusted by $5,813,628 in options issued for services, $91,713 amortization of deferred compensation, $209,709 in common stock issued for services, $1,045,208 in depreciation expenses and patent amortization expenses, ($379,037) in prepaid expenses, ($135,661) in accounts payable, accrued bonuses and accrued expenses and $119,040 in cashless option exercise expense. Net cash used in operating activities consisted of payments for research and development, legal, professional and consulting expenses, rent and other expenditures necessary to develop our business infrastructure.

Net cash used by investing activities was $2,209,722 for the year ended December 31, 2022, consisting of $260,415 in cost for intangibles, $1,307,187 in asset additions for the Colorado headquarter facility and labs and $642,120 in a loan issuance.

Net cash provided by financing activities was $13,345,141 for the year ended December 31, 2022 and consisted of $653,895 in proceeds from exercise of options and warrants, $12,775,268 in proceeds from resale of common stock to an institutional investor offset by $84,022 in cashless option exercise tax payments.

On December 31, 2022, our cash and cash equivalents totaled $24,102,151, our assets totaled $29,263,472, our liabilities totaled $1,710,449 and we had stockholders' equity of $27,553,023.

For the year ended December 31, 2021

Net cash used in operating activities was $10,038,626 for the year ended December 31, 2021, primarily attributable to the net loss of $18,631,381 adjusted by $11,001 in warrants issued for services, $1,022,985 in options issued for services, $2,059,464 in common stock issued for services, $878,520 in depreciation expenses and patent amortization expenses, ($410,700) in Paycheck Protection Program loan forgiveness, $334,877 in prepaid expenses, $1,023,785 in accounts payable, accrued bonuses and accrued expenses and $3,672,823 in cashless option exercise expense. Net cash used in operating activities consisted of payments for research and development, legal, professional and consulting expenses, rent and other expenditures necessary to develop our business infrastructure.

Net cash used by investing activities was $1,116,179 for the year ended December 31, 2021, consisting of $18,649 in cost for intangibles and $1,097,530 in asset additions primarily for the Colorado headquarter facility and labs.

Net cash provided by financing activities was $31,280,827 for the year ended December 31, 2021 and consisted of $2,379,225 in proceeds from exercise of options and warrants, $30,350,674 in proceeds from resale of common stock to an institutional investor offset by $1,435,965 in cashless option exercise tax payments and $13,107 repayment of equipment purchased.

On December 31, 2021, our cash and cash equivalents totaled $23,432,612, our assets totaled $27,228,575, our liabilities totaled $2,024,303 and we had stockholders' equity of $25,204,272.

Contractual Obligations

See "Note 8–Commitments" of the notes to the financial statements contained elsewhere within this Annual Report on Form 10-K for a discussion of our operating lease for office and laboratory space.

Item 7A. Quantitative and Qualitative Disclosures About Market Risk

At December 31, 2023, we had $31.4 million in cash and cash equivalents. For the purposes of this Item 7A. we consider all highly liquid instruments with maturities of three months or less at the time of purchase to be cash equivalents. The fair value of all of our cash equivalents is determined based on "Level 1" inputs, which are based upon quoted prices for identical or similar instruments in markets that are active. We do not use any market risk sensitive instruments to hedge any risks, and we hold no market risk sensitive instruments for trading or speculative purposes. We place our cash investments in instruments that meet credit quality standards. At December 31, 2022, we had deposits with a financial institution that exceeded the Federal Depository Insurance coverage.

Market Interest Rate Risk

We are exposed to market risk related to changes in interest rates. Our primary exposure to market risk is interest rate sensitivity, which is affected by changes in the general level of U.S. interest rates. If a 10% change in interest rates had occurred on December 31, 2023, this change would not have had a material effect on the fair value of our investment portfolio as of that date.

Due to the short holding period of our investments and the nature of our investments, we have concluded that we do not have a material financial market risk exposure.

Item 8. Financial Statements and Supplementary Data

Our Financial Statements are attached as Appendix A (following Exhibits) and included as part of this Form 10-K Report. A list of our Financial Statements is provided in response to Item 15 of this Form 10-K Report.

Item 9. Changes In and Disagreements With Accountants On Accounting and Financial Disclosure

None.

Item 9A. Controls and Procedures.

Evaluation of Disclosure Controls and Procedures

As of December 31, 2023, our Company evaluated the effectiveness and design and operation of its disclosure controls and procedures. Our Company's disclosure controls and procedures are the controls and other procedures that we designed to ensure that our Company records, processes, summarizes, and reports in a timely manner the information that it must disclose in reports that our Company files with or submits to the Securities and Exchange Commission. Our principal executive officer and principal financial officer reviewed and participated in this evaluation. Based on this evaluation, our Company made the determination that its disclosure controls and procedures were effective.

Management's Annual Report on Internal Control Over Financial Reporting

Our management is responsible for establishing and maintaining adequate internal control over financial reporting, as such term is defined in Exchange Act Rules 13a-15(f) and 15d-15(f). Under the supervision and with the participation of management, including our principal executive officer and principal financial officer, we conducted an evaluation of the effectiveness of our internal controls over financial reporting based on the framework in Internal Control-Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission ("COSO"). Based on this evaluation, management has concluded that our internal control over financial reporting was effective as of December 31, 2023.

The Company's internal control over financial reporting includes policies and procedures that (1) pertain to maintenance of records that, in reasonable detail, accurately and fairly reflect transactions and dispositions of the assets of the Company; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the Company are being made only in accordance with authorizations of management and directors of the Company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the Company's assets that could have a material effect on the financial statements.

Our management, including our principal executive officer and principal financial officer, does not expect that our disclosure controls or our internal control over financial reporting will prevent or detect all errors and all fraud. A control system, no matter how well designed and operated, can provide only reasonable, not absolute, assurance that the control system's objectives will be met. Internal control over financial reporting is a process that involves human diligence and compliance and is subject to lapses in judgment and breakdowns resulting from human failures. In addition, the design of any system of controls is based in part on certain assumptions about the likelihood of future events, and controls may become inadequate if conditions change. There can be no assurance that any design will succeed in achieving its stated goals under all potential future conditions.

Audit Report on Internal Controls Over Financial Reporting of the Registered Public Accounting Firm

Morison Cogen LLP, the Company's independent registered public accounting firm has audited the financial statements included in this Annual Report on Form 10-K and, as part of their audit, has issued their report, included herein, on the effectiveness of the Company's internal control over financial reporting as of December 31, 2023.

Changes in Internal Control Over Financial Reporting

No change in our Company's internal control over financial reporting occurred during our fourth fiscal quarter that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

Item 9B. Other Information

Trading Arrangements

On December 6, 2023, Ronald Bucchi, a member of our Company's Board of Directors, adopted a non-Rule 10b5–1 trading arrangement as defined in Item 408(c) of Regulation S-K. The arrangement provided for the sale of 27,000 shares of the Company's common stock and it terminated on December 6, 2023, after all of the shares were sold. The trading arrangement was adopted during an open trading window and satisfied the Company's policies regarding insider transactions.

On December 13, 2023, Fred Leonberger, a member of our Company's Board of Directors, adopted a non-Rule 10b5–1 trading arrangement as defined in Item 408(c) of Regulation S-K. The arrangement provided for the sale of 75,000 shares of the Company's common stock and it terminated on December 13, 2023, after all of the shares were sold. The trading arrangement was adopted during an open trading window and satisfied the Company's policies regarding insider transactions.

Item 9C. Disclosure Regarding Foreign Jurisdictions that Prevent Inspections.

None.

PART III

Item 10. Directors, Executive Officers and Corporate Governance.

Information required under this Item will be contained in our definitive proxy statement, which will be filed within 120 days of December 31, 2023, our most recent fiscal year end, and is incorporated herein by reference.

Item 11. Executive Compensation.

Information required under this Item will be contained in our definitive proxy statement, which will be filed within 120 days of December 31, 2023, our most recent fiscal year end, and is incorporated herein by reference.

Item 12. Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters.

Information required under this Item will be contained in our definitive proxy statement, which will be filed within 120 days of December 31, 2023, our most recent fiscal year end, and is incorporated herein by reference.

Item 13. Certain Relationships and Related Transactions, and Director Independence.

Information required under this Item will be contained in our definitive proxy statement, which will be filed within 120 days of December 31, 2023, our most recent fiscal year end, and is incorporated herein by reference.

Item 14. Principal Accountant Fees and Services.

Information required under this Item will be contained in our definitive proxy statement, which will be filed within 120 days of December 31, 2023, our most recent fiscal year end, and is incorporated herein by reference.

PART IV

Item 15. Exhibits, Financial Statement Schedules

(a) The following Audited Financial Statements are filed as part of this Form 10-K Report:

Report of Independent Registered Public Accounting Firm
Balance Sheets
Statements of Comprehensive Loss
Statement of Stockholders' Equity
Statements of Cash Flows

(b) The following exhibits are filed as part of this report.

Exhibit No.	Description of Exhibit	Location
3.1	Articles of Incorporation	Incorporated by reference to Company's Form 10-SB as filed with the SEC on April 13, 2007
3.2	Certificate of Amendment to Articles of Incorporation	Incorporated by reference to Company's Definitive Schedule 14C Information Statement as filed with the SEC on February 19, 2008
3.3	Certificate of Amendment to Articles of Incorporation	Incorporated by reference to Company's Form S-1 Registration Statement as filed with the SEC on August 3, 2015
3.4	Amended and Restated Bylaws	Incorporated by reference to the Company's Form 10-Q as filed with the SEC on November 9, 2023
4.1	Description of Registrant's Securities	Filed herewith
10.1	Employee Agreement – Michael Lebby	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on March 22, 2017
10.2	Employee Agreement Amendment - Michael Lebby	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on April 20, 2021
10.3	Employee Agreement Amendment - Michael Lebby	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on January 21, 2022
10.4	Employee Agreement Amendment – Michael Lebby	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on March 20, 2023
10.5	Employee Agreement Amendment – Michael Lebby	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on April 27, 2023
10.6	Employee Agreement - James Marcelli	Incorporated by reference to Company's Form 10-Q as filed with the SEC on August 12, 2015
10.7	Employee Agreement Amendment - James Marcelli	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on April 20, 2021
10.8	Employee Agreement Amendment - James Marcelli	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on January 21, 2022
10.9	Employee Agreement Amendment – James Marcelli	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on March 20, 2023
10.10	Employee Agreement Amendment – James Marcelli	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on April 27, 2023
10.11	Form of Executive Paid Time Off Waiver Agreement	Incorporated by reference to the Company's Form 10-K as filed with the SEC on March 16, 2018
10.12	Form of Director Agreement	Incorporated by reference to the Company's Form 10-K as filed with the SEC on March 16, 2018
10.13	Form of Director and Officer Indemnification Agreement	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on January 21, 2022
10.14	Form of Director's Non-Disclosure Agreement	Incorporated by reference to the Company's Form 10-K as filed with the SEC on March 16, 2018
10.15	Operations Committee Charter	Incorporated by reference to the Company's Form 10-Q as filed with the SEC on August 15, 2016
10.16	Statement of Operations Committee Work - Frederick J. Leonberger	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on April 3, 2017
10.17	Statement of Operations Committee Work - Siraj Nour El-Ahmadi	Incorporated by reference to the Company's Form 10-K as filed with the SEC on March 31, 2021

10.18	2007 Employee Stock Plan	Incorporated by reference to Company's Definitive Schedule 14C Information Statement as filed with the SEC on February 19, 2008
10.19	2007 Employee Stock Plan Amendment	Incorporated by reference to Company's Definitive Schedule 14A Proxy Statement as filed with the SEC on July 22, 2014
10.20	2016 Equity Incentive Plan	Incorporated by reference to Appendix A to the Company's Definitive Schedule 14A filed with the SEC on April 20, 2016
10.21	2016 Equity Incentive Plan Amendment	Incorporated by reference to Appendix A to the Company's Definitive Schedule 14A filed with the SEC on April 12, 2019
10.22	2016 Equity Incentive Plan Amendment No. 2	Incorporated by reference to Appendix A to the Company's Definitive Schedule 14A filed with the SEC on April 14, 2023
10.23	Form of Non-qualified Stock Option Award Agreement - Employees	Incorporated by reference to the Company's Annual Report on Form 10-K as filed with the SEC on March 17, 2017
10.24	Form of Non-qualified Stock Option Award Agreement - Executive Officers	Incorporated by reference to the Company's Annual Report on Form 10-K as filed with the SEC on March 17, 2017
10.25	Form of Non-qualified Stock Option Award Agreement - Non Employee Directors	Incorporated by reference to the Company's Annual Report on Form 10-K as filed with the SEC on March 17, 2017
10.26	Form of Restricted Stock Award Agreement -Non Employee Directors	Incorporated by reference to the Company's Annual Report on Form 10-K as filed with the SEC on March 1, 2022
10.27	Lease Agreement dated October 26, 2017	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on November 2, 2017
10.28	First Amendment to the October 26, 2017 Lease Agreement dated November 22, 2022	Incorporated by reference to Company's Form 10-K as filed with the SEC on March 1, 2023
10.29	Purchase Agreement, dated October 4, 2021, by and between the Company and Lincoln Park	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on October 5, 2021
10.30	Registration Rights Agreement, dated October 4, 2021, by and between the Company and Lincoln Park	Incorporated by reference to the Company's Current Report on Form 8-K as filed with the SEC on October 5, 2021
10.31	Purchase Agreement, dated February 28, 2023, by and between the Company and Lincoln Park	Incorporated by reference to Company's Form 10-K as filed with the SEC on March 1, 2023
10.32	Registration Rights Agreement, dated February 28, 2023, by and between the Company and Lincoln Park	Incorporated by reference to Company's Form 10-K as filed with the SEC on March 1, 2023
14.1	Code of Ethics and Business Conduct	Incorporated by reference to the Company's Form 10-K as filed with the SEC on March 16, 2018
19.1	Insider Trading Policy	Filed herewith
21.1	Subsidiaries of the Registrant	Filed herewith
23.1	Consent of Independent Registered Public Accounting Firm - Morison Cogen LLP	Filed herewith

