UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CHONGQING HKC OPTOELECTRONICS TECHNOLOGY CO., LTD.,
Petitioner,

v.

138 EAST LCD ADVANCEMENTS LIMITED,
Patent Owner.

Case IPR2023-00475
U.S. Patent No. 7,116,390

DECLARATION OF MICHAEL LEBBY, PH.D.

I, Michael Lebby, Ph.D., of San Francisco, California, declare that:

I. ASSIGNMENT

1. I have been retained by Robins Kaplan LLP on behalf of 138 East LCD Advancements Limited ("138 East") as an expert with regard to this matter. I understand that Petitioner Chongqing HKC Optoelectronics Technology Co., Ltd. ("HKC") is requesting that the Patent Trial and Appeal Board ("Board") institute *inter partes* review (IPR) of U.S. Pat. No. 7,116,390 ("'390 patent" or "'390") (Ex. 1001).

2. In my capacity as an expert, I have been asked to provide my independent analysis and opinions regarding the '390 patent, the prosecution history of the '390 patent, the publications relied upon by Petitioner, and the opinions offered by Petitioner's expert, Dr. Carl Sechen, in his declaration ("Sechen Declaration") (Ex. 1002). My opinions and conclusions are fully discussed in later sections of this declaration.

3. I am an independent consultant, and I am not, and have never been, an employee of 138 East or HKC. I am being compensated for my time at the rate of $450 per hour for my work on this matter. This compensation is not contingent in any way upon my opinions, any testimony I present in this matter, or the outcome of this matter. I received no compensation for this declaration beyond my normal hourly compensation based on my time actually spent analyzing the '390 patent,

the prosecution history of the ’390 patent, the publications relied upon by Petitioner, the Sechen Declaration, and other related materials. I will not receive any added compensation based on the outcome of any IPR or other proceedings involving the ’390 patent.

II. BACKGROUND AND QUALIFICATIONS

4. I am a technologist and an internationally recognized business leader with approximately 40 years of experience working in integrated photonics and optoelectronics design and manufacturing. Throughout the course of my educational and professional activities, I have worked extensively with optoelectronic devices like the light-emitting diode (“LED”), lasers, liquid crystal displays (“LCD”), detectors, image sensors, and their associated device packaging, electronics, and module design with board and chip level interconnect.

5. In general, I have worked in nearly every aspect of the optoelectronics business, ranging from epitaxial wafer growth, device design using modeling and simulation, device fabrication, testing, and qualification, to the implementation of devices into packages, both hermetic and non-hermetic, as well as analysis of package materials such as plastics (including plastic housings such as resin-packaged lead frame housings), metallic-based packages, semiconductor-based packages, and ceramic-based packages. I have also designed device packages (through-pin, surface mount, flip-chip, and various combinations thereof) for

printed circuit board mounting and I've optimized performance through radio frequency (RF) and electronic signal design. Many of the designed packages were implemented into modules and sub-system/luminaire/display applications. The modules have been fiber-optic, display, lighting, and sensing-based.

6. I have also worked in commercially based industrial research-and-development laboratories to bring new optoelectronic and photonic-based technologies from the research proof-of-concept phase through prototyping and qualified manufacturing for volume release. I have been both an entrepreneur (e.g., Ignis Optics Inc, One Chip Photonics, Lightwave Logic Inc.), as well as an intrapreneur (e.g., Motorola, Intel, TE Connectivity (previously Tyco Electronics), AT&T Bell Labs), creating innovative new programs, both as venture backed start-ups as well as corporate funded divisions. I have built these entities to develop optoelectronics, electronics, and photonics technology from the laboratory and fabrication clean room to production factories.

7. I received a Bachelor of Electrical Engineering degree in 1984, a Master of Business Administration in 1985, and a Doctorate degree in 1987, all from University of Bradford in the United Kingdom. My Ph.D. thesis involved the design and fabrication of both optoelectronic and electronic semiconductor devices, and their associated characterization. In 2004, I was awarded a Doctor of Engineering degree (a higher doctorate degree) from University of Bradford for my

technical contributions to the field, with citation to "Technical Contributions to Optoelectronics."

8. My career started in the late 1970s at the Ministry of Defense in UK where I spent time at their R&D facility in Malvern (RSRE – Royal Signals and Radar Establishment). I worked on semiconductor device design, fabrication, and characterization, and especially materials using III-V compound semiconductors. I also worked on ceramic-based RF electronic packaging and electrical signal layouts that included low-temperature co-fired ceramic (LTCC). My research work in semiconductor device design then took me to AT&T Bell Laboratories in 1985, where I pursued research in novel device designs using III-V semiconductor material systems that included FETs, bipolar transistors, LEDs, laser diodes, and photodetectors. The devices researched became the subject of my Ph.D. thesis that was granted in 1987.

9. I moved to Motorola in 1989 to further develop my semiconductor engineering and development skills, and I became a Research and Development Manager in the photonics division of Motorola until I left the company in 1998. During my time at Motorola, I worked on many photonic technology projects that included optical interconnects, displays, associated electronics, LEDs, and laser devices, as well as the packaging and reliability of mobile product prototypes. At that time, I was particularly interested in miniature displays using several

technologies such as LEDs, lasers, Liquid Crystal Displays ("LCDs"), and organic LEDs. I was also particularly interested in miniature color displays, in which LEDs could be utilized, and the associated drive electronics for them.

10. Unfortunately, in the early 1990s for full RGB (red, green and blue) color displays, only red wavelength Phosphide (GaAsP and/or InGaAlP) and AlGaAs-based LED technology was advanced in technology and performance. Green wavelength Gallium Phosphide based LEDs had low emission output, and blue wavelength emission LEDs were only available using pure Silicon Carbide on Silicon Carbide substrate wafers, with very low emission output. I worked closely with Motorola's mobile divisions on new and novel display prototypes to research and develop how best to innovate with full color red, green, and blue (RGB) displays. A number of alternative technologies were evaluated, such as LCDs, organic LEDs ("OLEDs"), and Gallium Nitride and Indium Gallium Nitride materials grown onto Sapphire.

11. During my time at Motorola as a Research and Development Manager, I designed packages for these displays and devices, which included standard TO-cans, over-molded plastic DIL solutions, and ceramic-based and semiconductor-based technology.

12. The compound semiconductors used in the early 1990s at Motorola corporate research, for which I was a Research and Development Manager,

included GaAs, InP, GaN, GaP, and InGaAlP, among other materials—all of which were intended to be designed into various light emitting sources and detectors in their associated package platforms. The research work at Motorola also included work on displays and, in particular, miniature displays for pagers, clam-shell phones, and head-mounted displays that included mounting onto eyeglasses (similar in concept to Google glass™). The types of displays ranged from large arrays of visible LEDs (i.e., 10,000 LEDs on a chip) that required custom LED packaging to tiny color LCDs, where work was conducted into approaches to efficiently package the displays. Some of the research work at Motorola utilized phosphor technology, especially for display projects that were based on field emission (i.e., the field emission display (FED)), as well as arrays of visible LED displays where a full color gamut was required by both internal and external customers. The phosphor technology performed down-conversion of light energy.

13. I also initiated Motorola's work in optical interconnect (Optobus™) technology, and was involved in research and development of the IC chip designs that this parallel interconnect module utilized.

14. I was one of Motorola's most prolific inventors, having over 150 issued utility patents as an inventor or a co-inventor by the end of the 1990s. Many of the photonics prototypes with which I was involved were subject to reliability

and stress testing that included humidity, temperature, optical, mechanical, and electrical evaluation. These consumer products all were driven using standard electronic integrated circuits ("ICs") and electronic signaling.

15. I filed my first Gallium Nitride patent in 1996, which taught design techniques using GaN and InGaN LEDs, shortly after the invention of high performance GaN/InGaN blue LEDs by Nichia in the early 1990s. My work at Motorola addressed, in part, the big issue at the time in the mid-1990s which was full color display and display electronics composed of red, green, and blue LEDs that could be utilized in mobile products as well as other applications. As part of this work, I was engaged in how to package these technologies that allowed for electrical, optical, and thermal high performance. Examples of patents on which I am a co-inventor with respect to high heat conductivity surface emitting optical devices include, for example, U.S. Patent No. 5,538,919, as well as U.S. Patent No. 5,818,404, U.S. Patent No. 5,739,800, and U.S. Patent No. 5,838,703, which address LED packaging solutions.

16. Another of my inventions was directed to a new semiconductor laser that had the potential to be manufactured at high volume. This device was called a vertical cavity surface emitting laser ("VCSEL"), and the invention was to optimize the performance using an oxide process, and is now the basis for the highest volume semiconductor laser today (with its recent implementation into

Apple's new iPhone Face ID system, in addition to being the laser diode utilized for the past decade in laser mice for personal computers). The VCSEL is a surface emitting diode laser and operates in a similar fashion to most LED chips today. Some of the goals of the research work at Motorola were to be able to package these VCSEL laser diodes in a similar approach to LEDs. Laser diodes require thermal issues to be addressed very carefully as they develop significant levels of heat during operation. The package designs at the time (including for lasers and LED packages) took into account thermal heat sinking and thermal paths to take the heat away from the source. My additional patents, including during my time at Motorola, are listed in my curriculum vitae (attached to this declaration as Appendix A).

17. Between 1998 and 1999, I worked as the Director of Technology and Business Development (Fiber Optics) for Tyco Electronics (previously AMP). I joined Tyco Electronics as a member of the Global Optoelectronics Division's management team. I was responsible for growing the optoelectronics business through external interactions that included mergers, acquisitions, strategic alliances, and technical strategic planning. Much of that work was laser and LED-based, and included designing and characterizing laser and LED-based packages and modules for customer qualification specifications.