31.1	Certification pursuant to Rule 13a-14(a) of the Securities Exchange Act of 1934, as amended, executed by the Principal Executive Officer of the Company.	Filed herewith
31.2	Certification pursuant to Rule 13a-14(a) of the Securities Exchange Act of 1934, as amended, executed by the Principal Financial Officer of the Company.	Filed herewith
32.1	Certification pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, executed by the Principal Executive Officer of the Company.	Filed herewith
32.2	Certification pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, executed by the Principal Financial Officer of the Company.	Filed herewith
97.1	Compensation Clawback Policy	Filed herewith
101.INS	Inline XBRL Instance Document (the instance document does not appear in the Interactive Data File because its XBRL tags are embedded within the Inline XBRL document)	
101.SCH	Inline XBRL Taxonomy Extension Schema Document	
101.CAL	Inline XBRL Taxonomy Extension Calculation Linkbase Document	
101.DEF	Inline XBRL Taxonomy Extension Definition Linkbase Document	
101.LAB	Inline XBRL Taxonomy Extension Label Linkbase Document	
101.PRE	Inline XBRL Taxonomy Extension Presentation Linkbase Document	
104	Cover Page Interactive Data File (formatted as Inline XBRL and contained in Exhibit 101)	

Item 16. Form 10-K Summary

None

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized.

LIGHTWAVE LOGIC, INC.
Registrant

By: /s/ Michael Lebby
Michael Lebby,
Chief Executive Officer
(Principal Executive Officer)

Date: February 29, 2024

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the registrant and in the capacities and on the dates indicated.

Signature	Title	Date
/s/ Michael Lebby Michael Lebby	Chief Executive Officer, Principal Executive Officer, Chair of the Board of Directors	February 29, 2024
/s/ James S. Marcelli James S. Marcelli	President, Chief Operating Officer, Principal Financial/Accounting Officer, Secretary, Director	February 29, 2024
/s/ Ronald A. Bucchi Ronald A. Bucchi	Director	February 29, 2024
/s/ Siraj Nour El-Ahmadi Siraj Nour El-Ahmadi	Director	February 29, 2024
/s/ Frederick J. Leonberger Frederick J. Leonberger	Director	February 29, 2024
/s/ Craig Ciesla Craig Ciesla	Director	February 29, 2024
/s/ Laila Partridge Laila Partridge	Director	February 29, 2024

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REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Board of Directors and
Stockholders of Lightwave Logic, Inc.

Opinions on the Financial Statements and Internal Control over Financial Reporting

We have audited the accompanying balance sheets of Lightwave Logic, Inc. (the Company) as of December 31, 2023 and 2022, and the related statements of comprehensive loss, stockholders' equity, and cash flows for each of the three years in the period ended December 31, 2023, and the related notes (collectively referred to as the financial statements). We also have audited the Company's internal control over financial reporting as of December 31, 2023, based on criteria established in *Internal Control – Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO).

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of the Company as of December 31, 2023 and 2022, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2023, in conformity with accounting principles generally accepted in the United States of America. Also, in our opinion, the Company maintained, in all material respects, effective internal control over financial reporting as of December 31, 2023, based on criteria established in *Internal Control – Integrated Framework (2013)* issued by COSO.

Basis for Opinion

The Company's management is responsible for these financial statements, for maintaining effective internal control over financial reporting, and for its assessment of the effectiveness of internal control over financial reporting included in the accompanying Management's Report on Internal Control over Financial Reporting. Our responsibility is to express an opinion on the Company's financial statements and an opinion on the Company's internal control over financial reporting based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) (PCAOB) and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audits to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud, and whether effective internal control over financial reporting was maintained in all material respects.

Our audits of the financial statements included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. Our audit of internal control over financial reporting included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, and testing and evaluating the design and operating effectiveness of internal control based on the assessed risk. Our audits also included performing such other procedures as we considered necessary in the circumstances. We believe that our audits provide a reasonable basis for our opinions.

To the Board of Directors and
Stockholders of Lightwave Logic, Inc.
(Continued)

Definition and Limitations of Internal Control over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

Critical Audit Matters

Critical audit matters are matters arising from the current period audit of the financial statements that were communicated or required to be communicated to the audit committee and that: (1) relate to accounts or disclosures that are material to the financial statements and (2) involved our especially challenging, subjective, or complex judgments. We determined that there are no critical audit matters.

/s/ Morison Cogen LLP

We have served as the Company's auditor since 2005.

Blue Bell, Pennsylvania
February 29, 2024

LIGHTWAVE LOGIC, INC.
BALANCE SHEETS

	December 31, 2023	December 31, 2022
ASSETS		
CURRENT ASSETS		
Cash and cash equivalents	$ 31,432,087	$ 24,102,151
Accounts Receivable	30,376	—
Prepaid expenses and other current assets	1,237,621	611,345
Loan receivable	—	642,120
	32,700,084	25,355,616
PROPERTY AND EQUIPMENT - NET	4,990,790	2,519,267
OTHER ASSETS		
Intangible assets - net	1,254,501	1,030,335
Operating Lease - Right of Use - Building	2,838,210	358,254
	4,092,711	1,388,589
TOTAL ASSETS	$ 41,783,585	$ 29,263,472
LIABILITIES AND STOCKHOLDERS' EQUITY		
CURRENT LIABILITIES		
Accounts payable	$ 1,447,596	$ 791,671
Accrued bonuses and accrued expenses	599,430	380,280
Accounts payable and accrued expenses - related parties	313,483	100,169
Deferred revenue	39,875	—
Deferred lease liability	38,297	41,778
Operating lease liability	144,120	190,125
	2,582,801	1,504,023
LONG TERM LIABILITIES		
Deferred lease liability	—	38,297
Operating lease liability	2,766,970	168,129
	2,766,970	206,426
TOTAL LIABILITIES	5,349,771	1,710,449
STOCKHOLDERS' EQUITY		
Preferred stock, $ 0.001 par value, 1,000,000 authorized, no shares issued or outstanding	—	—
Common stock $ 0.001 par value, 250,000,000 authorized, 118,137,309 and 112,882,793 issued and outstanding at December 31, 2023 and December 31, 2022	118,137	112,883
Additional paid-in-capital	164,619,363	134,406,825
Deferred compensation	(432,293)	(133,324)
Accumulated deficit	(127,871,393)	(106,833,361)
TOTAL STOCKHOLDERS' EQUITY	36,433,814	27,553,023
TOTAL LIABILITIES AND STOCKHOLDERS' EQUITY	$ 41,783,585	$ 29,263,472

The accompanying notes are an integral part of these financial statements.

LIGHTWAVE LOGIC, INC.
STATEMENTS OF COMPREHENSIVE LOSS
FOR THE YEARS ENDING DECEMBER 31, 2023, 2022 AND 2021

	For the Year Ending December 31, 2023	For the Year Ending December 31, 2022	For the Year Ending December 31, 2021
NET SALES	$ 40,502	$ —	$ —
COST AND EXPENSE			
Cost of sales	2,513	—	—

Research and development	15,903,689	12,805,374	12,476,040
General and administrative	5,359,565	4,334,290	4,520,403
	21,265,767	17,139,664	16,996,443
LOSS FROM OPERATIONS	(21,225,265)	(17,139,664)	(16,996,443)
OTHER INCOME (EXPENSE)			
Paycheck Protection Program loan forgiveness	—	—	410,700
Interest income	657,546	91,659	13,826
Commitment fee	(673,578)	(209,709)	(2,059,464)
Gain on disposal of property and equipment	215,509	—	—
Other (expense) income	(12,244)	27,234	—
NET LOSS	$ (21,038,032)	$ (17,230,480)	$ (18,631,381)
LOSS PER SHARE			
Basic	$ (0.18)	$ (0.15)	$ (0.18)
Diluted	$ (0.18)	$ (0.15)	$ (0.18)
WEIGHTED AVERAGE NUMBER OF SHARES			
Basic	115,467,300	111,814,926	105,223,959
Diluted	115,467,300	111,814,926	105,223,959

The accompanying notes are an integral part of these financial statements

LIGHTWAVE LOGIC, INC.
STATEMENT OF STOCKHOLDERS' EQUITY
FOR THE YEARS ENDING DECEMBER 31, 2023, 2022 AND 2021

	Number of Shares	Common Stock	Additional Paid-in Capital	Deferred Compensation	Accumulated Deficit	Total
BALANCE AT DECEMBER 31, 2022	112,882,793	$ 112,883	$ 134,406,825	$ (133,324)	$ (106,833,361)	$ 27,553,023
Common stock issued to institutional investor	3,650,400	3,650	19,989,709	—	—	19,993,359
Common stock issued for commitment shares	112,739	113	673,465	—	—	673,578
Common stock sales at the market by investment banking company	202,115	202	1,515,676	—	—	1,515,878
Exercise of options	914,408	914	776,760	—	—	777,674
Exercise of warrants	269,000	269	235,981	—	—	236,250
Options issued for services	—	—	6,459,387	—	—	6,459,387
Restricted stock awards issued for future services	105,854	106	561,560	(561,666)	—	—
Deferred compensation	—	—	—	262,697	—	262,697
Net loss for the year ending December 31, 2023	—	—	—	—	(21,038,032)	(21,038,032)
BALANCE AT DECEMBER 31, 2023	118,137,309	$ 118,137	$ 164,619,363	$ (432,293)	$ (127,871,393)	$ 36,433,814

	Number of Shares	Common Stock	Additional Paid-in Capital	Deferred Compensation	Accumulated Deficit	Total
BALANCE AT DECEMBER 31, 2021	110,555,459	$ 110,556	$ 114,696,597	$ —	$ (89,602,881)	$ 25,204,272
Common stock issued to institutional investor	1,625,000	1,625	12,773,643	—	—	12,775,268
Common stock issued for commitment shares	23,468	22	209,687	—	—	209,709
Exercise of options	302,950	303	257,592	—	—	257,895
Cashless exercise of 4,375 options	2,596	3	35,015	—	—	35,018
Exercise of warrants	350,000	350	395,650	—	—	396,000
Options issued for services	—	—	5,813,628	—	—	5,813,628
Restricted stock awards issued for future services	28,500	29	274,995	(275,024)	—	—
Forfeiture restricted stock awards issued for future services	(5,180)	(5)	(49,982)	49,987	—	—
Deferred compensation	—	—	—	91,713	—	91,713
Net loss for the year ending December 31, 2022	—	—	—	—	(17,230,480)	(17,230,480)
BALANCE AT DECEMBER 31, 2022	112,882,793	$ 112,883	$ 134,406,825	$ (133,324)	$ (106,833,361)	$ 27,553,023

	Number of Shares	Common Stock	Additional Paid-in Capital	Deferred Compensation	Accumulated Deficit	Total
BALANCE AT DECEMBER 31, 2020	97,775,789	$ 97,776	$ 76,649,170	$ —	$ (70,971,500)	$ 5,775,446
Common stock issued to institutional investor	9,290,011	9,291	30,341,383	—	—	30,350,674
Common stock issued for commitment shares	514,536	514	2,058,950	—	—	2,059,464

Exercise of options	2,046,250	2,046	1,948,829	—	—	1,950,875
Cashless exercise of 445,252 options	251,873	252	2,236,606	—	—	2,236,858
Exercise of warrants	677,000	677	427,673	—	—	428,350
Options issued for services	—	—	1,022,985	—	—	1,022,985
Warrants issued for services	—	—	11,001	—	—	11,001
Net loss for the year ending December 31, 2021	—	—	—	—	(18,631,381)	(18,631,381)
BALANCE AT DECEMBER 31, 2021	110,555,459	$ 110,556	$ 114,696,597	$ —	$ (89,602,881)	$ 25,204,272

The accompanying notes are an integral part of these financial statements

LIGHTWAVE LOGIC, INC.
STATEMENTS OF CASH FLOWS
FOR THE YEARS ENDING DECEMBER 31, 2023, 2022 AND 2021

	For the Year Ending December 31, 2023	For the Year Ending December 31, 2022	For the Year Ending December 31, 2021
CASH FLOWS FROM OPERATING ACTIVITIES			
Net loss	$ (21,038,032)	$ (17,230,480)	$ (18,631,381)
Adjustments to reconcile net loss to net cash used in operating activities			
Warrants issued for services	—	—	11,001
Stock options issued for services	6,459,387	5,813,628	1,022,985
Amortization of deferred compensation	262,697	91,713	—
Cashless option exercise	—	53,219	3,407,444
Common stock issued for services and fees	673,578	209,709	2,059,464
Depreciation and amortization of patents	1,119,141	1,045,208	878,520
Amortization of right of use asset	184,835	178,192	167,007
Gain on disposal of property and equipment	(215,509)	—	—
Paycheck Protection Program loan forgiveness	—	—	(410,700)
Decrease (increase) in assets			
Accounts receivable	(30,376)	—	—
Prepaid expenses and other current assets	(587,540)	(379,037)	334,877
Increase (decrease) in liabilities			
Accounts payable	655,925	575,937	46,487
Accrued bonuses and accrued expenses	219,150	(737,800)	1,036,684
Accounts payable and accrued expenses-related parties	213,314	67,980	(17,608)
Deferred revenue	39,875	—	—
Deferred lease liability	(41,778)	(41,778)	(41,778)
Operating lease liability	(150,691)	(178,192)	(167,007)
Net cash used in operating activities	(12,236,024)	(10,531,701)	(10,304,005)
CASH FLOWS FROM INVESTING ACTIVITIES			
Cost of intangibles	(307,687)	(260,415)	(18,649)
Purchase of property and equipment	(3,292,224)	(1,307,187)	(1,097,530)
Repayment (issuance) of loan	642,120	(642,120)	—
Sale of property and equipment	590	—	—
Net cash used in investing activities	(2,957,201)	(2,209,722)	(1,116,179)
CASH FLOWS FROM FINANCING ACTIVITIES			
Exercise of options and warrants	1,013,924	653,895	2,379,225
Cashless option exercise tax payments	—	(18,201)	(1,170,586)
Issuance of common stock, institutional investor	19,993,359	12,775,268	30,350,674
At the market sale by investment banking company	1,515,878	—	—
Repayment of equipment purchase payable	—	—	(13,107)
Net cash provided by financing activities	22,523,161	13,410,962	31,546,206
NET INCREASE IN CASH AND CASH EQUIVALENTS	7,329,936	669,539	20,126,022
CASH AND CASH EQUIVALENTS - BEGINNING OF YEAR	24,102,151	23,432,612	3,306,590
CASH AND CASH EQUIVALENTS - END OF YEAR	$ 31,432,087	$ 24,102,151	$ 23,432,612
Supplemental Disclosure of Non-cash investing and financing activities :			
Amended Operating Lease - Right of Use - Building and Operating lease liability	$ 2,703,527	$ —	$ —

The accompanying notes are an integral part of these financial statements

LIGHTWAVE LOGIC, INC.
NOTES TO FINANCIAL STATEMENTS
DECEMBER 31, 2023, 2022 AND 2021

NOTE 1 – SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

History and Nature of Business
Lightwave Logic, Inc. (the “Company”) is a technology company focused on the development of next generation photonic devices and electro-optic polymer materials systems for applications in high speed fiber-optic data communications, telecommunications and optical computing markets. The Company's first revenue stream is from

a technology material supply and licensing agreement that incorporates the Company's patented electro-optic polymer materials for use in manufacturing photonic devices. Currently, the Company is in various stages of photonic device and materials development and evaluation with potential customers and strategic partners. The Company expects to obtain additional revenue from material supply and licensing agreements, technology transfer agreements and the production and direct sale of its own photonic devices.

The Company's current development activities are subject to significant risks and uncertainties, including failing to secure additional funding to operationalize the Company's technology now under development.

Lightwave Logic, Inc. was organized under the laws of the State of Nevada in 1997, and it commenced with its current business plan in 2004.

Basis of Presentation
The accompanying financial statements are presented in accordance with accounting principles generally accepted in the United States of America.

Estimates
The preparation of financial statements in conformity with accounting principles generally accepted in the United States requires management to make estimates and assumptions that affect the amounts reported in the financial statements and accompanying disclosures. Although these estimates are based on management's best knowledge of current events and actions the Company may undertake in the future, actual results could differ from the estimates.

Cash Equivalents
For the purposes of the statement of cash flows, the Company considers all highly liquid instruments with maturities of three months or less at the time of purchase to be cash equivalents.

Concentration of Credit Risk
Certain financial instruments potentially subject the Company to concentrations of credit risk. These financial instruments consist primarily of cash. At December 31, 2023, the Company did have deposits with a financial institution that exceed the Federal Depository Insurance coverage.

Property and Equipment
Equipment is stated at cost. Depreciation is principally provided by use of straight-line methods for financial and tax reporting purposes over the estimated useful lives of the assets, generally 5 years. When property is retired or otherwise disposed of, the cost and accumulated depreciation are removed from the accounts and any resulting gain or loss is included in operations.

NOTE 1 – SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

Intangible Assets
Definite-lived intangible assets are stated at cost. Patents are amortized over their estimated useful lives, commencing from the date of grant for the remaining legal lives of the patents. The patents generally have a term of up to 20 years from the date of filing of the earliest related patent application. When certain patent applications are abandoned by the Company for claims that are covered by patents already granted to the Company, the cost of patent applications are removed from the accounts and the resulting expense is reflected in the statement of comprehensive loss.

Fair Value of Financial Instruments
The carrying value of the Company's short-term financial instruments such as cash, accounts payable and accrued expenses approximate their fair values because of their short maturities.

Revenue Recognition and Deferred Revenue
The rights and benefits to the Company's patented electro-optic polymer materials are conveyed to the customer through technology license and material supply agreements where the Company provides the licensee a supply of its proprietary polymers for use in the licensee's manufacturing of photonic devices (the "Licensed Product") as well as non-exclusive, royalty-bearing license to intellectual property rights in the Company's patented polymer technology. The Company receives license and royalty payments under such commercial agreements, some of which are nonrefundable upfront payments for license fees. These advances are initially recorded as deferred revenue on the Company's balance sheets. The Company believes that the licenses provided and materials transferred under such agreements are not distinct from each other for financial reporting purposes and as such, they are accounted for as a single performance obligation. Advance payments for license fees and minimum annual royalties are recognized on a pro-rata basis over the related contract term. Royalties from licensee's sale of the Licensed Product that exceed the minimum annual royalty are recognized when cumulative royalties exceed the minimum royalty. Milestone license fees are recognized when the licensee reaches the milestone of selling a contractually specified number of units of the Licensed Product.

Revenue associated with the sale of the Company's patented electro-optic polymer materials for incorporation into the customers' commercial photonic devices or for their device development and evaluation activities will be recognized at the time title passes, which is typically at the time of shipment or at the time of delivery, depending upon the contractual agreement between the parties.

Cost of Sales
Cost of sales consists of labor costs, material costs and manufacturing overhead costs associated with the production of materials transferred to the customer under the technology license and material supply agreement at the Company's facility.

Income Taxes
The Company follows Financial Accounting Standards Board ("FASB") Accounting Standards Codification ("ASC") 740, "Income Taxes," which requires an asset and liability approach to financial accounting and reporting for income taxes. Deferred income tax assets and liabilities are computed annually for temporary differences between the financial statement and tax bases of assets and liabilities that will result in taxable or deductible amounts in the future based on enacted tax laws and rates applicable to the periods in which the differences are expected to affect taxable income. Valuation allowances are established when necessary to reduce deferred tax assets to the amount expected to be realized. Income tax expense is the tax payable or refundable for the period plus or minus the change during the period in deferred tax assets and liabilities.

NOTE 1 – SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

Stock-based Payments
The Company accounts for stock-based compensation under the provisions of Financial Accounting Standards Board (FASB) Accounting Standards Codification (ASC) 718, "Compensation - Stock Compensation", which requires the measurement and recognition of compensation expense for all stock-based awards made to employees and directors based on estimated fair values on the grant date. The fair value of restricted stock awards is estimated by the market price of the Company's common stock at the date of grant. Restricted stock awards are being amortized to expense over the vesting period. The Company estimates the fair value of option and warrant awards on the date of grant using the Black-Scholes model. The value of the portion of the award that is ultimately expected to vest is recognized as expense over the requisite service periods using the straight-line method. In June 2018, the FASB issued ASU No. 2018-07, *Compensation – Stock Compensation (Topic 718),*

Improvements to Nonemployee Share-Based Payment Accounting (the "2018 Update). The amendments in the 2018 Update expand the scope of Topic 718 to include share-based payment transactions for acquiring goods and services from non-employees. Prior to the 2018 Update, Topic 718 applied only to share- based transactions to employees. Consistent with the accounting requirement for employee share-based payment awards, nonemployee share-based payment awards within the scope of Topic 718 are measured at grant-date fair value of the equity instruments that an entity is obligated to issue when the good has been delivered or the service has been rendered and any other conditions necessary to earn the right to benefit from the instruments have been satisfied.

The Company has elected to account for forfeiture of stock-based awards as they occur.

Loss Per Share
The Company follows FASB ASC 260, "Earnings per Share", resulting in the presentation of basic and diluted earnings per share. Because the Company reported a net loss in 2023, 2022 and 2021, common stock equivalents, including stock options and warrants were anti-dilutive; therefore, the amounts reported for basic and dilutive loss per share were the same.

Recoverability of Long-Lived Assets
The Company follows FASB ASC 360, "Property, Plant, and Equipment". Long-lived assets to be held and used are reviewed for impairment whenever events or changes in circumstances indicate that the related carrying amount may not be recoverable. When required, impairment losses on assets to be held and used are recognized based on the excess of the asset's carrying amount.

Comprehensive Income (Loss)
The Company follows FASB ASC 220.10, "Reporting Comprehensive Income (Loss)." Comprehensive income (loss) is a more inclusive financial reporting methodology that includes disclosure of certain financial information that historically has not been recognized in the calculation of net income (loss). Since the Company has no items of other comprehensive income (loss), comprehensive income (loss) is equal to net income (loss).

Recently Adopted Accounting Pronouncements
As of December 31, 2023 and for the period then ended, there are no recently adopted accounting standards that have a material effect on the Company's financial statements.

Recently Issued Accounting Pronouncements Not Yet Adopted
As of December 31, 2023, there are no recently issued accounting standards not yet adopted which would have a material effect on the Company's financial statements.

NOTE 1 – SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

Reclassifications

Certain reclassifications have been made to the 2022 financial statement in order to conform to the 2023 financial statement presentation.

NOTE 2 – MANAGEMENT'S PLANS

Our future expenditures and capital requirements will depend on numerous factors, including: the progress of our research and development efforts; the rate at which we can, directly or through arrangements with original equipment manufacturers, introduce and sell products incorporating our polymer materials technology; the costs of filing, prosecuting, defending and enforcing any patent claims and other intellectual property rights; market acceptance of our products and competing technological developments; and our ability to establish cooperative development, joint venture and licensing arrangements. We expect that we will incur approximately $ 1,830,000 of expenditures per month over the next 12 months. Our current cash position enables us to finance our operations through July 2025. On February 28, 2023, the Company entered into a purchase agreement with the institutional investor to sell up to $ 30,000,000 of common stock over a 36-month period (described in Note 11). Pursuant to the purchase agreement, the Company received $ 3,335,300 in January and February 2024 and a remaining available amount of $ 10,518,648 is available to the Company per the agreement. On December 9, 2022, the Company entered into a sales agreement with an investment banking company whereby the Company may offer and sell shares of its common stock having an aggregate offering price of up to $ 35,000,000 from time to time through or to the investment banking company, as sales agent or principal (described in Note 11). Pursuant to the sales agreement, the Company received $ 52,669 in January and February 2024 and the remaining available amount of $ 33,382,897 is available to the Company per the agreement. The Company's first commercial agreement occurred in May 2023 from a material supply and license agreement that incorporates the Company's patented electro-optic polymer materials for use in manufacturing photonic devices (described in Note 3). For the year ended December 31, 2023, we recognized $ 40,502 in revenue related to this agreement. Our cash requirements are expected to increase at a rate consistent with the Company's path to revenue as we expand our activities and operations with the objective of commercializing our electro-optic polymer technology. We currently have no debt to service.

NOTE 3 – REVENUE

The Company recognizes revenue in accordance with ASC Topic 606, Revenue from Contracts with Customers (Topic 606). The standard establishes the principles that an entity shall apply to report useful information to users of financial statements about the nature, amount, timing, and uncertainty of revenue and cash flows from a contract with a customer.

The Company's first commercial agreement occurred in May 2023, in the form of a four-year material supply and license agreement (the "License Agreement") that incorporates the Company's patented electro-optic polymer materials for use in manufacturing of photonic devices (the "Licensed Product"). The licensee shall pay the Company a running royalty with a minimum royalty paid on an annual basis over the term of the License Agreement. Additional future revenue will be generated from royalties from the licensee's sale of Licensed Product that exceed the minimum royalty payments and milestone license fees. The License Agreement is a non-exclusive material supply and license agreement.

NOTE 3 – REVENUE (CONTINUED)

Timing of Revenue Recognition and Contract Balances

Revenues related to the initial license fee and a minimum annual royalty are recognized over time commencing with the License Agreement in May 2023. An up-front license fee in the amount of $ 50,000 was paid during the period ending December 31, 2023. $ 39,875 of this amount is recorded in short term liability deferred revenue

in the Company's balance sheet as of December 31, 2023.

For the year ended December 31, 2023, the Company recognized $ 40,502 in revenue related to this agreement.

Contract balances are as follows:

	December 31, 2023
Accounts receivable, net	$ 30,376
Short-term contract assets	$ —
Long-term contract assets	$ —
Short-term liability deferred revenue	$ 39,875
Long-term liability deferred revenue	$ —

A roll forward of contract balances is not disclosed since there were no contracts as of December 31, 2022.