18. In 1999, I left Tyco and started employment at Intel. At Intel, I was involved heavily in photonic technology, especially technology that supported silicon photonic device platforms. As a culmination of this work, I was one of Intel's founders of its silicon photonics division in the year 2000, and worked to set up a fabrication facility in South San Jose. The work involved integrating silicon FET electronics with optoelectronics onto the same silicon semiconductor wafer. I was also part of Intel Capital's optical investment team, and participated in over 30 photonics investments into photonics and especially devices, packaging and modules. Technologies investigated at the time included lasers, LEDs, and displays.

19. At the end of 2000, I left Intel and raised venture capital funding for a company called Ignis Optics Inc. The main goal of the company was to design and manufacture in high volume very high-performance fiber optic transceiver modules with data rates up to OC-192, or approximately 10 Gbps. The fiber optic transceiver modules have the capability of transmitting and receiving optical signals that are controlled using programmable electronics and packaged optoelectronics chips, such as laser diodes and photodetectors. The optoelectronics chips were packaged using laminated ceramic-based technology as can be seen in my patents, for example, U.S. Patent No. 6,999,644 (a discrete optoelectronic package for a laser diode with a provisional filing of 15th February 2002). In this

patent, a laser diode chip was mounted onto a laminated ceramic package with electrical and thermal design features. Further, other of my patented inventions, such as U.S. Patent Nos. 6,663,296 and 6,795,461, also taught the use of a laminated ceramic package for a surface emitting laser diode and/or LEDs, with a priority date of 23rd April 2001. I am also an inventor or co-inventor on ceramic-based optoelectronic packaging patents that were designed for thermal engineering issues, dating to the 1990s, for example: U.S. Patent Nos. 5,045,908; 5,125,054; 5,959,315; 5,228,101; 5,313,545; 5,337,391; 5,361,317; 5,369,529; 5,416,870; 5,428,704; 5,521,992; 5,545,359; 5,539,200; 6,064,780; 5,543,958; 5,486,946; 5,625,734; 5,739,800; and 5,905,750; as well as EP0633607A1; EP0635741A2; and JPH0756062A.

20. In 2005, I took up employment for a trade association based in Washington, D.C., called OIDA (Optoelectronics Industry Development Association). As head of this trade association, and with photonics and electronics manufacturers that included fiber optics, displays, sensing, defense, aerospace, LED lighting, and automotive vendors as members, I was in-part responsible for industry-based technology roadmaps; and I implemented common industry roadmap methodologies with common features such as “Red Brick Walls” and transferred them into optoelectronics roadmaps for the industry in which were featured LEDs, fiber-optics, optics, fiber, optical sensors, displays, and their

associated packaging. I am the first person to coin the phase and define 'Purple Brick Walls' for Global optoelectronic roadmaps.

21. In 2010, I became the General Manager and CTO of Translucent, Inc., a high-tech start-up company which developed and manufactured silicon and rare earth oxide-based epitaxial semiconductor wafers. One of the key drivers at Translucent was to develop a new and novel platform for the growth of GaN and InGaN onto silicon for low-cost LED manufacturing on larger format substrate wafers (e.g., 200mm) in order to achieve economies of scale and lower chip costs.

22. Translucent pioneered the deposition of single crystal rare earth oxides such as Erbium Oxide (ErOx), Gadolinium Oxide (GdOx), Neodinium Oxide (NdOx), etc., that, when grown, single crystal layers of GaN/InGaN/AlN could be grown on top of them. This allowed a lattice-matched and monolithic-based wafer template to be manufactured for LED fabrication. While at Translucent, I researched various epitaxial semiconductor layer structures that utilized rare earth oxide technology in order to improve the performance of LEDs used individually, as well as in array form. Other material growth work at Translucent focused on the growth of Silicon Germanium (SiGe) compounds with rare earth oxides, and various crystal orientation wafer substrates.

23. I am currently serving as the Chief Executive Officer and Chief Technology Officer of GenusTechnik Inc. GenusTechnik Inc. is my consulting

company through which I engage in my expert witness work. I also presently hold the position of Chief Executive Officer of Lightwave Logic Inc. (LWLG) where I also serve as a Director on the Board of Directors. Lightwave Logic is a company that is developing optical polymer modulators for the fiber optic communications industry.

24. Throughout my career, I have also had an active role in a number of technical professional organizations, including, among others, IEEE Components, Packaging, and Manufacturing Technology (CPMT), IEEE Electronic Components and Technology Conferences (ECTC); IEEE TC-10 (Technical Committee on Optoelectronics), and IEEE Optoelectronics Industry Development Association (OIDA). Through these organizations, I have consistently been a part of committees, events, and workshops relating to semiconductor, optoelectronics, electronics, and packaging technology.

25. I also serve as a Technical Expert/Consultant for the Photonics Unit of the European Commission. In my work at the European Commission, I review and advise on general photonics and electronics technology.

26. My work has also led to over 220 USPTO utility patents issued in semiconductors, electronics, and optoelectronics, including a number of patents relating to display technology. This number increases to over 450 patents if

international derivative patents are included in the total. I am the author of more than 60 technical publications.

27. I am a fellow of IEEE, OSA (Optical Society of America, now called Optica), NAI (National Academy of Inventors).

III. BASIS FOR OPINIONS

28. I believe that I am qualified to render opinions regarding the technology described and claimed in the ’390 patent, based on my experience and education. Based on my expertise and qualifications, I believe that I am qualified to provide opinions as to the state of the art and what a POSITA would have understood, known, or concluded as of the conception of the inventions of the ’390 patent. In particular, during my tenure at Motorola’s Corporate Research Laboratories between 1989 and 1998, I regularly did both research and development work with LCD technology, including different display innovations including, for example, fabrication, electronics, optics, packaging, as well as module design. At the time Motorola was focused on miniature displays for hand-held products that included pagers, walkie-talkie communicators, mobile phones, and other communications devices such as virtual and heads-up displays. During the 1990s, LCDs and their associated electronics were one of the technologies developed at Motorola that could provide color displays with lower power consumption compared to previous LED based displays.

29. In reaching my opinions and conclusions, I have relied upon my education, my work experience in the relevant field, and my training, and considered and relied upon my review and analysis of the following materials:

- Petition (Paper 1)
- '390 patent (Ex. 1001)
- Sechen Declaration (Ex. 1002)
- Sechen CV (Ex. 1003)
- '390 prosecution history (Ex. 1004)
- JP2002049052A ("*Muraide*") (Ex. 1005)
- JP2002196311A ("*Sunao*") (Ex. 1006)
- U.S. Patent No. 6,862,071 ("*Fujikawa*") (Ex. 1007)
- U.S. Patent No. 6,262,702 ("*Murade II*") (Ex. 1008)
- U.S. Pub. Patent Application No. 20030063248A ("*Komeno*") (Ex. 1009)
- U.S. Patent No. 6,433,767 ("*Murade III*") (Ex. 1010)
- Declaration of Wenye Tan (Ex. 1011).
- M.A. Karim, *ElectroOptical Displays* (Marcel Dekker 1992)
- W.C. O'Mara, *Liquid Crystal Flat Panel Displays* (Springer Science+Business Media 1993)
- R. Chen, *Liquid Crystal Displays Fundamental Physics and Technology* (John Wiley & Sons 2011)

- N. Koide, *The Liquid Crystal Display Story* (Springer Japan 2014)

IV. LEVEL OF ORDINARY SKILL IN THE ART

30. For purposes of this Declaration only, I do not dispute the level of skill for a POSITA as set forth at page 8 of the Petition and in ¶40 of the Sechen Declaration. Pet., 8; Ex. 1002, ¶40.

31. Based on my experience, I am qualified to render opinions regarding the technology claimed and described in the ’390 patent, including as it relates to LCD circuit and wiring design, layout, and fabrication. Based on my expertise and qualifications, I am qualified to provide an opinion as to what a POSITA would have understood, known, or concluded as of approximately 2003-2004.

V. RELEVANT LEGAL PRINCIPLES

32. For the purposes of this declaration, I have been informed about certain aspects of the law that are relevant to my analysis and opinions. I have applied these legal principles in rendering my opinions below.

A. Claim construction

33. I understand that the ordinary and customary meaning of a claim term is the meaning that the term would have to a POSITA at the time of the invention.

34. In the absence of an express intent on the part of the inventor to give a special meaning to the claim terms, the words are presumed to take on the ordinary and customary meanings attributed to them by a POSITA.

35. I understand that it is the use of the words in the context of the written description, and as customarily used by those skilled in the relevant art, that accurately reflects both the ordinary and the customary meaning of the terms in the claims.

36. I understand that the basis for a term's ordinary and customary meaning may be derived from a variety of sources, including the words of the claims themselves, the remainder of the specification, the prosecution history, and extrinsic evidence concerning relevant scientific principles, the meaning of technical terms, and the state of the art at the time of the invention.

37. I have been instructed that dictionary definitions or definitions from technical references can be used to inform or confirm the ordinary and customary meaning of words found in a claim, but that in construing claim terms, the general meanings gleaned from reference sources, such as dictionaries, must always be compared against the use of the terms in the context of the claim itself.

38. I understand that a patent applicant is entitled to be his or her own lexicographer (in other words, provide his or her own meaning to a word or phrase) and may rebut the presumption that claim terms are to be given their plain and

ordinary meaning. To do so, the applicant must clearly set forth a definition of the term that is different from its ordinary and customary meaning. Where the applicant provides an explicit definition for a term, that definition will control interpretation of the term as it is used in the claim in which it appears. I understand that the specification can also be relied on for more than just explicit lexicography to determine the meaning of a claim term. For example, I understand that the meaning of a particular claim term may also be determined by implication, that is, according to the usage of the term in the context of the specification.

B. Anticipation (35 U.S.C. § 102)

39. I understand that under U.S. Patent Law, 35 U.S.C. § 102, a claim is invalid as anticipated if all elements of the claims are disclosed, expressly or by necessary implication, in a single publication that qualifies as "prior art" to the patent in question and in a way that enables a person having ordinary skill in the art to make and use the invention.

40. I understand that a prior art reference describes the claimed invention if it either expressly or inherently describes each and every feature set forth in the claim; that is, in determining whether a single prior art reference anticipates a patent claim, one should take into consideration not only what is expressly disclosed in that reference, but also what is inherently present as a natural result of the practice of the system or method disclosed in that reference.

41. I understand that to establish inherency, the evidence must make clear that the missing descriptive matter is necessarily present in the item of prior art and that it would be so recognized by a person having ordinary skill in the art.

C. Obviousness (35 U.S.C. § 103(a))

42. I understand that under U.S. Patent Law, 35 U.S.C. § 103, a claim is invalid as obvious if the differences sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

43. I am informed that an obviousness analysis requires an assessment of the scope and content of the prior art, the differences between the art and the claims at issue, and the level of ordinary skill in the art. I am told that it is against this backdrop that obviousness is assessed.

44. I am informed that a POSITA is a hypothetical person who is presumed to be aware of all the pertinent prior art. I am also informed that an obviousness analysis may take account of the inferences and creative steps that a POSITA would employ.

VI. BACKGROUND OF THE '390 PATENT

A. Technology overview

45. The '390 patent generally describes and claims configurations (called "layouts") of circuits and wiring lines used in LCD display devices and materials used to make and connect those components. In particular, the '390 patent describes and claims layouts with several specific elements, including but not limited to (1) a counter potential wiring line placed closer to the edge of a TFT substrate than wiring lines supplying driving circuits also on that substrate; (2) the counter potential wiring line and other wiring lines arranged so that they do not intersect; and (3) the counter potential wiring line and other wiring lines made from the same conductive film. Ex. 1001, 21:52-22:12 (claim 1).

46. The '390 inventions improve the picture quality of LCD displays while reducing the size of the peripheral region outside the display area and simplifying the manufacturing process. Ex. 1001, 1:33-2:35. The '390 inventions achieve these benefits with a novel layout of circuits and wires in an LCD device. Ex. 1001, 1:33-2:35, 13:6-39, 14:18-15:31, 16:36-51.

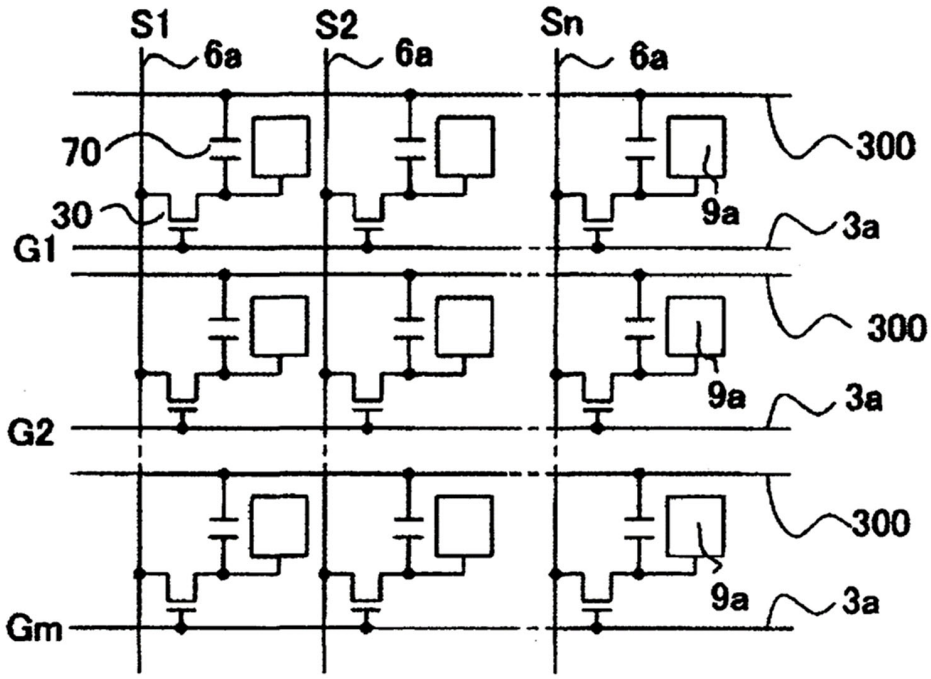
47. LCD devices typically have several fundamental components, described here to provide context for the '390 inventions. LCD displays produce images by transmitting light through liquid crystal (LC) molecules controlled by an array of thin film transistors (TFTs) that supply voltages to pixel electrodes. Ex.

1001, 1:14-32, 10:33-65, 12:61-13:5. The liquid crystal molecules are sealed in an area between two substrates. *Id.*

48. One substrate, called the "element substrate" or "TFT array substrate" in the '390 patent, includes the TFTs and the circuitry and wiring needed to control those TFTs to supply voltages to the pixel electrodes and produce images. Ex. 1001, 1:14-32, 9:13-20, Fig. 1, Fig. 2. The second substrate, called the "counter substrate" in the '390 patent, *id.* 9:13-20, includes a "counter electrode" supplied with a predetermined electrical potential, called a "counter potential" or "counter electrode potential." *Id.*, 4:23-38, 10:3-25, 12:61-13:5, Fig. 1, Fig. 2. The counter potential creates an electric field between the pixel electrodes supplied by the TFTs and the counter substrate that causes the liquid crystal molecules to rotate and change the direction of light passed through them to create different levels of brightness. *Id.*, 4:39-52, 10:50-65.

49. The image display region of an LCD device contains an array of many TFTs to control individual pixels or sub-pixels in the display. Ex. 1001, 9:13-20, 10:33-40, Fig. 1, Fig. 3. The TFTs are controlled by voltages supplied on "data lines" that supply image signals and "scanning lines" that control the gates of the TFTs. *Id.*, 10:26-49. Figure 3 of the '390 patent illustrates "data lines 6a," which

provide "image signals S1, S2, . . . , and Sn" to an array of "TFTs 30," and also "scanning lines 3a," which provide "scanning signals G1, G2, . . . , and Gn":

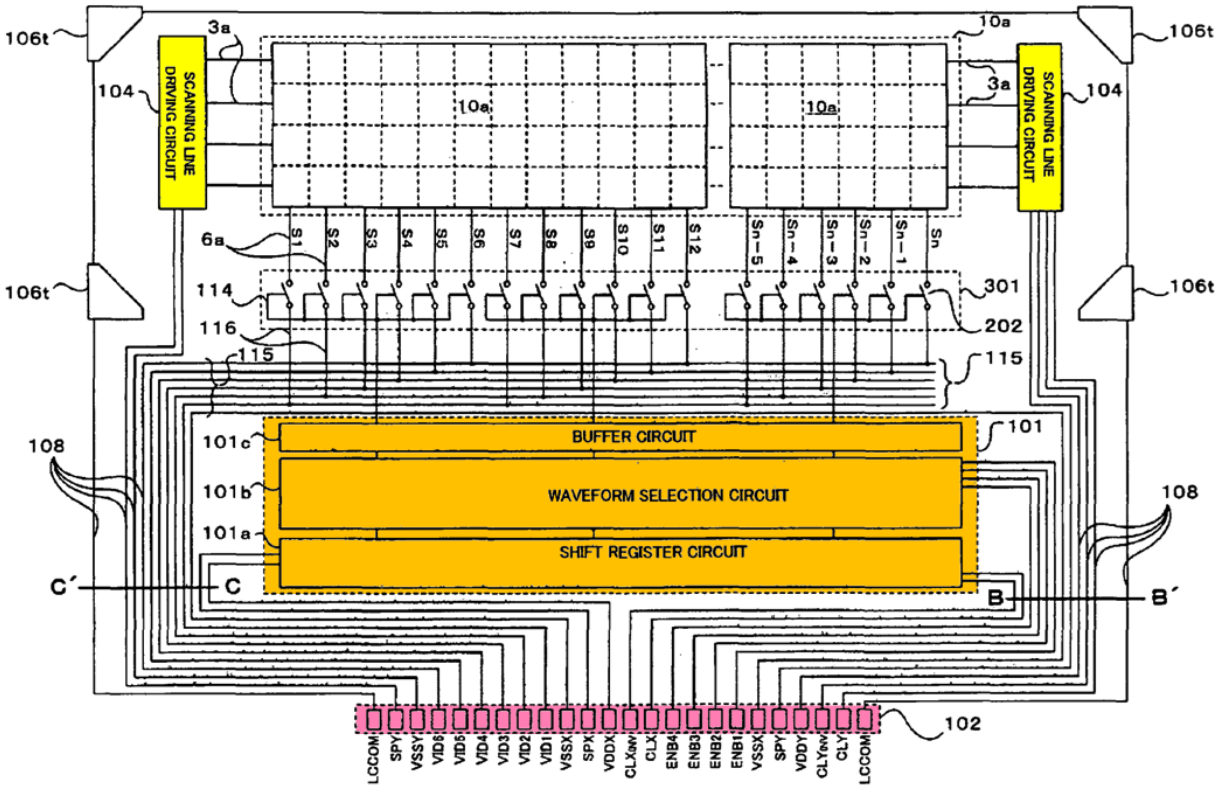


Ex. 1001, Fig. 3, 8:27-30, 10:26-49.