Assets Recognized for the Costs to Obtain a Contract

There are no assets recognized for the costs to obtain the License Agreement.

NOTE 4 – PREPAID EXPENSES AND OTHER CURRENT ASSETS

Prepaid expenses and other current assets consist of the following:

	December 31, 2023	December 31, 2022
Materials fabrication	$ 475,936	$ —
License	241,936	94,195
Insurance	237,791	218,767
Prototype devices	161,267	40,473
Other	53,373	45,675
Rent	36,525	36,525
Deposit for equipment	20,000	59,850
Investor relations	6,313	18,250
Lease incentive receivable	4,480	—
Legal	—	83,941
Loan interest receivable	—	13,669
	$ 1,237,621	$ 611,345

NOTE 5 – LOAN RECEIVABLE

On September 7, 2022, the Company entered into a convertible loan agreement (the "Loan") with an entity and issued a loan on September 12, 2022 in the amount of EUR 600,000 bearing interest at 7 % per annum with a maturity date of March 31, 2023 . The Company recorded $ 13,375 of interest income for the year ended December 31, 2022. The exchange rates used for the conversion of the EUR denominated loan were the December 31, 2022 reporting period end date exchange rate for the loan principal resulting in a balance of $ 642,120 and interest receivable resulting in a balance of $ 13,669 and the average exchange rate for the period ending December 31, 2022 for interest income. The loan and interest were repaid in February and March 2023. The Company recorded $ 11,125 of interest income for the period ended December 31, 2023 and used the average exchange rate for the conversion of the EUR denominated interest income for the period.

NOTE 6 – PROPERTY AND EQUIPMENT

Property and equipment consist of the following:

	December 31, 2023	December 31, 2022
Office equipment	$ 146,196	$ 119,404
Lab equipment	8,937,847	6,234,777
Furniture	74,119	33,128
Leasehold improvements	396,111	184,843
Software	111,077	—
	9,665,350	6,572,152
Less: Accumulated depreciation	4,674,560	4,052,885
	$ 4,990,790	$ 2,519,267

Depreciation expense for the years ending December 31, 2023, 2022 and 2021 was $ 1,035,620 , $ 966,995 and $ 792,004 . During the year ending December 31, 2023, the Company disposed of equipment for proceeds of $ 590 , trade-in credit of $ 216,090 and a gain of $ 215,509 . During the year ending December 31, 2022, the Company retired $ 70,963 of leasehold improvements. During the year ended December 31, 2021, the Company did no t sell or retire property and equipment.

NOTE 7 – INTANGIBLE ASSETS

This represents legal fees and patent fees associated with the prosecution of patent applications. The Company has recorded amortization expense on patents granted, which are amortized over the remaining legal life. Maintenance patent fees are paid to a government patent authority to maintain a granted patent in force. Some countries require the payment of maintenance fees for pending patent applications. Maintenance fees paid after a patent is granted are expensed, as these are considered ongoing costs to "maintain a patent". Maintenance fees paid prior to a patent grant date are capitalized to patent costs, as these are considered "patent application costs". No amortization expense has been recorded on the remaining patent applications since patents on these applications have yet to be granted.

Intangible assets consist of the following:

	December 31, 2023	December 31, 2022
Patents	$ 1,913,751	$ 1,606,064
Less: Accumulated amortization	659,250	575,729
	$ 1,254,501	$ 1,030,335

Amortization expense for the years ending December 31, 2023, 2022 and 2021 was $ 83,521 , $ 78,213 and $ 86,516 . There were no patent costs written off for the years ended December 31, 2023, 2022 and 2021.

NOTE 8 – COMMITMENTS

On October 30, 2017, the Company entered into a lease agreement (the "Lease") to lease approximately 13,420 square feet of office, chemistry, clean room and research and development space located in Colorado for the Company's principal executive offices and research and development facility. The term of the lease is sixty-one (61) months, beginning on November 1, 2017 and ending on November 30, 2022 . During January 2022, the term was extended for an additional twenty-four (24) months. This extension did not require a lease modification as the additional option period was included in the original computation as of January 1, 2019. Base rent for the first year of the lease term is approximately $ 168,824 , with an increase in annual base rent of approximately 3 % in each subsequent year of the lease term. As specified in the lease, the Company paid the landlord (i) all base rent for the period November 1, 2017 and ending on October 31, 2019, in the sum of $ 347,045 ; and (ii) the estimated amount of tenant's proportionate share of operating expenses for the same period in the sum of $ 186,293 . Commencing on November 1, 2019, monthly installments of base rent and one-twelfth of landlord's estimate of tenant's proportionate share of annual operating expenses shall be due on the first day of each calendar month. The lease also provides that (i) on November 1, 2019 landlord shall pay the Company for the cost of the cosmetic improvements in the amount of $3.00 per rentable square foot of the premises, and (ii) on or prior to November 1, 2019, the Company shall deposit with Landlord the sum of $ 36,525 as a security deposit which shall be held by landlord to secure the Company's obligations under the lease. On October 30, 2017, the Company entered into an agreement with the tenant leasing the premise from the landlord ("Original Lessee") whereby the Original Lessee agreed to pay the Company the sum of $260,000 in consideration of the Company entering into the lease and landlord agreeing to the early termination of the Original Lessee's lease agreement with landlord. The consideration of $ 260,000 was received on November 1, 2017.

Due to the adoption of the new lease standard, the Company has capitalized the present value of the minimum lease payments commencing November 1, 2019, including the additional option period using an estimated incremental borrowing rate of 6.5 %. The minimum lease payments do not include common area annual expenses which are considered to be non-lease components.

As of January 1, 2019 the operating lease right-of-use asset and operating lease liability amounted to $ 885,094 with no cumulative-effect adjustment to the opening balance of retained earnings/accumulated deficit.

On November 22, 2022, the Company entered into an amendment to the Lease ("the Amended Lease") to lease an additional approximately 9,684 square feet of adjacent office and warehouse space. The term of the Amended Lease is one hundred twenty (128) months, with an effective date of June 1, 2023 . Base rent through January 31, 2024 of the Amended Lease term is approximately $ 30,517 per month. The base rent for the next full year of the Amended Lease term is approximately $ 377,288 , with an increase in annual base rent of approximately 3 % in each subsequent year of the lease term. Commencing on June 1, 2023, monthly installments of base rent and one-twelfth of landlord's estimate of tenant's proportionate share of annual operating expenses shall be due on the first day of each calendar month. The Amended Lease also provides an allowance of up to $ 43,216 to be used solely for the cost of renovations to the additional lease premises. As of June 1, 2023, the operating lease right-of-use asset and operating lease liability amounted to $ 2,945,322 .

The Company has elected not to recognize right-of-use assets and lease liabilities arising from short-term leases. There are no other material operating leases.

NOTE 8 – COMMITMENTS (CONTINUED)

The Company is obligated under the Amended Lease for office, chemistry, clean room and research and development space. The aggregate minimum future lease payments under the Amended Lease, including the extended term are as follows:

YEARS ENDING DECEMBER 31,	AMOUNT
2024	$ 376,364
2025	387,666
2026	399,199
2027	411,174
2028	423,612
Thereafter	2,357,570
	4,355,585
Less discounted interest	(1,444,495)
TOTAL	$ 2,911,090

Rent expense totaling $ 236,170 and $ 78,724 is included in research and development and general and administrative expenses for the year ended December 31, 2023. Rent expense totaling $ 138,394 and $ 46,132 is included in research and development and general and administrative expenses for the year ended December 31, 2022. Rent expense totaling $ 134,243 and $ 44,747 is included in research and development and general and administrative expenses for the year ended December 31, 2021.

NOTE 9 – PAYCHECK PROTECTION PROGRAM ADVANCE

On April 24, 2020, the Company received $ 410,700 in loan funding from the Paycheck Protection Program, established pursuant to the Coronavirus Aid, Relief, and Economic Security Act enacted on March 27, 2020 and administered by the U.S. Small Business Administration. The unsecured loan is evidenced by a promissory note of the Company dated April 23, 2020 in the principal amount of $ 410,700 , to Community Banks of Colorado, a division of NBH Bank, the lender. The loan proceeds have been used to cover payroll costs, rent and utility costs. The loan was eligible for forgiveness as part of the CARES Act if certain requirements were met. The loan was forgiven by the Small Business Administration in its entirety on January 22, 2021.

NOTE 10 – INCOME TAXES

As discussed in Note 1, the Company utilizes the asset and liability method of accounting for income taxes in accordance with FASB ASC 740.

The income tax (benefit) provision consists of the following:

	2023	2022	2021
Current	$ —	$ —	$ —
Deferred	(6,526,000)	(5,071,000)	(3,692,000)
Change in valuation allowance	6,526,000	5,071,000	3,692,000
	$ —	$ —	$ —

NOTE 10 – INCOME TAXES (CONTINUED)

The reconciliation of the statutory federal rate to the Company's effective income tax rate is as follows:

	2023		2022		2021	
	Amount	%	Amount	%	Amount	%
Income tax benefit at U.S. federal income tax rate	($4,418,000)	(21)	($3,618,000)	(21)	($3,913,000)	(21)
State tax benefit, net of federal tax effect	(957,000)	(5)	(784,000)	(4)	(838,000)	(4)
Federal deduction net of tax	44,000	—	35,000	—	38,000	—
Tax exempt income	—	—	—	—	(111,000)	(1)
Non-deductible share-based compensation	1,653,000	8	1,430,000	8	899,000	5
Exercised share based compensation	(2,850,000)	(13)	(2,981,000)	(17)	—	—
Other	2,000	—	847,000	5	233,000	1
Change in valuation allowance	6,526,000	31	5,071,000	29	3,692,000	20
	$ —	—	$ —	—	$ —	—

The components of deferred tax assets as of December 31, 2023, 2022 and 2021 are as follows:

	2023	2022	2021
Deferred tax asset for NOL carryforwards	$ 29,018,000	$ 23,930,000	$ 19,966,000
Share-based compensation	3,889,000	2,451,000	1,242,000
Other	(102,000)	(102,000)	—
Valuation allowance	(32,805,000)	(26,279,000)	(21,208,000)
	$ —	$ —	$ —

The valuation allowance for deferred tax assets as of December 31, 2023, 2022 and 2021 was $ 32,805,000 , $ 26,279,000 and $ 21,208,000 , respectively. The change in the total valuation for the year ended December 31, 2023 was an increase of $ 6,526,000 , for the year ended December 31, 2022 was an increase of $ 5,071,000 and for the year ended December 31, 2021 was an increase of $ 3,692,000 . In assessing the realization of deferred tax assets, management considers whether it is more likely than not that some portion or all of the deferred tax assets will not be realized. The ultimate realization of deferred tax assets is dependent upon the generation of future taxable income during the periods in which the net operating losses and temporary differences become deductible. Management considered projected future taxable income and tax planning strategies in making this assessment. The value of the deferred tax assets was offset by a valuation allowance, due to the current uncertainty of the future realization of the deferred tax assets.

As of December 31, 2023, the Company had net operating loss carry forwards of approximately $ 117,985,000 and is comprised of net operating losses in the amount of approximately $ 38,275,000 recorded in tax years beginning prior to January 1, 2018 expiring through the year ending December 31, 2038 and net operating losses recorded in tax years beginning January 1, 2018 and after in the amount of approximately $ 79,710,000 which are allowed for an indefinite carryforward period but may be subject to limitations. This amount can be used to offset future taxable income of the Company.

NOTE 10 – INCOME TAXES (CONTINUED)

The timing and manner in which the Company can utilize operating loss carryforwards in any year may be limited by provisions of the Internal Revenue Code regarding changes in ownership of corporations. Such limitation may have an impact on the ultimate realization of its carryforwards and future tax deductions.

The Company follows FASB ASC 740-10, which provides guidance for the recognition and measurement of certain tax positions in an enterprise's financial statements. Recognition involves a determination of whether it is more likely than not that a tax position will be sustained upon examination with the presumption that the tax position will be examined by the appropriate taxing authority having full knowledge of all relevant information. The adoption of FASB ASC 740-10 did not require an adjustment to the Company's financial statements.

The Company's policy is to record interest and penalties associated with unrecognized tax benefits as additional income taxes in the statement of operations. As of January 1, 2023, the Company had no unrecognized tax benefits and no charge during 2023, and accordingly, the Company did not recognize any interest or penalties during 2023 related to unrecognized tax benefits. There is no accrual for uncertain tax positions as of December 31, 2023.

The Company files U.S. income tax returns and a state income tax return. With few exceptions, the U.S. and state income tax returns filed for the tax years ending on December 31, 2020 and thereafter are subject to examination by the relevant taxing authorities.

NOTE 11 – STOCKHOLDERS' EQUITY

Preferred Stock

Pursuant to the Company's Articles of Incorporation, the Company's board of directors is empowered, without stockholder approval, to issue series of preferred stock

with any designations, rights and preferences as they may from time to time determine. The rights and preferences of this preferred stock may be superior to the rights and preferences of the Company's common stock; consequently, preferred stock, if issued could have dividend, liquidation, conversion, voting or other rights that could adversely affect the voting power or other rights of the common stock. Additionally, preferred stock, if issued, could be utilized, under special circumstances, as a method of discouraging, delaying or preventing a change in control of the Company's business or a takeover from a third party.