50. Circuits control the TFTs in the array: "a data line driving circuit"' for providing the image signals, and "scanning line driving circuits" for the scanning signals. *Id.*, 1:14-32, 9:47-60. Figure 4 illustrates "data line driving circuit 101" (highlighted below in orange) connected to "data lines 6a" and "scanning line driving circuits 104" (highlighted in yellow) connected to "scanning lines 3a" that provide signals to "image display region 10a" where the TFTs reside. *Id.*, Fig. 4, 11:29-40, 10:33-49. The "data line driving circuit 101" and "scanning line driving circuits 104" are supplied from external sources via "external circuit connection

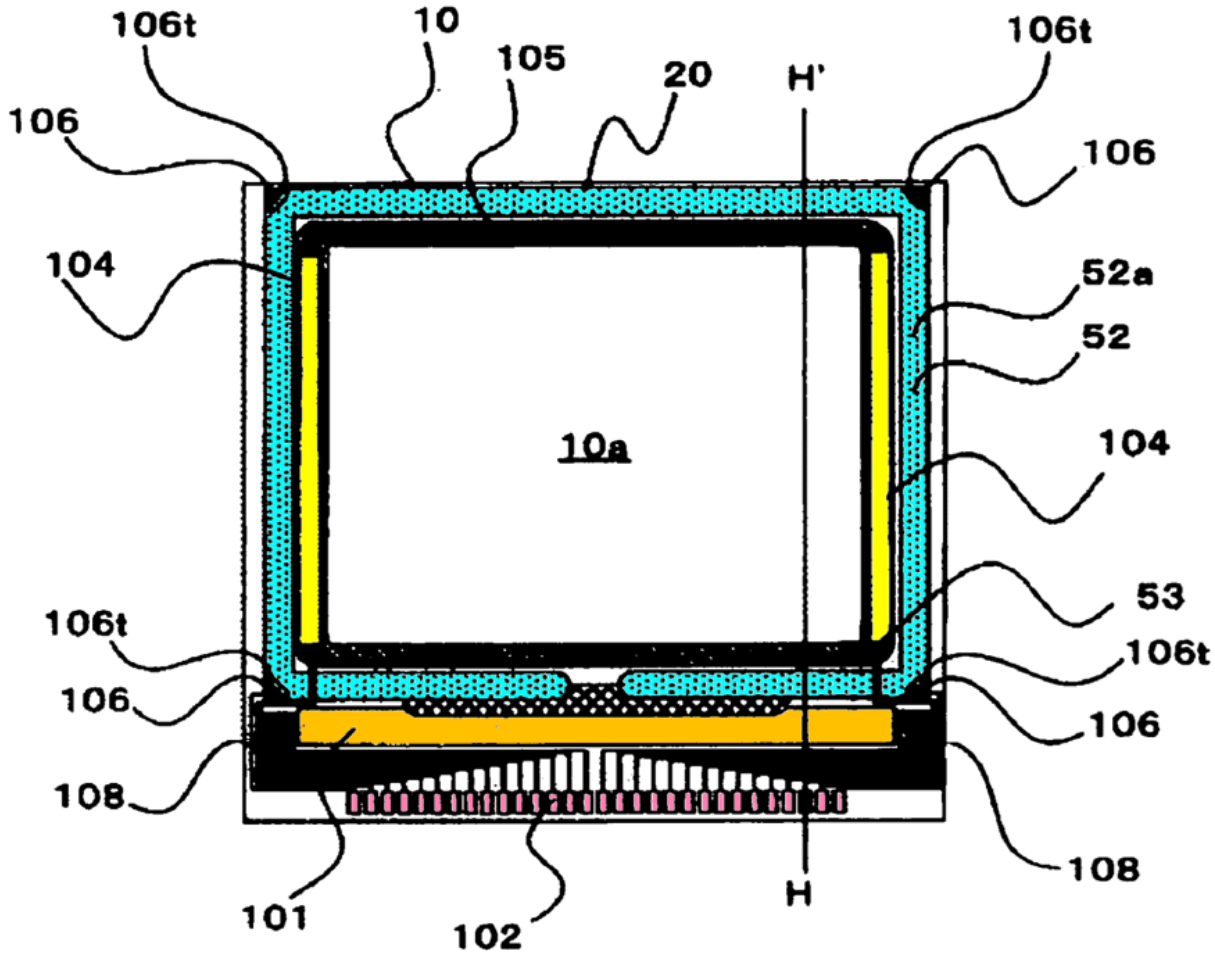
terminals 102" (highlighted in pink) and "main wiring lines 108" (not highlighted).

Id., 9:47-10:2, 11:29-40.



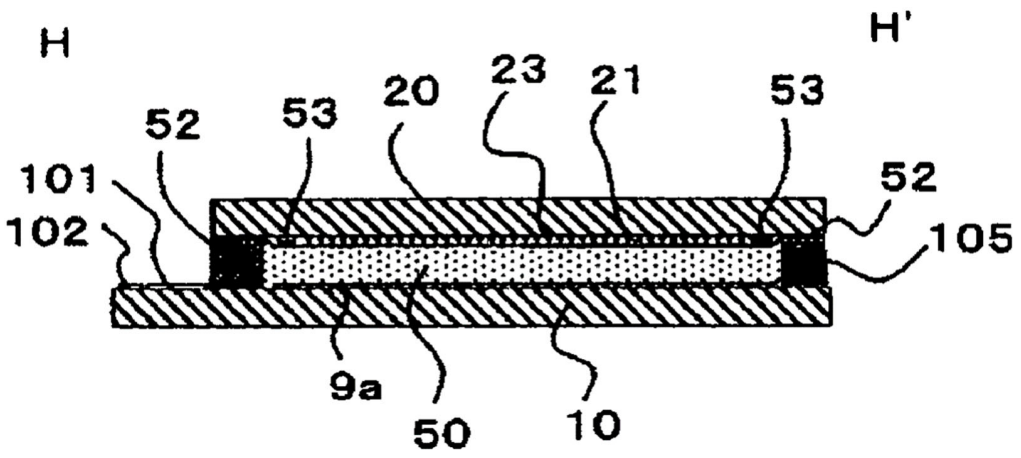
Id., Fig. 4 (emphasis added), 11:29-40.

51. Figure 1 illustrates these circuits at a less granular level of detail. It also illustrates "seal material 52," (highlighted in blue) which encloses the liquid crystal material between the substrates:



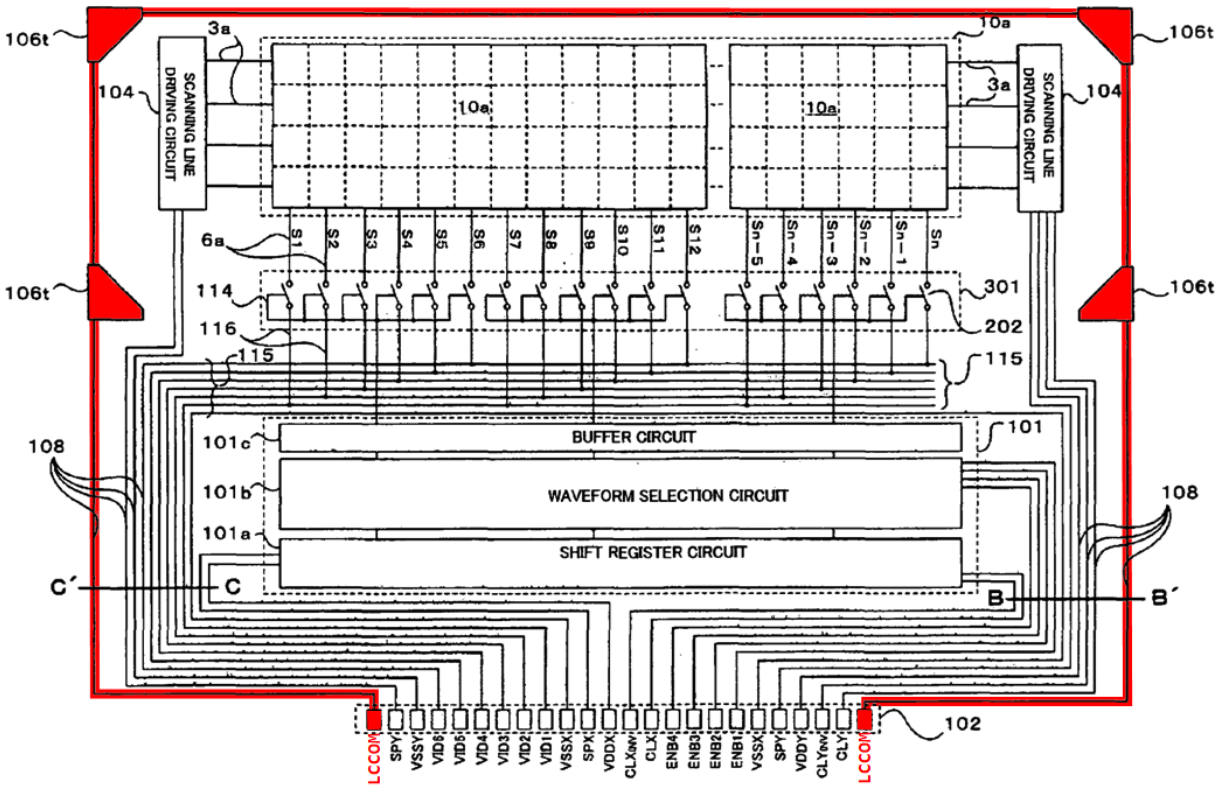
Id., Fig. 1 (emphasis added), 9:47-60.

52. Figure 2 provides a cross-section across the line H—H' shown in Figure 1. *Id.*, 9:8-10. Figure 2 illustrates "liquid crystal layer 50" between "TFT array substrate 10" and "counter substrate 20" and sealed in by "seal material 52":



Id., Fig. 2, 9:13-20.

53. The "TFT array substrate 10" and "counter substrate 20" are electrically connected by "conduction terminals 106t," as shown in Figures 1 and 4. Ex. 1001, Fig. 1, Fig. 4, 10:14-25, 12:61-13:5. The terminals provide a "counter electrode potential LCCOM" to the counter substrate via "counter electrode potential line LLCCOM" and its corresponding external terminal "TLCCOM" on the element substrate. *Id.*, 12:61-15:31. The items highlighted in red below illustrate the electrical counter potential path on the element substrate:



Id., Fig. 4, (emphasis added), 12:61-14:9.

54. The ’390 inventions relate to the layout and fabrication of these components. The inventions provide a layout of circuits, terminals, and main wiring lines that improve upon the prior art by reducing the area occupied by circuits and wiring while improving image quality and simplifying manufacturing. The integration of three particular characteristics of the inventive layout differs from all the references and combinations presented in the Petition and by Dr. Sechen.

55. First, the ’390 inventions locate the counter electrode potential line and corresponding terminal nearer the edge of the element substrate than a

plurality of other main wiring lines 108 coupled to the peripheral driving circuits 101 and 104, as shown in the annotated Figure 4 above. Ex. 1001, 13:6-39. This allows a reduction in size of the element substrate and a decrease in resistance in the wiring lines in conjunction with the second and third aspects of the inventions discussed below. *Id.*, 13:6-39, 14:18-15:54, 16:36-51.

56. Second, the '390 inventions provide a layout of main wiring lines 108 such that those lines do not intersect. Ex. 1001, 13:6-39, 14:18-15:54; Ex. 2001, ¶56. The '390 patent explains an example way of achieving this layout by locating the "scanning line driving circuits 104" within the seal region 52a (as illustrated in Figure 1, above) instead of outside that region. Ex. 1001, 13:6-39; Ex. 2001, ¶56. The specification explains:

> According to the present embodiment, in particular, the scanning line driving circuits 104 are arranged further inside than the seal region 52*a* illustrated in FIG. 1. That is, in FIGS. 4 and 5, the scanning line driving circuits 104 are arranged to be closer to the center of the TFT array substrate 10 than the counter electrode potential lines LLCCOM provided along the edges of the TFT array substrate 10 so as to pass through the four upper and lower conduction terminals 106*t* and to surround the

> image display region 10*a* and various driving circuits. Therefore, compared with the case in which the scanning line driving circuits 104 are arranged outside the seal region 52*a* in the peripheral region, it is possible to reduce the space of the peripheral region in the TFT array substrate 10 and to miniaturize the entire device. Furthermore, it is possible to lay out the group of the plurality of main wiring lines 108*a* including the counter electrode potential lines LLCCOM and the various signal wiring lines that reach the scanning line driving circuits 104 and the group of the plurality of main wiring lines 108*b* including the various signal wiring lines that reach the data line driving circuit 101 in plan view without intersecting each other.

Id. That is, the arrangement of seal and scanning line driving circuits allows locating the counter electrode potential line near the edge of the element substrate without crossing any other main wiring lines. *Id.*

57. Third, the ’390 inventions fabricate all main wiring lines, including the counter electrode potential line, from the same conductive material. Ex. 1001, 14:18-15:31, 16:36-51. The ’390 inventions achieve this by eliminating

intersections of any main wiring lines, including the counter electrode potential line. *Id.* When lines intersect, they require separate wiring line layers, separated by an insulating film, at the intersections. *Id.* Because the ’390 inventions avoid intersections, they allow fabricating the main wiring lines from the same conductive film, which decreases resistance and simplifies the manufacturing process. *Id.*

58. Claim 1 recites these elements of the ’390 invention. Ex. 1001, 21:52-22:12 (claim 1). It recites (1) a counter electrode potential line located nearest the edge of the substrate among a plurality of main wiring lines, including lines coupled to peripheral driving circuits; (2) a layout of main wiring lines such that they do not intersect; and (3) main wiring lines made out of the same conductive film:

> 1. An electro-optical device, comprising:
>
> a plurality of pixel portions provided in an image display region on an element substrate;
>
> in a peripheral region of the image display region on the element substrate, a plurality of external circuit connection terminals, a plurality of main wiring lines each having one end coupled to each of the plurality of external circuit connection terminals,

and peripheral driving circuits coupled to the other ends of the main wiring lines, the peripheral driving circuits driving the pixel portions based on electric signals supplied from the external circuit connection terminals through the main wiring lines,

a counter electrode provided in the peripheral region on a counter substrate that is arranged to face the element substrate;

a counter electrode potential line that supplies counter electrode potential to the counter electrode, which is at least one of the plurality of main wiring lines,

upper and lower conduction terminals that are provided in the peripheral region on the element substrate, and that are connected to the counter electrode potential line,

the plurality of main wiring lines being made of a same conductive film and being planarly laid out so as not to intersect each other in the peripheral region; and

the counter electrode potential line being closest to edges of the element substrate, among the plurality of main wiring lines.

Ex. 1001, 21:52-22:12 (claim 1).

B. Publications disclosed and considered during prosecution

59. I understand that several publications were disclosed to the United States Patent and Trademark Office ("USPTO") by the applicant for the '390 patent during prosecution of the application that led to the '390 patent.

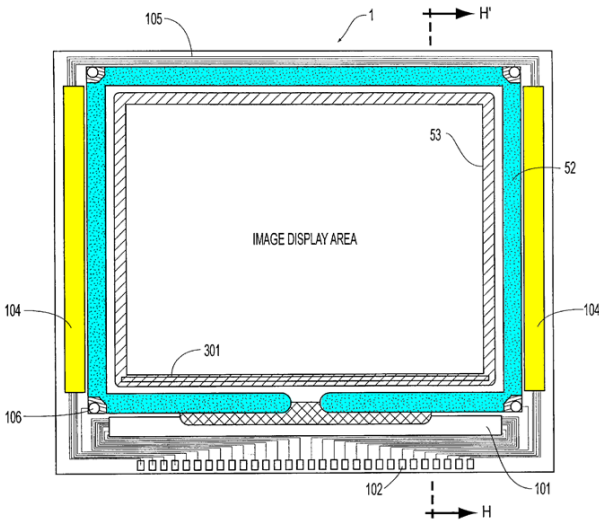
60. I understand that the *Muraide* reference, relied upon by the Petition and Dr. Sechen, was disclosed to the USPTO during prosecution of the application that led to the '390 patent.

61. I understand that the applicant for the '390 patent also disclosed, among other references, a reference called *Kaito*, JP10-253984, Ex. 1004, 224-241. I have reviewed the English translation of *Kaito* that the applicant for the '390 patent disclosed to the USPTO during prosecution. Ex. 1004, 224-231.

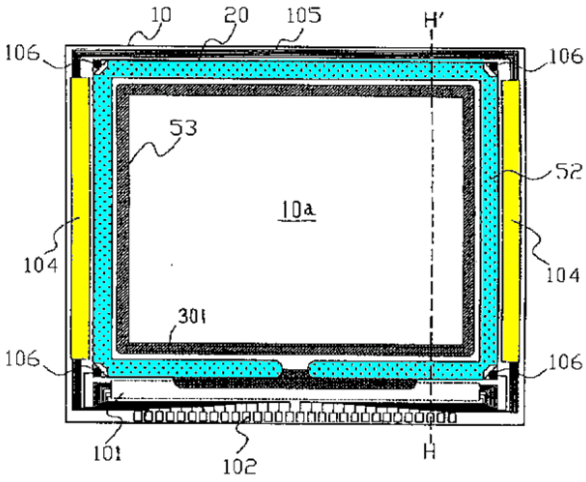
62. I have compared the *Muraide* and *Kaito* publications disclosed to the USPTO during prosecution to the material relied upon from the publications addressed by the Petition and Dr. Sechen. In that comparison, I have observed that a POSITA would recognize many similarities.

63. For example, the *Murade II* reference relied upon by the Petition and Dr. Sechen describes a similar layout of external terminals, a counter potential wiring line, vertical conductive terminals, and scanning line driving circuits as *Muraide*, which the '390 applicant disclosed to the USPTO. In particular, *Murade II* and *Muraide* both teach placing the scanning line driving circuits (labeled 104 in both references, highlighted in yellow) outside the LCD seal (labeled 52 in both references, highlighted in blue):

***Murade II*, Fig. 12 (Ex. 1008)**



***Muraide*, Fig. 11 (Ex. 1005)**



Ex. 1008, Fig. 12 (emphasis added); Ex. 1005, Fig. 11 (emphasis added).

64. In addition, both *Murade II* and *Muraide* teach aligning the counter substrate (highlighted in green, called "opposite substrate" in *Murade II*) with the edge of the LCD seal:

***Murade II*, Fig. 13 (Ex. 1008)**

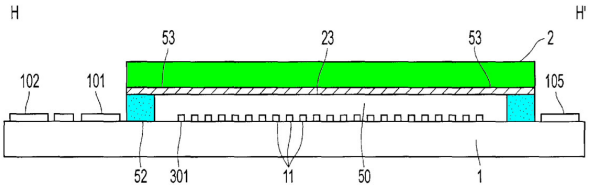
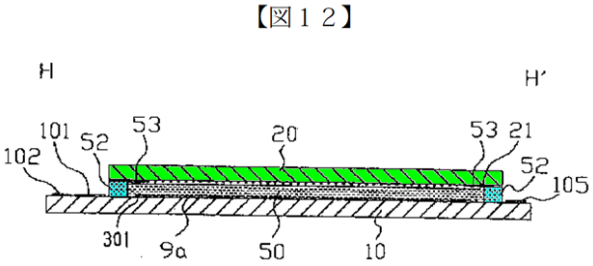