Common Stock Options and Warrants

In January 2019, the Company signed a purchase agreement with the institutional investor to sell up to $ 25,000,000 of common stock. The Company registered 9,500,000 shares pursuant to a registration statement filed on January 30, 2019 which became effective February 13, 2019. The Company issued 350,000 shares of common stock to the institutional investor as an initial commitment fee valued at $ 258,125 , fair value, and 812,500 shares of common stock are reserved for additional commitment fees to the institutional investor in accordance with the terms of the purchase agreement. The Company registered an additional 6,000,000 shares pursuant to a registration statement filed on January 24, 2020 which became effective February 4, 2020. The Company registered an additional 8,000,000 shares pursuant to a registration statement filed on November 20, 2020 which became effective November 20, 2020. During the period January 2019 through December 31, 2023, the institutional investor purchased 22,337,500 shares of common stock for proceeds of $ 23,773,924 and the Company issued 772,666 shares of common stock as additional commitment fee, valued at $ 1,575,509 , fair value, leaving 39,834 in reserve for additional commitment fees. During the year ending December 31, 2023, the institutional investor did not purchase any shares of common stock. All the registered shares under the purchase agreement have been issued as of December 31, 2023.

NOTE 11 – STOCKHOLDERS' EQUITY (CONTINUED)

Common Stock Options and Warrants (Continued)

On July 2, 2021, the Company filed a $100,000,000 universal shelf registration statement with the U.S. Securities and Exchange Commission which became effective on July 9, 2021.

On October 4, 2021, the Company entered into a purchase agreement with the institutional investor to sell up to $ 33,000,000 of common stock over a 36-month period. Concurrently with entering into the purchase agreement, the Company also entered into a registration rights agreement which provides the institutional investor with certain registration rights related to the shares issued under the purchase agreement. Pursuant to the purchase agreement, the Company issued 30,312 shares of common stock to the institutional investor as an initial commitment fee valued at $ 279,174 , fair value, and 60,623 shares of common stock are reserved for additional commitment fees to the institutional investor in accordance with the terms of the purchase agreement. During the period October 4, 2021 through December 31, 2023, the institutional investor purchased 3,632,456 shares of common stock for proceeds of $ 33,000,000 and the Company issued 60,623 shares of common stock as additional commitment fee, valued at $ 694,531 fair value. During the year ending December 31, 2023, pursuant to the purchase agreement, the institutional investor purchased 779,945 shares of common stock for proceeds of $ 3,847,307 and the Company issued 7,069 shares of common stock as additional commitment fee, valued at $ 38,161 fair value. All of the registered shares under the purchase agreement have been issued as of December 31, 2023.

On February 28, 2023, the Company entered into a purchase agreement with an institutional investor to sell up to $ 30,000,000 of common stock over a 36-month period. Concurrently with entering into the purchase agreement, the Company also entered into a registration rights agreement which provides the institutional investor with certain registration rights related to the shares issued under the purchase agreement. Pursuant to the purchase agreement, the Company issued 50,891 shares of common stock to the institutional investor as an initial commitment fee valued at $ 279,391 , fair value, and 101,781 shares of common stock are reserved for additional commitment fees to the institutional investor in accordance with the terms of the purchase agreement. During the period February 28, 2023 through December 31, 2023, the institutional investor purchased 2,870,455 shares of common stock for proceeds of $ 16,146,052 and the Company issued 54,779 shares of common stock as additional commitment fee, valued at $ 356,026 fair value. During January and February 2024, pursuant to the purchase agreement, the institutional investor purchased 800,000 shares of common stock for proceeds of $ 3,335,300 and the Company issued 11,319 shares of common stock as additional commitment fee, valued at $ 50,841 fair value, leaving 35,683 in reserve for additional commitment fees.

On December 9, 2022, the Company entered into a sales agreement with an investment banking company. In accordance with the terms of this sales agreement, the Company may offer and sell shares of its common stock having an aggregate offering price of up to $ 35,000,000 from time to time through or to the investment banking company, as sales agent or principal. Sales of shares of the Company's common stock, if any, may be made by any method deemed to be an "at the market offering". The sales agent is entitled to compensation under the terms of the sales agreement at a commission rate equal to 3 % of the gross proceeds of the sales price of common stock that they sell. During the twelve months period ending December 31, 2023, pursuant to the sales agreement, the investment banking company sold 202,115 shares of the Company's common stock for proceeds of $ 1,515,878 after a payment of the commission in the amount of $ 46,884 to the investment banking company. During January and February 2024, pursuant to the sales agreement, the investment banking company sold 12,150 shares of the Company's common stock for proceeds of $ 52,669 after a payment of the commission in the amount of $ 1,629 to the investment banking company.

NOTE 11 – STOCKHOLDERS' EQUITY (CONTINUED)

Restricted Stock Awards

On March 16, 2023, the Compensation Committee of the Board of Directors approved grants totaling 99,616 Restricted Stock Awards to the Company's four outside directors. Each RSA had a grant date fair value of $ 5.22 which shall be amortized on a straight-line basis over the vesting period into director's compensation expenses within the Consolidated Statement of Comprehensive Loss. Such RSAs were granted under the 2016 Equity Incentive Plan ("2016 Plan") and vest in total 8,338 shares on March 16, 2023, with the remaining vesting in 33 equal monthly installments in total of 2,766 shares beginning April 1, 2023.

On August 1, 2023, the Compensation Committee of the Board of Directors approved a grant totaling 6,238 Restricted Stock Awards to the Company's outside director. The new RSA had a grant date fair value of $ 6.68 which shall be amortized on a straight-line basis over the vesting period into director's compensation expenses within the Consolidated Statement of Comprehensive Loss. Such RSA was granted under the 2016 Plan. 218 shares from this grant vested on August 1, with the remaining vesting in 28 equal monthly installments in total of 215 shares beginning September 1, 2023.

Upon the occurrence of a Change in Control, 100% of the unvested Restricted Stock shall vest as of the date of the Change in Control. Upon vesting, the restrictions on the shares lapse.

NOTE 12 – STOCK BASED COMPENSATION

During 2007, the Board of Directors of the Company adopted the 2007 Employee Stock Plan ("2007 Plan") that was approved by the shareholders. Under the 2007 Plan, the Company is authorized to grant options to purchase up to 10,000,000 shares of common stock to directors, officers, employees and consultants who provide services to the Company. The 2007 Plan is intended to permit stock options granted to employees under the 2007 Plan to qualify as incentive stock options under Section 422 of the Internal Revenue Code of 1986, as amended ("Incentive Stock Options"). All options granted under the 2007 Plan, which are not intended to qualify as Incentive

Stock Options are deemed to be non-qualified options ("Non-Statutory Stock Options").

Effective June 24, 2016, the 2007 Plan was terminated. As of December 31, 2023, options to purchase 2,063,000 shares of common stock have been issued and are outstanding.

During 2016, the Board of Directors of the Company adopted the 2016 Plan that was approved by the shareholders at the 2016 annual meeting of shareholders on May 20, 2016. Under the 2016 Plan, the Company is authorized to grant awards of incentive and non-qualified stock options and restricted stock to purchase up to 3,000,000 shares of common stock to employees, directors and consultants. Effective May 16, 2019, the number of shares of the Company's common stock available for issuance under the 2016 Plan was increased from 3,000,000 to 8,000,000 shares. Effective May 25, 2023, the number of shares of the Company's common stock available for issuance under the 2016 Plan was increased from 8,000,000 to 13,000,000 shares and awards of restricted stock units are authorized for issuance. As of December 31, 2023, options to purchase 6,227,807 shares of common stock have been issued and are outstanding and 129,174 restricted shares of common stock have been granted. As of December 31, 2023, 5,291,784 shares of common stock remain available for grants under the 2016 Plan.

Both plans are administered by the Company's Board of Directors or its compensation committee which determines the persons to whom awards will be granted, the number of awards to be granted, and the specific terms of each grant. Subject to the provisions regarding Ten Percent Shareholders, (as defined in the 2016 Plan), the exercise price per share of each option cannot be less than 100% of the fair market value of a share of common stock on the date of grant. Options granted under the 2016 Plan are generally exercisable for a period of 10 years from the date of grant and may vest on the grant date, another specified date or over a period of time.

NOTE 12 – STOCK BASED COMPENSATION (CONTINUED)

The Company uses the Black-Scholes option pricing model to calculate the grant-date fair value of an award, with the following assumptions for 2023: no dividend yield in all years, expected volatility, based on the Company's historical volatility, 73.7 % to 77.2 %, risk-free interest rate between 3.37 % to 4.82 % and expected option life of 10 years. Prior to May 2018, the expected life is based on the estimated average of the life of options using the "simplified" method, as prescribed in FASB ASC 718, due to insufficient historical exercise activity during recent years. Starting in May 2018, the expected life is based on the legal contractual life of options.

The Black-Scholes option pricing model assumptions for 2022 are as follows: no dividend yield in all years, expected volatility, based on the Company's historical volatility, 74.7 % to 76.4 %, risk-free interest rate between 1.87 % to 3.84 % and expected option life of 10 years.

The Black-Scholes option pricing model assumptions for 2021 are as follows: no dividend yield in all years, expected volatility, based on the Company's historical volatility, 70.4 % to 77.1 %, risk-free interest rate between 1.15 % to 1.73 % and expected option life of 10 years.

As of December 31, 2023, there was $ 3,295,335 of unrecognized compensation expense related to non-vested market-based share awards that is expected to be recognized through December 2026.

Share-based compensation was recognized as follows:

	2023	2022	2021
2007 Employee Stock Option Plan	$ —	$ —	$ —
2016 Equity Incentive Plan	6,459,387	5,813,628	1,022,985
2016 Equity Incentive Plan restricted stock awards	262,697	91,713	—
Warrants	—	—	11,001
Total share-based compensation	$ 6,722,084	$ 5,905,341	$ 1,033,986

NOTE 12 – STOCK BASED COMPENSATION (CONTINUED)

The following tables summarize all stock option and warrant activity of the Company during the years ended December 31, 2023, 2022 and 2021:

	Non-Qualified Stock Options and Warrants Outstanding and Exercisable		
	Number of Shares	Exercise Price	Weighted Average Exercise Price
Outstanding, December 31, 2020	10,022,500	$ 0.51 - $ 1.69	$ 0.85
Granted	1,061,000	$ 1.27 - $ 16.81	$ 2.32
Forfeited	(28,750)	$ 0.64 - $ 0.86	$ 0.82
Exercised	(3,168,502)	$ 0.60 - $ 1.50	$ 0.88
Outstanding, December 31, 2021	7,886,248	$ 0.51 - $ 16.81	$ 1.02
Granted	884,500	$ 5.81 - $ 10.86	$ 9.18
Expired	(25,000)	$ 1.69	$ 1.69
Forfeited	(15,250)	$ 1.46 - $ 7.53	$ 5.71
Exercised	(657,325)	$ 0.64 - $ 5.81	$ 1.00
Outstanding, December 31, 2022	8,073,173	$ 0.51 - $ 16.81	$ 1.91
Granted	1,959,667	$ 4.28 - $ 7.67	$ 5.24
Forfeited	(39,625)	$ 6.25 - $ 8.93	$ 7.12

Exercised	(1,183,408)	$ 0.67 - $ 5.22	$ 0.86
Outstanding, December 31, 2023	8,809,807	$ 0.51 - $ 16.81	$ 2.76
Exercisable, December 31, 2023	7,967,605	$ 0.51 - $ 16.81	$ 2.49

The aggregate intrinsic value of options and warrants outstanding and exercisable as of December 31, 2023 was $ 24,308,723 and $ 24,214,724 , respectively. The aggregate intrinsic value is calculated as the difference between the exercise price of the underlying options and warrants and the closing stock price of $ 4.98 for the Company's common stock on December 31, 2023. During the year ending December 31, 2023, 914,408 options with the aggregate intrinsic value of $ 4,698,996 were exercised for proceeds of $ 777,674 . During the year ending December 31, 2023, 269,000 warrants with the aggregate intrinsic value of $ 1,162,230 were exercised for proceeds of $ 236,250 . During the year ending December 31, 2022, 302,950 options with the aggregate intrinsic value of $ 2,920,861 were exercised for proceeds of $ 257,895 and 4,375 options with the aggregate intrinsic value of $ 53,219 were exercised via cashless method. During the year ending December 31, 2022, 350,000 warrants with the aggregate intrinsic value of $ 2,555,750 were exercised for proceeds of $ 396,000 . During the year ending December 31, 2021, 2,046,250 options with the aggregate intrinsic value of $ 22,351,788 were exercised for proceeds of $ 1,950,875 . During the year ending December 31, 2021, 677,000 warrants with the aggregate intrinsic value of $ 6,796,400 were exercised for proceeds of $ 428,350 and 445,252 options with the aggregate intrinsic value of $ 3,406,530 were exercised via cashless method.