FIG. 13

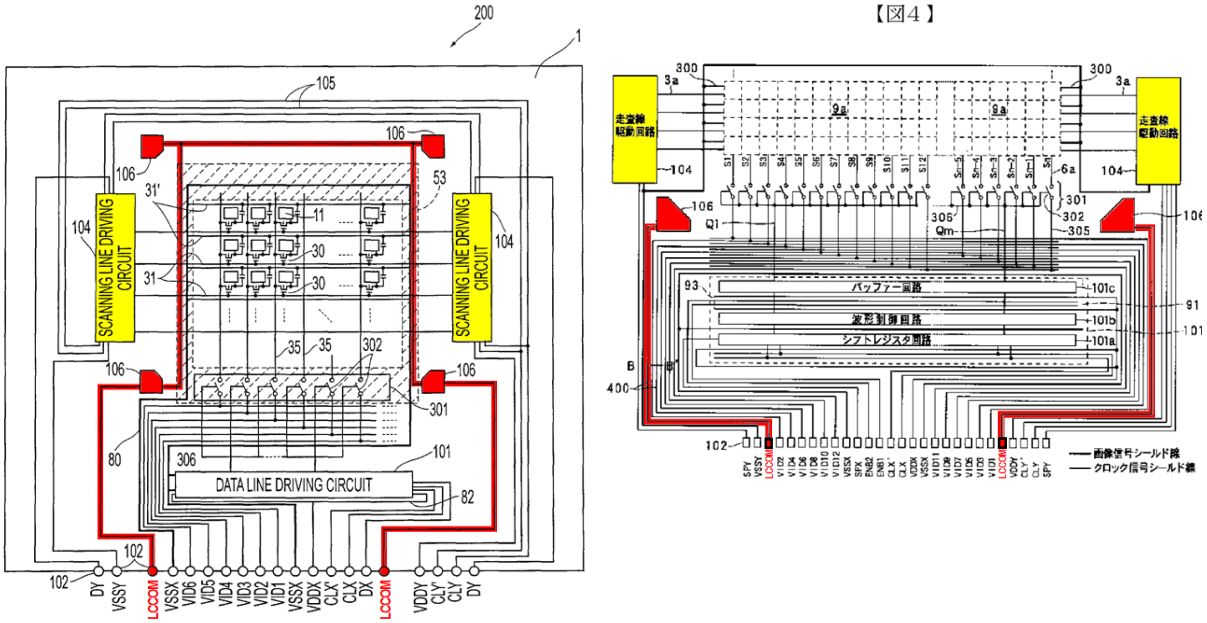
***Muraide*, Fig. 12 (Ex. 1005)**



Ex. 1008, Fig. 13 (emphasis added), 14:38-39, 30:64-31:15, 31:39-58; Ex. 1005, Fig. 12 (emphasis added), ¶[0106].

65. These characteristics of both *Murade II* and *Muraide* also result in the scanning line driving circuits (highlighted in yellow) being located closer to the edge of the LCD substrate than the vertical conductive terminals (highlighted in red) between the substrates to which the counter potential line (also highlighted in red) must run:

***Murade II*, Fig. 1 (Ex. 1008)** ***Muraide*, Fig. 4 (Ex. 1005)**

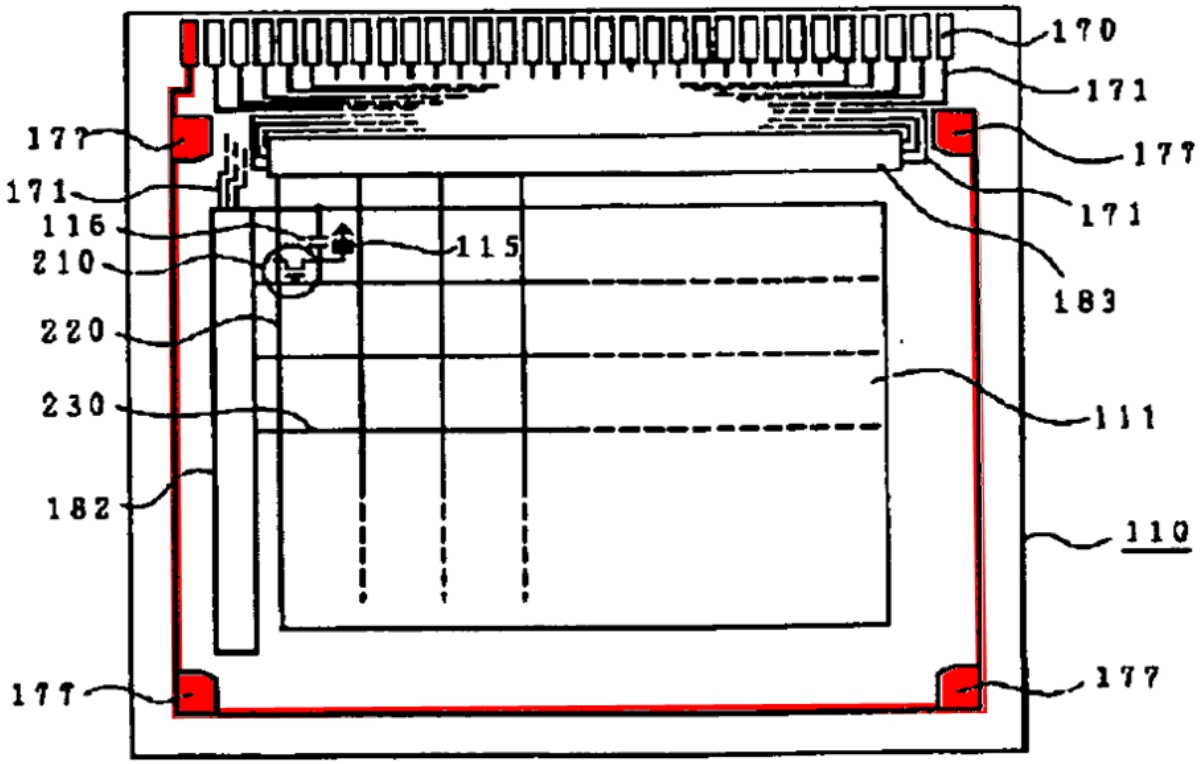


Ex. 1008, Fig. 1 (emphasis added); Ex. 1005, Fig. 4 (emphasis added).

66. I also observed that a POSITA would recognize similarities between the *Kaito* reference disclosed to the USPTO during prosecution and the teaching of a "counter electrode potential line . . . closest to the edge of the substrate," which the Petition and Dr. Sechen argue is a "design choice" and also taught by *Sunao*, *Komeno*, and *Fujikawa*. Pet., 2, 19-24, 52-53, 68-70; Ex. 1002, ¶¶70-77, ¶¶149-151, ¶¶190-195.

67. In particular, *Kaito* locates its vertical conductive terminals, counter potential line, and counter potential conductive terminal nearer the edge of the TFT substrate than any other lines or circuits. Ex. 1004, 227-228 (¶¶[0022]-[0025]), 237

(Figs. 2, 3). *Kaito* describes a "contact section 177" for providing electrical contact from a "connection terminal block 170" on a "TFT substrate 110" to a "common electrode 121" on an opposite substrate 120. *Id. Kaito*'s Figure 3 illustrates the counter potential path, highlighted in red:

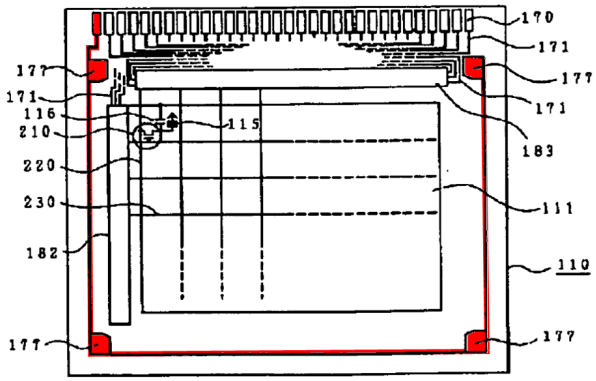


Ex. 1004, 237 (Fig. 3 (emphasis added)), 227-228 (¶¶[0022]-[0025]).

68. A POSITA would therefore have recognized that *Kaito* describes the feature that the Petition and Dr. Sechen rely upon as a "design choice" or allegedly disclosed by *Sunao*, *Komeno*, and *Fujikawa*: a "counter electrode potential line . . . closest to the edge of the substrate." Pet., 2, 19-24, 52-53, 68-70; Ex. 1002, ¶¶70-77, ¶¶149-151, ¶¶190-195. To illustrate, the counter potential paths from these references are emphasized below in red for ease of review:

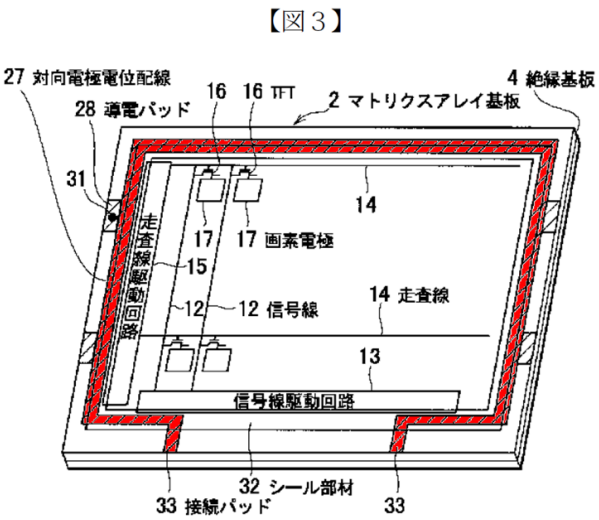
***Kaito*, Fig. 3 (Ex. 1004, 237)**

(considered during prosecution)



***Sunao*, Fig. 3 (Ex. 1006)**

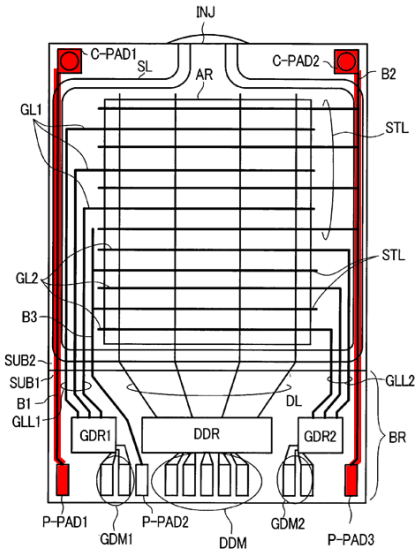
(asserted in Grounds 1, 2, 4, 5)