Non-Qualified Stock Options and Warrants Outstanding

Range of Exercise Prices	Number Outstanding Currently Exercisable at December 31, 2023	Weighted Average Remaining Contractual Life	Weighted Average Exercise Price of Options and Warrants Currently Exercisable
$ 0.51 - $ 16.81	7,967,605	5.4 Years	$ 2.49

NOTE 12 – STOCK BASED COMPENSATION (CONTINUED)

The fair value of restricted stock awards is estimated by the market price of the Company's common stock at the date of grant. Restricted stock activity during the year ending December 31, 2023, 2022 and 2021 are as follows:

	Restricted Stock Awards Year ended					
	December 31, 2023		December 31, 2022		December 31, 2021	
	Number of Shares	Weighted Average Grant Date Fair Value per Share	Number of Shares	Weighted Average Grant Date Fair Value per Share	Number of Shares	Weighted Average Grant Date Fair Value per Share
Non-vested, beginning of period	13,816	$ 9.65	—	$ —	—	$ —
Granted	105,854	5.31	28,500	9.65	—	—
Vested	(41,218)	6.00	(9,504)	9.65	—	—
Cancelled and forfeited	—	—	(5,180)	9.65	—	—
Non-vested, end of period	78,452	$ 5.71	13,816	$ 9.65	—	$ —

Restricted stock awards are being amortized to expense over the vesting period. As of December 31, 2023 and 2022, the unamortized value of the restricted stock awards was $ 432,292 and $ 133,324 , respectively.

NOTE 13 – RELATED PARTY

At December 31, 2023 the Company had a legal accrual to a related party of $ 115,160 , accounting service fee accrual and expense reimbursement to related parties of $ 102,351 , fees and travel expense accruals to directors in the amount of $ 53,776 , fees, consulting expense and travel expense accruals of advisory board members in the amount of $ 33,746 , and travel and office expense accruals of officers in the amount of $ 8,450 . At December 31, 2022 the Company had a legal accrual to a related party of $ 60,577 , fees and consulting expense accruals of advisory board members in the amount of $ 18,000 , fees to directors in the amount of $ 13,500 , travel and office expense accruals of officers in the amount of $ 4,859 and accounting service fee accrual and expense reimbursement to related parties of $ 3,233 .

NOTE 14 – RETIREMENT PLAN

The Company established a 401(k) retirement plan covering all eligible employees beginning November 15, 2013. A contribution of $ 72,570 was charged to expense and accrued for the year ending December 31, 2023 to all eligible non-executive participants. A contribution of $ 57,126 was charged to expense and accrued for the year ending December 31, 2022 to all eligible non-executive participants. A contribution of $ 53,035 was charged to expense and accrued for the year ending December 31, 2021 to all eligible non-executive participants.

EXHIBIT 4.1

DESCRIPTION OF THE REGISTRANT'S SECURITIES REGISTERED PURSUANT TO SECTION 12 OF THE SECURITIES EXCHANGE ACT OF 1934

Lightwave Logic, Inc. (the "Company" or "we" or "our") has one class of securities registered under Section 12 of the Securities Exchange Act of 1934, our common stock, par value $0.001 per share (the "common stock").

Description of Common Stock

The following description of our common stock is a summary and does not purport to be complete. It is subject to and qualified in its entirety by reference to our Articles of Incorporation, as amended (the "articles of incorporation") and our Amended and Restated Bylaws (the "bylaws"), each of which are incorporated by reference as an exhibit to the Annual Report on Form 10-K of which this exhibit is a part. We encourage you to read our articles of incorporation, our bylaws and the applicable provisions of the Nevada Revised Statutes for additional information.

Authorized Share Capital. The Company's authorized capital stock consists of 250,000,000 shares of common stock, par value $0.001 per share and 1,000,000 shares of preferred stock, par value $0.001 per share.

Voting. Each outstanding share of common stock is entitled to one vote on all matters to be submitted to a vote of the shareholders. Holders do not have preemptive rights, so we may issue additional shares that may reduce each holder's voting and financial interest in our Company. Cumulative voting does not apply to the election of directors, so holders of more than 50% of the shares voted for the election of directors can elect all of the directors. All elections for directors shall be decided by a plurality vote; all other questions shall be decided by majority vote except as otherwise provided by Nevada Revised Statutes. Our bylaws permit the holders of the same percentage of all shareholders entitled to vote at a meeting to take action by written consent without a meeting.

Dividend Rights. Holders of common stock are entitled to receive dividends when, as and if declared by the board of directors out of funds legally available therefor.

Liquidation Preferences. In the event of liquidation, dissolution or winding up of our Company, holders of common stock are entitled to share ratably in all assets remaining available for distribution to them after payment of liabilities and after provision has been made for each class of stock, if any, having preference over the common stock.

Other Terms. Holders of common stock do not have any conversion, redemption provisions or other subscription rights. All of the outstanding shares of common stock are fully paid and non-assessable.

Anti-Takeover Provisions

Certain of our charter, statutory and contractual provisions could make the removal of our management and directors more difficult and may discourage transactions that otherwise could involve payment of a premium over prevailing market prices for our common stock. Furthermore, the existence of the foregoing provisions could lower the price that investors might be willing to pay in the future for shares of our common stock. They could also deter potential acquirers of our Company, thereby reducing the likelihood that you could receive a premium for your common stock in an acquisition.

Charter and Bylaw Provisions

Our articles of incorporation and bylaws contain the following provisions that may have the effect of discouraging unsolicited acquisition proposals:

- authorize our board of directors to create and issue, without stockholder approval, preferred stock, thereby increasing the number of outstanding shares, which can deter or prevent a takeover attempt;
- prohibit cumulative voting in the election of directors, which would otherwise allow less than a majority of stockholders to elect director candidates;
- empower our board of directors to fill any vacancy on our board of directors, whether such vacancy occurs as a result of an increase in the number of directors or otherwise;
- provide that our board of directors be divided into three classes, with approximately one-third of the directors to be elected each year;
- provide that special meetings of our stockholders may only be called by t he chairperson, president or chief executive officer, or by resolution of the board of directors or at the request in writing of stockholders owning 66 2/3% in amount of the entire capital stock of the Company issued and outstanding and entitled to vote;
- establish advance notice procedures with regard to stockholder proposals relating to stockholder nominees for director and other stockholder proposals;
- provide that our board of directors is expressly authorized to adopt, amend or repeal our bylaws; and
- provide that our directors will be elected by a plurality of the votes cast in the election of directors.

These provisions could lower the price that future investors might be willing to pay for shares of our common stock.

Nevada Law

Nevada Revised Statutes sections 78.378 to 78.3793 provide state regulation over the acquisition of a controlling interest in certain Nevada corporations unless the articles of incorporation or bylaws of the corporation provide that the provisions of these sections do not apply. Our articles of incorporation and bylaws do not state that these provisions do not apply. The statute creates a number of restrictions on the ability of a person or entity to acquire control of a Nevada company by setting down certain rules of conduct and voting restrictions in any acquisition attempt, among other things. The statute contains certain limitations and it may not apply to our Company. These provisions may have the effect of deterring hostile takeovers or delaying changes in control, which could depress the market price of our common stock and deprive shareholders of opportunities to realize a premium on shares of common stock held by them.

Contractual Provisions

Our employee stock option agreements include change-in-control provisions that allow us to grant options or stock purchase rights that may become vested immediately upon a change in control. The terms of change of control provisions contained in certain of our senior executive employee agreements may also discourage a change in control of our Company.

Our board of directors also has the power to adopt a shareholder rights plan that could delay or prevent a change in control of our Company even if the change in control is generally beneficial to our shareholders. These plans, sometimes called "poison pills," are oftentimes criticized by institutional investors or their advisors and could affect our rating by such investors or advisors. If our board of directors adopts such a plan, it might have the effect of reducing the price that new investors are willing to pay for shares of our common stock.

Together, these charter, statutory and contractual provisions could make the removal of our management and directors more difficult and may discourage

transactions that otherwise could involve payment of a premium over prevailing market prices for our common stock. Furthermore, the existence of the foregoing provisions, could limit the price that investors might be willing to pay in the future for shares of our common stock. They could also deter potential acquirers of our Company, thereby reducing the likelihood that you could receive a premium for your common stock in an acquisition.

Listing

Our common stock is listed on the NASDAQ Capital Market under the symbol "LWLG."

Transfer Agent and Registrar

The transfer agent and registrar for our common stock is Broadridge.

Preferred Stock

Our common stock is subject to the express terms of the Company's preferred stock and any series thereof. The board of directors may issue preferred stock with voting, dividend, liquidation and other rights that could adversely affect the relative rights of the holders of the common stock.

Lightwave Logic, Inc.
INSIDER TRADING POLICY

August 17, 2021, as amended February 8, 2024

A. INTRODUCTION

Lightwave Logic, Inc., a Nevada corporation (the "Company"), recognizes that its directors, officers, and other employees may invest from time to time in the common stock of the Company. However, all of the Company's employees must exercise caution to conduct these transactions in compliance with applicable securities laws. In particular, all employees must avoid trading in the Company's securities while in possession of material, non-public information about the Company.

This policy governs trading in the Company's securities by the following persons (" Covered Persons"): all executive officers, directors, employees, and agents of the Company, and its subsidiaries, and the Immediate Family Members (as defined below) of executive officers, directors and employees of the Company. The policy is designed to assist persons in possession of material non- public information (so-called "insiders") in determining when trading in the Company's securities is appropriate. The policy also restricts trading by Covered Persons in certain circumstances in order to avoid any transaction that might result in a violation of applicable securities laws. These guidelines cover not only the purchase and sale of common stock, but also the purchase and sale of options, warrants, puts, calls, and other convertible securities.

These guidelines also address additional obligations of the following persons under Section 16 of the Securities Exchange Act of 1934, as amended (the "Exchange Act") ("Section 16 Insiders"): the Company's directors, executive officers and holders of more than 10% of the outstanding shares of any class of the Company's securities registered under Section 12 of the Exchange Act. Section 16(b) requires Section 16 Insiders to disgorge "short-swing" profits realized from the purchase and sale of the Company's securities within a six-month period. Section 16(a) imposes extensive reporting obligations.

B. WHAT IS MATERIAL, NON-PUBLIC INFORMATION?

This policy relates primarily to "material, non-public information" about the Company. Material information is information that could be expected to affect the investment decision of a reasonable investor or to alter significantly the market price of the Company's common stock or other securities. Examples of such information include proposed mergers or acquisitions, changes in dividends, changes in expected operating results (favorable or unfavorable), quarterly and annual earnings announcements, and any other important business developments.

Material information is "non-public" if it has not been widely disseminated to the public. Such dissemination occurs when the information is reported in the Company's annual or quarterly reports, is the subject of a prior widely-disseminated press release, or is widely reported in the media through market letters, analysts' reports, statistical services or other means.

C. THE COMPANY'S BASIC POLICY

The Company's basic policy regarding the use of material, non-public information is as follows:

1. No Unauthorized Disclosure of Material Non-Public Information

All Covered Persons have an obligation to maintain the confidentiality of material information about the Company and its activities as well as any other material non-public information obtained, including, but not limited to, non-public material information relating to other companies obtained in the course of their employment and/or affiliation with the Company. Covered Persons may not disclose any material, non-public information to third parties, including friends, relatives, or acquaintances. Such information may only be disclosed to the Company's other employees and agents who have a clear right to know the information in order to fulfill their responsibilities to the Company.

Any Covered Person who participates in an unauthorized disclosure of material information will be subject to disciplinary action by the Company, and will be liable to the Company for any losses caused by such disclosure.

In order to avoid any unintentional disclosures of material information, all Covered Persons (except the Company's Spokesperson, as defined below) should avoid discussions with third parties with respect to Company matters that might be considered material and confidential. Inquiries received from third parties relating to Company information that may be material or confidential should be referred to the Company's Spokesperson. See "Compliance With SEC Regulation FD," below. If an employee believes he or she has inadvertently disclosed material confidential information to a third party, he or she should contact the Chief Executive Officer immediately.

2. No Trading on Material Information Prior To Disclosure

No Covered Person of the Company may trade in the Company's securities if he or she is in possession of material, non-public information, except for: (a) the exercise of any stock option previously granted to such person by the Company (but not the sale of the underlying common stock); or (b) any sale of securities to, or purchase of securities from, the Company that either would not constitute a purchase or sale under Section 16(b) of the Exchange Act or would constitute an exempt transaction under Section 16(b); or (c) any transaction with the Company that has been approved by the Board of Directors (the "Board"); or (d) purchases or sales made pursuant to a Qualified Trading Program (as defined in Section C.4. below). The transactions described in subsections (a) through (d) above are referred to herein as "Exempt Trades".

A Covered Person who uses material, non-public information to trade in the Company's securities will violate civil and criminal provisions of federal securities laws. This liability may also extend to outsiders who receive such information and use it to trade in the Company's securities. If the Covered Person is uncertain

whether the information is material, or whether it has been disclosed to the public, he or she must discuss the matter with the Company's Chief Executive Officer, President or Chief Operating Officer.

3. No Trading on Material Information Until Two Trading Days After Disclosure

Except for Exempt Trades, no Covered Person may trade in the Company's securities until two trading days after the date of the public release of the material information by the Company. This delay is necessary to permit the dissemination of this information to the investing public.

4. Qualified Trading Program

Any Covered Person may request that a written contract, instruction or plan for the purchase or sale of Company securities (a " Trading Program") be designated a "Qualified Trading Program" by submitting such trading program to the Chief Operating Officer, or such other officer as the Board may determine from time to time (each, a "Designated Officer"), together with a certification that such Covered Person was not aware of any material, non-public information concerning the Company or the Company securities at the time of entering into such Trading Program (other than information which will be made public before the execution of the first transaction thereunder). Upon receipt of such a request, the Designated Officer shall determine whether to designate the Trading Program as a Qualified Trading Program for purposes of this policy, taking into account all factors that he or she shall deem relevant in his or her sole discretion (after consultation with the Company's legal counsel), including whether the Trading Program appears on its face to be responsive to the requirements of SEC Rule 10b5-1. A Trading Program shall cease to be a Qualified Trading Program for purposes of this policy: (a) at any time that the Designated Officer so determines;(b) if there is a deviation in any transaction from the terms specified in such Trading Program; or (c) if the person entering into such Trading Program hedges or seeks to offset the consequence of any transaction pursuant to such Trading Program.

5. Prohibited Transactions

The following transactions in the Company's securities are prohibited:

(a) Short-term trading. Section 16 Insiders who purchase Company securities may not sell any Company securities of the same class for at least six months after the purchase in violation of Section 16(b) of the Exchange Act ;

(b) Short sales. Covered Persons may not sell the Company's securities short;

(c) Options trading. Covered Persons may not buy or sell puts or calls or other derivative securities on the Company's securities, unless advance approval is obtained from the Designated Officer;

(d) Trading on margin or pledging. Covered Persons may not hold Company securities in a margin account or pledge Company securities as collateral for a loan, unless advance approval is obtained from the Designated Officer; and

(e) Hedging. Covered Persons may not enter into hedging or monetization transactions or similar arrangements with respect to Company securities.

D. OTHER TRADING RESTRICTIONS

In addition to the Company's basic policy, the Company has adopted the following specific trading restrictions in order to implement its policy. These restrictions do not apply to Exempt Trades, as described in Section C.2. above.

1. Trading Restrictions Based on Quarterly Results

No Covered Person may trade in the Company's securities during the period starting fifteen (15) calendar days prior to the filing of the 10-Q until two (2) trading days after filing the 10-Q (10-Q filings). This restriction applies even if the insider is not in possession of material, non- public information.

2. Trading Restrictions Based on Annual Results

No Covered Person may trade in the Company's securities during the period starting forty-five (45) calendar days prior to the filing of the 10-K until two (2) trading days after filing the 10-K (10-K filing). This restriction applies even if the insider is not in possession of material, non-public information.

3. Trading Restrictions Related to Proxy Statements and Registration Statements

No Covered Person may trade in the Company's securities for a period of two trading days after any material filings made by the Company with the Securities and Exchange Commission. Such filings might include proxy statements, registration statements, and Current Reports on Form 8-K.

4. Trading Restrictions Related to General News Release

No Covered Person may trade in the Company's securities for a period of two trading days after any press release of a general nature (*i.e.*, regarding new contracts, plant openings, staff appointments, etc.).

5. Trading Restrictions Announced by the Company

No Covered Person may trade in the Company's securities during any restricted period announced by the Company. The Company may make announcements from time to time due to pending negotiations regarding acquisition and financing, or other material corporate developments that have not yet been disclosed to the public.

6. Trading Restrictions Relating To Pension Plans

Directors and executive officers of the Company are prohibited from, trading in the Company's equity securities during a blackout period imposed under an "individual account" retirement or pension plan of the Company, during which at least 50% of the plan participants are unable to purchase, sell or otherwise acquire or transfer an interest in equity securities of the Company, due to a temporary suspension of trading by the Company or the plan fiduciary.

E. CERTAIN IMMEDIATE FAMILY MEMBERS ARE SUBJECT TO POLICY

This policy shall apply to purchases and sales of Company securities by or for the account of an Immediate Family Member of an executive officer or director of the Company to the same extent as to such transactions by or for the account of such officer or director. As used in this policy, " Immediate Family Member" means: (a) any parent, child, spouse or sibling of an executive officer or director of the Company, other than adult family members who do not live with or depend financially on such officer or director and who exercise independent control over their personal investment decisions; (b) any trust or similar arrangement for the benefit of an executive officer or director or a person who is otherwise an Immediate Family Member; and (c) any personal charitable foundation or similar arrangement established by an executive officer or director or a person who is otherwise an Immediate Family Member.

F. SUMMARY

The purpose of these guidelines is to assist Covered Persons in developing an investment strategy that will satisfy their personal needs and comply with applicable securities laws. Its overriding goal is to establish fairness for all segments of the investing public, particularly the shareholders of the Company, and to avoid the appearance of any conflict of interest.

The guidelines are summarized as follows:

Situation	Policy
Material information	No trading permitted prior to disclosure
Material information after disclosure	No trading until two trading days after disclosure
First, Second and Third Fiscal Quarters	No trading starting fifteen (15) calendar days prior to the filing of the 10-Q until two (2) trading days after filing the 10-Q (10-Q filings).
Fiscal year	No trading starting forty-five (45) calendar days prior to the filing of the 10-K until two (2) trading days after filing the 10-K (10-K filing).
Securities filings	No trading for two trading days after filing
General news releases	No trading for two trading days after the release
Restricted trading periods	No trading without written permission of Chief Executive Officer or Chief Operating Officer

G. SHORT SWING PROFITS

The Company's Section 16 Insiders are also subject to Section 16(b) of the Exchange Act and the rules promulgated thereunder. Section 16(b) provides for disgorgements of profits by these persons in connection with sales and purchases of the Company's equity securities within a six-month period. The rules under Section 16(b) are very complicated and often are broadly construed. If you have any questions regarding its application, you should promptly discuss them with the Company's Chief Operating Officer and/or outside legal counsel.

Under Section 16(a) of the Exchange Act, most changes in a Section 16 Insider's beneficial ownership of equity securities of the Company must be filed electronically with the SEC on Form 4 before the end of the second business day following the day on which a transaction resulting in a change of beneficial ownership is executed. In addition to purchases and sales, the two-day requirement applies to many transactions that formerly were reportable after the end of the Company's fiscal year on Form 5, including stock and option grants, restricted stock grants, and most other equity compensation transactions. A very limited number of transactions still will be reportable on Form 5 at the end of the year, including gifts, inheritances and certain purchases (which, when combined with other purchases in the preceding six months, amount to less than $10,000).

Any late or delinquent Form 4 filings by Section 16 Insiders are required to be reported in the Company's proxy statement in a separate captioned section. The SEC has been granted broad authority by the Sarbanes-Oxley Act of 2002 to seek "any equitable relief that may be appropriate or necessary for the benefit of investors" for violations of any of these (or any other) provisions of the securities laws. Consequently, it is important to both you and the Company that such filings are made on a timely basis. Again, if you have any questions concerning the application of Section 16(a), please promptly contact the Company's Chief Operating Officer and/or outside legal counsel.

H. COMPLIANCE WITH SEC REGULATION FD

The following provisions govern communications by employees of the Company with securities analysts, fund managers, reporters, shareholders, and others who are not bound by a duty of confidentiality to the Company (generically referred to herein as "analysts"), whether direct, at investment conferences, on conference calls, or otherwise.

(a) The only employees authorized to discuss the Company's affairs with analysts are the Company's Chairman, Chief Executive Officer, President, Chief Operating Officer, and the Executive Vice Presidents (each referred to as a "Spokesperson"). Any other employee who is contacted by an analyst must refer the analyst to a Spokesperson. The Company's Chairman, Chief Executive Officer, President, or Chief Operating Officer may authorize another employee to speak with an analyst with respect to a particular topic or on a particular occasion.

(b) It is the Company's policy that all Company communications to analysts comply with applicable law, including Regulation FD under the Securities Exchange Act of 1934. A Spokesperson may not provide material information to an analyst unless such information shall have been previously or is simultaneously disclosed in a manner intended to provide broad, non-exclusionary distribution of the information to the public. In the event of an inadvertent disclosure of information that might be material, the disclosing Spokesperson shall consult with counsel as to whether prompt public dissemination of such information is required.

(c) A Spokesperson may discuss with analysts the Company's technology, products, and markets, as well as other factual corporate information, such as headcount, facilities, and the like, provided such information is not material or has previously been disclosed publicly.

(d) A Spokesperson may discuss with analysts financial results of operations for completed quarters once those results have been publicly disclosed, but shall not disclose any material information regarding those results that have not been publicly disseminated.

(e) A Spokesperson shall not disclose to analysts any material information regarding the Company's internal projections of future operating results, pending transactions, customer or supplier developments or other matters that have not been publicly disseminated. A Spokesperson shall not endorse or ratify revenue or earnings projections made by an analyst or express comfort with "the range".

(f) A Spokesperson may review a draft of an analyst's report, if requested by the analyst to do so, solely for the purpose of correcting any objective factual errors in the report. A Spokesperson who engages in such a review shall make clear to the analyst that the Company does not comment on any forward-looking information contained in the report or otherwise endorse the analyst's forecasts or financial models.

(g) A Spokesperson will not circulate externally copies of any analyst reports, but rather should refer any such requests to the analyst's firm.

(h) In appropriate circumstances, a Spokesperson shall consult with securities counsel to determine compliance with this policy, Regulation FD, and the safe harbor for forward-looking information.

(i) A Spokesperson may not depart from the principles set forth in this policy without the explicit prior approval of the Company's Chairman, Chief Executive Officer or President and the Chief Operating Officer.

(j) Any violation of this policy shall be brought to the attention of the Company's senior management and may constitute "cause" for immediate termination of employment.

I. VIOLATIONS OF INSIDER TRADING LAWS

Penalties for trading on or communicating material non-public information can be severe, both for individuals involved in such unlawful conduct and their employers and supervisors, and may include jail terms, criminal fines, civil penalties and civil enforcement injunctions. Given the severity of the potential penalties, compliance with this Policy is absolutely mandatory.

(a) Legal Penalties. A person who violates insider trading laws by engaging in transactions in a company's securities when he or she has material non-public information can be sentenced to a substantial jail term and required to pay a criminal penalty of several times the amount of profits gained or losses avoided.

In addition, a person who tips others may also be liable for transactions by the tippees to whom he or she has disclosed material non-public information. Tippers can be subject to the same penalties and sanctions as the tippees, and the SEC has imposed large penalties even when the tipper did not profit from the transaction.

The SEC can also seek substantial civil penalties from any person who, at the time of an insider trading violation, "directly or indirectly controlled the person who committed such violation," which would apply to the Company and/or management and supervisory personnel. These control persons may be held liable for up to the greater of $1 million or three times the amount of the profits gained or losses avoided. Even for violations that result in a small or no profit, the SEC can seek penalties from a company and/or its management and supervisory personnel as control persons.

(b) Company-imposed Penalties. Employees who violate this Policy may be subject to disciplinary action by the Company, including dismissal for cause. Any exceptions to the Policy, if permitted, may only be granted by the Designated Officer and must be provided before any activity contrary to the above requirements takes place."

The undersigned "Covered Person" hereby acknowledges that he or she has read this Insider Trading Policy and agrees to comply with the policies and procedures set forth herein. To the extent such Covered Person is an Officer or Director of Lightwave Logic, Inc , he/she further agrees that they will inform their immediate family members of these restrictions.

COVERED PERSON:

By _____ Date _____

Name _____

Position with Lightwave Logic, Inc. (check one)

____ Employee ____ Officer ____Director ____Agent

EXHIBIT 21.1

SUBSIDIARIES OF LIGHTWAVE LOGIC, INC.

None.

EXHIBIT 23.1

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

The Board of Directors of
Lightwave Logic, Inc.

We hereby consent to the incorporation by reference in the registration statements of Lightwave Logic, Inc. on:

- Form S-8 (No. 333-273055)
- Form S-8 (No. 333-234737)
- Form S-8 (No. 333-213541)
- Form S-8 (No. 333-189943)
- Form S-8 (No. 333-198916)
- Form S-3 (No. 333-257670)

of our reports dated February 29, 2024, relating to the financial statements of Lightwave Logic, Inc. and the effectiveness of internal control over financial reporting.

/s/ Morison Cogen LLP

Blue Bell, Pennsylvania
Date: February 29, 2024

EXHIBIT 31.1

CERTIFICATION

I, Michael Lebby, certify that:

1. I have reviewed this Annual Report on Form 10-K of Lightwave Logic, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

(a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

(b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

(c) Evaluated the effectiveness of the registrant’s disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

(d) Disclosed in this report any change in the registrant’s internal control over financial reporting that occurred during the registrant’s most recent fiscal quarter (the registrant’s fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant’s internal control over financial reporting; and

5. The registrant’s other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant’s auditors and the audit committee of the registrant’s board of directors (or persons performing the equivalent functions):

(a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant’s ability to record, process, summarize and report financial information; and

(b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant’s internal control over financial reporting.

Date: February 29, 2024

/s/ Michael Lebby
Michael Lebby
Chief Executive Officer
(Principal Executive Officer)

EXHIBIT 31.2

CERTIFICATION

I, James S. Marcelli, certify that:

1. I have reviewed this Annual Report on Form 10-K of Lightwave Logic, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

(a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

(b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

(c) Evaluated the effectiveness of the registrant’s disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

(d) Disclosed in this report any change in the registrant’s internal control over financial reporting that occurred during the registrant’s most recent fiscal quarter (the registrant’s fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant’s internal control over financial reporting; and

5. The registrant’s other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant’s auditors and the audit committee of the registrant’s board of directors (or persons performing the equivalent functions):

(a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant’s ability to record, process, summarize and report financial information; and

(b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant’s internal control over financial reporting.