***Komeno*, Fig. 1 (Ex. 1009)**

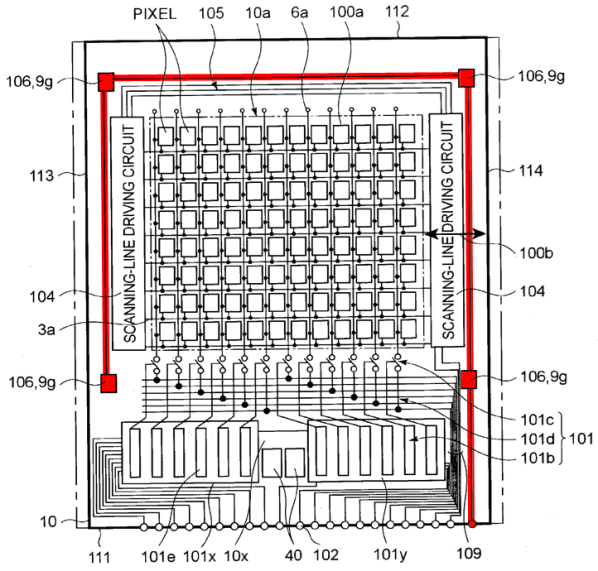
(asserted in Grounds 1, 2, 4, 5)

FIG. 1



***Fujikawa*, Fig. 2 (Ex. 1007)**

(asserted in Ground 3)



Ex. 1004, 237 (Fig. 3 (emphasis added)); Ex. 1006, Fig. 3 (emphasis added); Ex. 1009, Fig. 1 (emphasis added); Ex. 1007, Fig. 2 (emphasis added).

VII. ANALYSIS OF *MURAIDE* AND THE COMBINATION OF *MURAIDE* WITH EITHER *SUNAO* OR *KOMENO* (GROUNDS 1, 2)

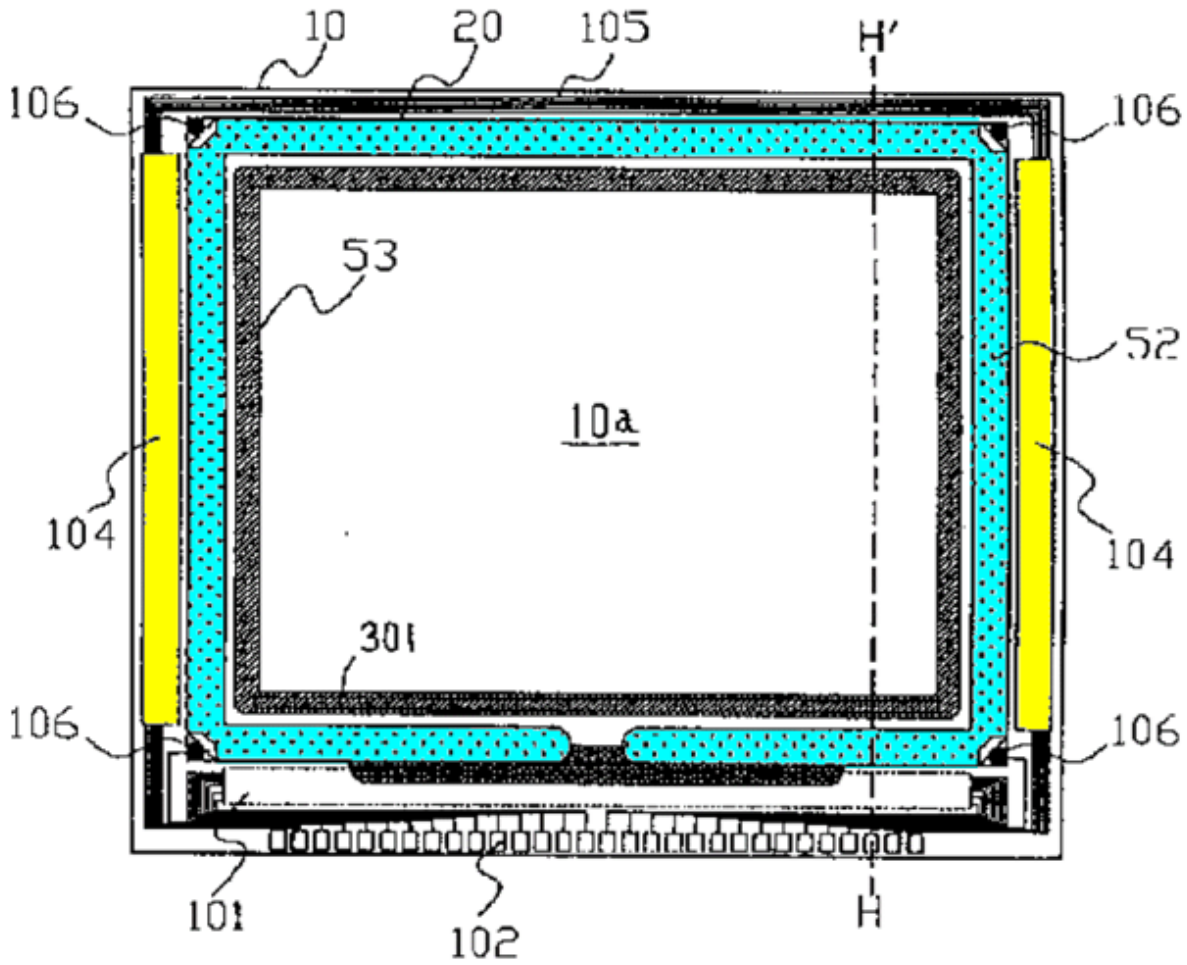
69. Dr. Sechen opines that *Muraide* in combination with *Sunao* or *Komeno* renders obvious claims 1-11 and 13 of the ’390 patent (Ground 1). I disagree with Dr. Sechen's conclusions regarding the combination of *Muraide* with either *Sunao* or *Komeno* for the reasons discussed below. These combinations do not teach all elements of claim 1 of the ’390 patent, and therefore they do not teach all elements of claims 2-11 and 13, which depend from claim 1.

70. Dr. Sechen also opines that *Muraide* in combination with *Sunao* or *Komeno* and in further combination with *Murade III* renders obvious claims 2-3 and 12 (Ground 2). I disagree with Dr. Sechen's conclusions regarding these combinations for at least the same reasons discussed below regarding the combination of *Muraide* with either *Sunao* or *Komeno*. These combinations do not teach all elements of claim 1 of the '390 patent, and therefore they do not teach all elements of claims 2-3 and 12, which depend from claim 1.

A. Overview of *Muraide*

71. *Muraide* describes an LCD layout in which the counter potential line does not reside nearer the edge of the substrate than wiring lines supplying scanning line driving circuits. Ex. 1005, ¶¶[0076]-[0078], ¶[0085], ¶¶[0105]-[0106], Fig. 4, Fig. 11, Fig. 12. *Muraide*'s placement of scanning line driving circuits relative to the LCD seal and counter substrate, and its fabrication process to achieve its noise-shielding goals, dictate this layout. *Id.*

72. *Muraide* locates its scanning line driving circuits outside the LCD seal, as illustrated in Figure 11 with "sealing material 52" highlighted in blue and "scanning line driving circuit 104" highlighted in yellow:



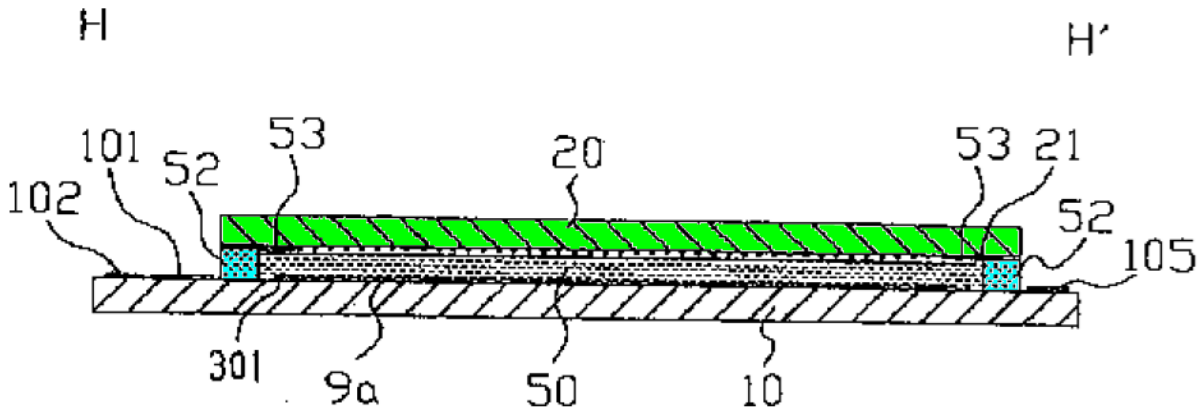
Ex. 1005, ¶[0106], Fig. 11 (emphasis added).