Date: February 29, 2024

/s/ James S. Marcelli
James S. Marcelli
Chief Operating Officer
(Principal Financial Officer)

EXHIBIT 32.1

CERTIFICATION PURSUANT TO
SECTION 1350, CHAPTER 63 OF TITLE 18, UNITED STATES CODE,
AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002

In connection with the Annual Report on Form 10-K of Lightwave Logic, Inc. (the "Company") for the year ended December 31, 2023 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I, Michael Lebby, Chief Executive Officer of our Company, certify, pursuant to Section 906 of the Sarbanes-Oxley Act of 2002 (subsections (a) and (b) of section 1350, Chapter 63 of Title 18, United States Code), that, to my knowledge:

1. The Report fully complies with the requirements of section 13(a) or 15(d) of the Securities Exchange Act of 1934; and

2. The information contained in the Report fairly presents, in all material respects, the financial condition and result of operations of our Company.

Date: February 29, 2024

/s/ Michael Lebby
Michael Lebby
Chief Executive Officer
(Principal Executive Officer)

The foregoing certification is being furnished solely pursuant to section 906 of the Sarbanes-Oxley Act of 2002 (subsections (a) and (b) of section 1350, Chapter 63 of Title 18, United States Code) and is not being filed as part of the Report or as a separate disclosure document.

EXHIBIT 32.2

CERTIFICATION PURSUANT TO
SECTION 1350, CHAPTER 63 OF TITLE 18, UNITED STATES CODE,
AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002

In connection with the Annual Report on Form 10-K of Lightwave Logic, Inc. (the "Company") for the year ended December 31, 2023 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I, James S. Marcelli, Chief Operating Officer of our Company, certify, pursuant to Section 906 of the Sarbanes-Oxley Act of 2002 (subsections (a) and (b) of section 1350, Chapter 63 of Title 18, United States Code), that, to my knowledge:

1. The Report fully complies with the requirements of section 13(a) or 15(d) of the Securities Exchange Act of 1934; and

2. The information contained in the Report fairly presents, in all material respects, the financial condition and result of operations of our Company.

Date: February 29, 2024

/s/ James S. Marcelli
James S. Marcelli
Chief Operating Officer
(Principal Financial Officer)

The foregoing certification is being furnished solely pursuant to section 906 of the Sarbanes-Oxley Act of 2002 (subsections (a) and (b) of section 1350, Chapter 63 of Title 18, United States Code) and is not being filed as part of the Report or as a separate disclosure document.

EXHIBIT 97.1

LIGHTWAVE LOGIC, INC. NASDAQ RULE 5608
EXECUTIVE OFFICER COMPENSATION CLAWBACK POLICY

EFFECTIVE NOVEMBER 9, 2023

1. Policy Purpose. The purpose of this Lightwave Logic, Inc. Nasdaq Rule 5608 Executive Officer Compensation Clawback Policy (this " ***Policy***") is to enabl Lightwave Logic, Inc. and its subsidiaries and affiliates (the "***Company***") to recover Erroneously Awarded Compensation in the event that the Company is required to prepare an Accounting Restatement. This Policy is intended to comply with the requirements set forth in Listing Rule 5608 of The Nasdaq Stock Market LLC and will be construed and interpreted in accordance with such intent. Unless otherwise defined in this Policy, capitalized terms will have the meaning ascribed to such terms in Section 7.

2. Policy Administration. This Policy will be administered by the Compensation Committee of the Board (the " ***Committee***") unless the Board determines to administer this Policy itself. The Committee has full and final authority to make all determinations under this Policy, in each case to the extent permitted under the Listing Rule and in compliance with (or pursuant to an exemption from the application of) Section 409A of the Code. All determinations and decisions made by the Committee pursuant to the provisions of this Policy will be final, conclusive and binding on all persons, including the Company, its affiliates, its stockholders and the Executive Officers. Any action or inaction by the Committee with respect to an Executive Officer under this Policy in no way limits the Committee's actions or decisions not to act with respect to any other Executive Officer under this Policy or under any similar policy, agreement or arrangement, nor will any such action or inaction serve as a waiver of any rights the Company may have against any Executive Officer other than as set forth in this Policy.

3. Policy Application. This Policy applies to all Incentive-Based Compensation received by a person (a) after beginning service as an Executive Officer, (b) w served as an Executive Officer at any time during the performance period for such Incentive-Based Compensation, (c) while the Company had a class of securities listed on a national securities exchange or a national securities association and (d) during the three completed fiscal years immediately preceding the Accounting Restatement Date. In addition to such last three completed fiscal years, the immediately preceding clause (d) includes any transition period that results from a change in the Company's fiscal year within or immediately following such three completed fiscal years, provided that a transition period between the last day of the Company's previous fiscal year end and the first day of its new fiscal year that comprises a period of nine to twelve months will be deemed a completed fiscal year. For purposes of this Section 3, Incentive-Based Compensation is deemed received in the Company's fiscal period during which the Financial Reporting Measure specified in the Incentive-Based Compensation award is attained, even if the payment or grant of the Incentive-Based Compensation occurs after the end of that period. For the avoidance of doubt, Incentive-Based Compensation that is subject to both a Financial Reporting Measure vesting condition and a service-based vesting condition will be considered received when the relevant Financial Reporting Measure is achieved, even if the Incentive-Based Compensation continues to be subject to the service-based vesting condition.

4. Policy Recovery Requirement. In the event of an Accounting Restatement, the Company must recover, reasonably promptly, Erroneously Awarded Compensation, in amounts determined pursuant to this Policy. The Company's obligation to recover Erroneously Awarded Compensation is not dependent on if or when the Company files restated financial statements. Recovery under this Policy with respect to an Executive Officer will not require the finding of any misconduct by such Executive Officer or such Executive Officer being found responsible for the accounting error leading to an Accounting Restatement. In the event of an Accounting Restatement, the Company will satisfy the Company's obligations under this Policy to recover any amount owed from any applicable Executive Officer by exercising its sole and absolute discretion in how to accomplish such recovery, to the extent permitted under the Listing Rule and in compliance with (or pursuant to an exemption from the application of) Section 409A of the Code. The Company's recovery obligation pursuant to this Section 4 will not apply to the extent that the Committee, or in the absence of the Committee, a majority of the independent directors serving on the Board, determines that such recovery would be impracticable and:

a. The direct expense paid to a third party to assist in enforcing this Policy would exceed the amount to be recovered. Before concluding that it woul impracticable to recover any amount of Erroneously Awarded Compensation based on expense of enforcement, the Company must make a reasonable attempt to recover such Erroneously Awarded Compensation, document such reasonable attempts to recover and provide that documentation to the Stock Exchange;

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b. Recovery would violate home country law where that law was adopted prior to November 28, 2022. Before concluding that it would be impractical any amount of Erroneously Awarded Compensation based on violation of home country law, the Company must obtain an opinion of home country counsel, acceptable to the Stock Exchange, that recovery would result in such a violation, and must provide such opinion to the Stock Exchange; or

c. Recovery would likely cause an otherwise tax-qualified retirement plan, under which benefits are broadly available to employees of the registrant, the requirements of Section 401(a)(13) or 411(a) of the Code.

5. Policy Prohibition on Indemnification and Insurance Reimbursement. The Company is prohibited from indemnifying any current or former Executive Office against the loss of Erroneously Awarded Compensation. Further, the Company is prohibited from paying or reimbursing an Executive Officer for purchasing insurance to cover any such loss.

6. Required Policy-Related Filings. The Company will file all disclosures with respect to this Policy in accordance with the requirements of the federal securit laws, including disclosures required by U.S. Securities and Exchange Commission filings.

7. Definitions.

a. "***Accounting Restatement***" means an accounting restatement due to the material noncompliance of the Company with any financial reporting re under the securities laws, including any required accounting restatement to correct an error in previously issued financial statements that is material to the previously issued financial statements or that would result in a material misstatement if the error were corrected in the current period or left uncorrected in the current period.

b. "***Accounting Restatement Date***" means the earlier to occur of (i) the date the Board, a committee of the Board or the officers of the Company au take such action if the Board action is not required, concludes, or reasonably should have concluded, that the Company is required to prepare an Accounting Restatement and (ii) the date a court, regulator or other legally authorized body directs the Company to prepare an Accounting Restatement.

c. "***Board***" means the board of directors of the Company.

d. "***Code***" means the U.S. Internal Revenue Code of 1986, as amended. Any reference to a section of the Code or regulation thereunder includes su regulation, any valid regulation or other official guidance promulgated under such section and any comparable provision of any future legislation or regulation amending, supplementing, or superseding such section or regulation.

e. "***Erroneously Awarded Compensation***" means, in the event of an Accounting Restatement, the amount of Incentive-Based Compensation previously received that exceeds the amount of Incentive-Based Compensation that otherwise would have been received had it been determined based on the restated amounts in such Accounting Restatement, and must be computed without regard to any taxes paid by the relevant Executive Officer. Notwithstanding the foregoing, for Incentive-Based Compensation based on stock price or total stockholder return where the amount of Erroneously Awarded Compensation is not subject to mathematical recalculation directly from the information in an Accounting Restatement (i) the amount of Erroneously Awarded Compensation must be based on a reasonable estimate of the effect of the Accounting Restatement on the stock price or total stockholder return upon which the Incentive-Based Compensation was received and (ii) the Company must maintain documentation of the determination of that reasonable estimate and provide such documentation to the Stock Exchange.

f. "***Executive Officer***" means the Company's president, principal financial officer, principal accounting officer (or if there is no such accounting offic controller), any vice-president of the Company in charge of a principal business unit, division or function (such as sales, administration or finance), any other officer who performs a policy-making function or any other person who performs similar policy-making functions for the Company. An executive officer of the Company's parent or subsidiary is deemed an "Executive Officer" if the executive officer performs such policy making functions for the Company.

g. "***Financial Reporting Measure***" means any measure that is determined and presented in accordance with the accounting principles used in prep Company's financial statements, and any measure that is derived wholly or in part from such measure, provided that a Financial Reporting Measure is not required to be presented within the Company's financial statements or included in a filing with the U.S. Securities and Exchange Commission to qualify as a "Financial Reporting Measure." For purposes of this Policy, "Financial Reporting Measure" includes, but is not limited to, stock price and total stockholder return.

h. "***Incentive-Based Compensation***" means any compensation that is granted, earned or vested based wholly or in part upon the attainment of a F Reporting Measure.

i. "***Stock Exchange***" means the national stock exchange on which the Company's common stock is listed.

8. Acknowledgement. Each Executive Officer will sign and return to the Company, within 30 calendar days following the later of (i) the effective date of this P first set forth above or (ii) the date the individual becomes an Executive Officer, the Acknowledgement Form attached as Exhibit A, pursuant to which the Executive Officer agrees to be bound by, and to comply with, the terms and conditions of this Policy.

9. Severability. The provisions in this Policy are intended to be applied to the fullest extent of the law. To the extent that any provision of this Policy is found t unenforceable or invalid under any applicable law, such provision will be applied to the maximum extent permitted, and will automatically be deemed amended in a manner consistent with its objectives to the extent necessary to conform to any limitations required under applicable law.

10. Amendment and Termination. The Board may amend this Policy from time to time in its sole and absolute discretion and will amend this Policy as it deem necessary to reflect the Listing Rule, to comply with (or maintain an exemption from the application of) Section 409A of the Code. The Board may terminate this Policy at any time.

11. Other Recovery Obligations and General Rights. To the extent that the application of this Policy would provide for recovery of Incentive-Based Compensa that the Company recovers pursuant to Section 304 of the Sarbanes-Oxley Act or other recovery obligations, the amount the relevant Executive Officer has already reimbursed the Company will be credited to the required recovery under this Policy. This Policy will not limit the rights of the Company to take any other actions or pursue other remedies that the Company may deem appropriate under the circumstances and under applicable law, in each case to the extent permitted under the Listing Rule and in compliance with (or pursuant to an exemption from the application of) Section 409A of the Code. Nothing contained in this Policy will limit the Company's ability to seek recoupment, in appropriate circumstances (including circumstances beyond the scope of this Policy) and as permitted by other applicable law, of any amounts from any individual, in each case to the extent permitted under the Listing Rule and in compliance with (or pursuant to an exemption from the application of) Section 409A of the Code.

12. Successors. This Policy is binding and enforceable against all Executive Officers and their beneficiaries, heirs, executors, administrators or other legal representatives.

13. Governing Law and Venue. This Policy and all rights and obligations hereunder are governed by and construed in accordance with the internal laws of the of Nevada, excluding any choice of law rules or principles that may direct the application of the laws of another jurisdiction.

EXHIBIT A

LIGHTWAVE LOGIC, INC. NASDAQ RULE 5608
EXECUTIVE OFFICER COMPENSATION CLAWBACK POLICY

ACKNOWLEDGEMENT FORM

By signing below, the undersigned acknowledges and confirms that the undersigned has received and reviewed a copy of the Lightwave Logic, Inc. Nasdaq Rule 5608 Executive Officer Compensation Clawback Policy (the "***Policy***").

By signing this Acknowledgement Form, the undersigned acknowledges and agrees that the undersigned is and will continue to be subject to the Policy and that the Policy will apply both during and after the undersigned's employment with Lightwave Logic, Inc. and, as applicable, its subsidiaries and affiliates (the "***Company***"). Further, by signing below, the undersigned agrees to abide by the terms of the Policy, including, without limitation, by returning any Erroneously Awarded Compensation (as defined in the Policy) to the Company to the extent required by, and in a manner consistent with, the Policy.

EXECUTIVE OFFICER

Signature

Print Name

Date