73. *Muraide*'s Figure 11 also illustrates "vertical conductive terminals 106," which supply a counter potential from "TFT array substrate 10" to a "counter substrate 20" at the corners of the LCD seal, farther from the edge than scanning

line driving circuit 104. Ex. 1005, ¶[0106], Fig. 11. *Muraide* explains that the vertical conductive terminals reside "in at least one position of a corner portion of the counter substrate 20." *Id.*

74. *Muraide*'s Figure 12 illustrates, in a cross-sectional view, that "counter substrate 20" (highlighted green, below) extends only to the "sealing material 52" (highlighted blue):

【図１２】

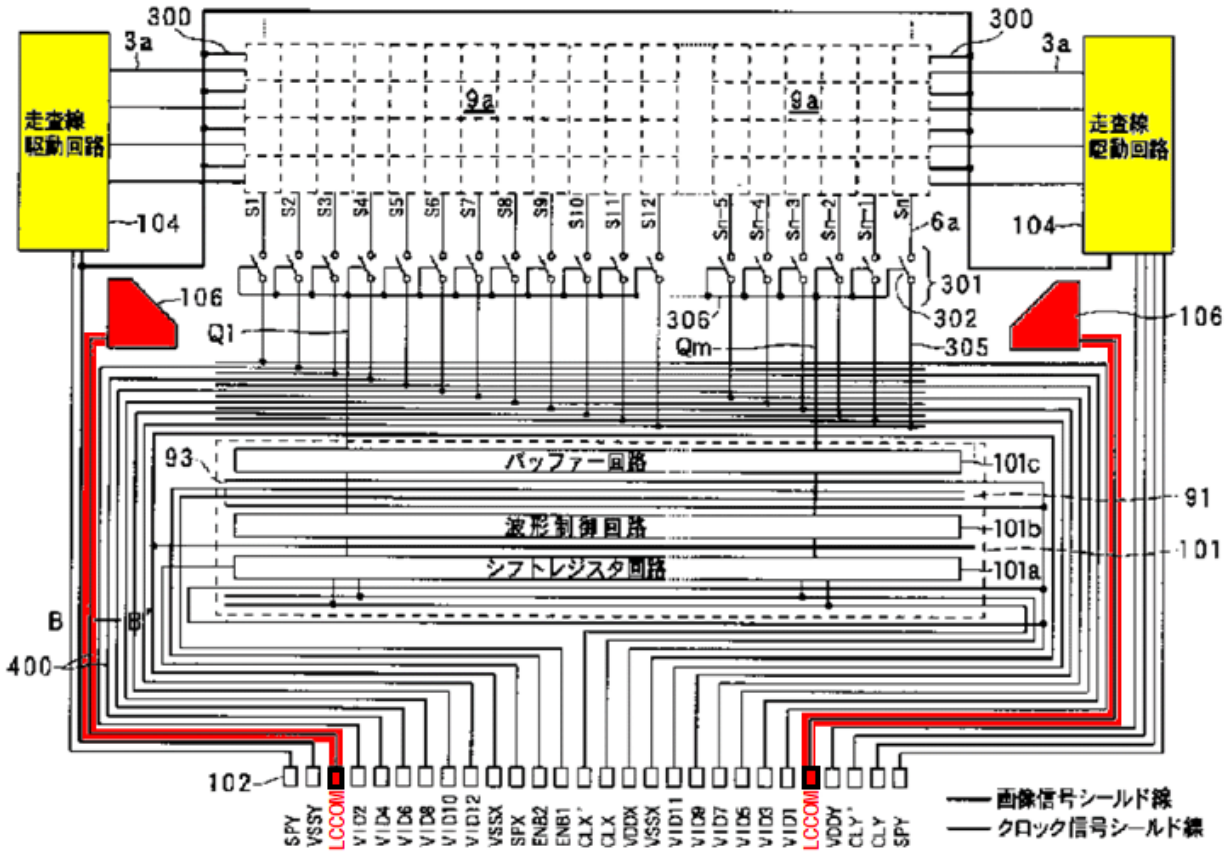


Ex. 1005, Fig. 12 (emphasis added), ¶[0106].

75. As a result of this design, *Muraide*'s scanning line driving circuit 104 (highlighted yellow, below) resides nearer the edge of TFT array substrate 10 than vertical conductive terminals 106 (highlighted red, below). Ex. 1005, ¶[0085], ¶[0106], Fig. 4, Fig. 11. *Muraide*'s Figure 4 illustrates the wiring layout corresponding to this circuit and substrate layout. *Muraide*'s layout places the external terminals 102 and wiring lines 400 supplying scanning line driving circuit

104 nearer the edge of TFT array substrate 10 than the terminal and line LCCOM (also highlighted red), which supplies a counter potential to vertical conductive terminals 106:

【図４】



Id. (emphasis added).

76. *Muraide*'s layout and the fabrication of its wiring lines attempts to reduce noise from control signal lines (such as clock signals CLX, CLX', CLY, and CLY') interfering with image signal lines (VID1 to VID12). Ex. 1005, ¶¶[0005]-

[0008], ¶¶[0086]-[0087], ¶[0100]. *Muraide* attempts to achieve this goal in two ways. *Id.* First, it provides a shield, such as an aluminum film, around the image signal lines VID1 to VID12. *Id.*, ¶¶[0086]-[0087]. Second, it arranges its wiring lines to provide voltage supply lines between the clock signal lines (CLX, CLX', CLY, and CLY') and the image signal lines (VID1 to VID12). *Id.*, ¶[0100].

77. In sum, *Muraide* teaches a specific layout of substrates, driving circuits, external terminals, and wiring lines—and a fabrication process tailored to that specific layout—to achieve its goals. *Muraide*'s layout does not allow reconfiguring its wiring layout without also reconfiguring its entire circuit layout and fabrication process.

B. Overview of *Sunao*

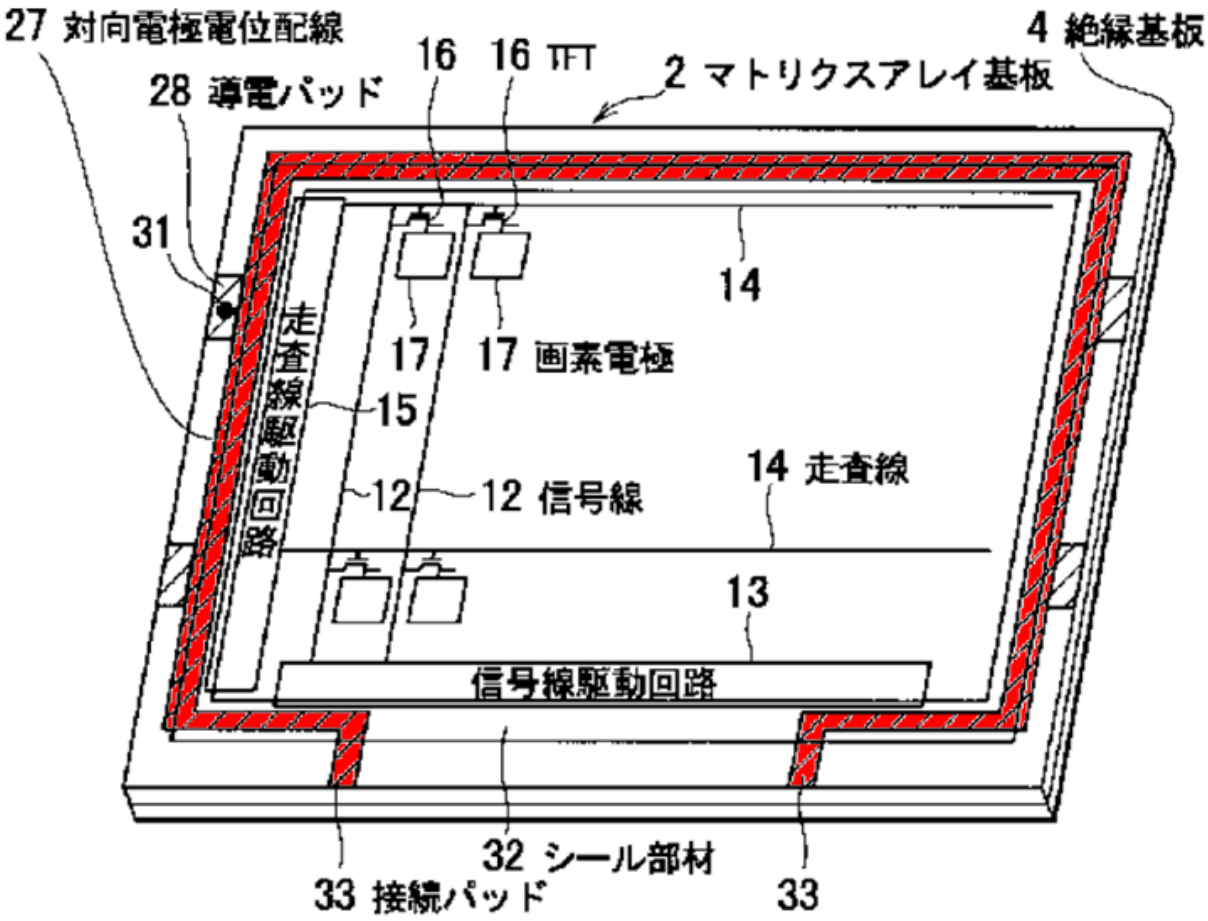
78. *Sunao* relates to providing an electrical potential to a counter electrode and to a metal frame surrounding an LCD device. Ex. 1006, Abstract, ¶¶[0007]-[0010]. *Sunao* does not relate to the layout of wiring lines connected to terminals on the substrate of an LCD device, and therefore does not describe that layout. *Sunao* explains that prior devices supplied different potentials to a counter electrode and metal frame, and if the two short-circuited, the difference in potential could flow through the counter electrode wiring and damage other components. *Id.*, ¶[0005]. To avoid this issue, prior devices placed an insulating spacer between the counter electrode and the metal frame, which increased the area of the device in

a peripheral region. *Id.*, ¶[0006], Fig. 5 (illustrating "insulating spacer 8" between "counter electrode 7" and "metal cover frame 6").

79. *Sunao* says it solves this problem by supplying the same electrical potential to the frame and the counter electrode instead of different potentials. Ex. 1006, ¶¶[0007]-[0010]. As a result, *Sunao*'s device can eliminate the insulating spacers present in prior devices and reduce the size of the LCD peripheral region. *Id.*

80. *Sunao* omits nearly all detail of its wiring layout, because its invention does not relate to that layout. *Sunao* illustrates only a single wiring line, "counter electrode potential wirings 27," highlighted in red below, supplied by "connection pad 33," and does not illustrate any other wiring lines supplying "signal line driving circuit 13" or "scanning line drive circuit 15" or terminals to supply such lines:

【図３】



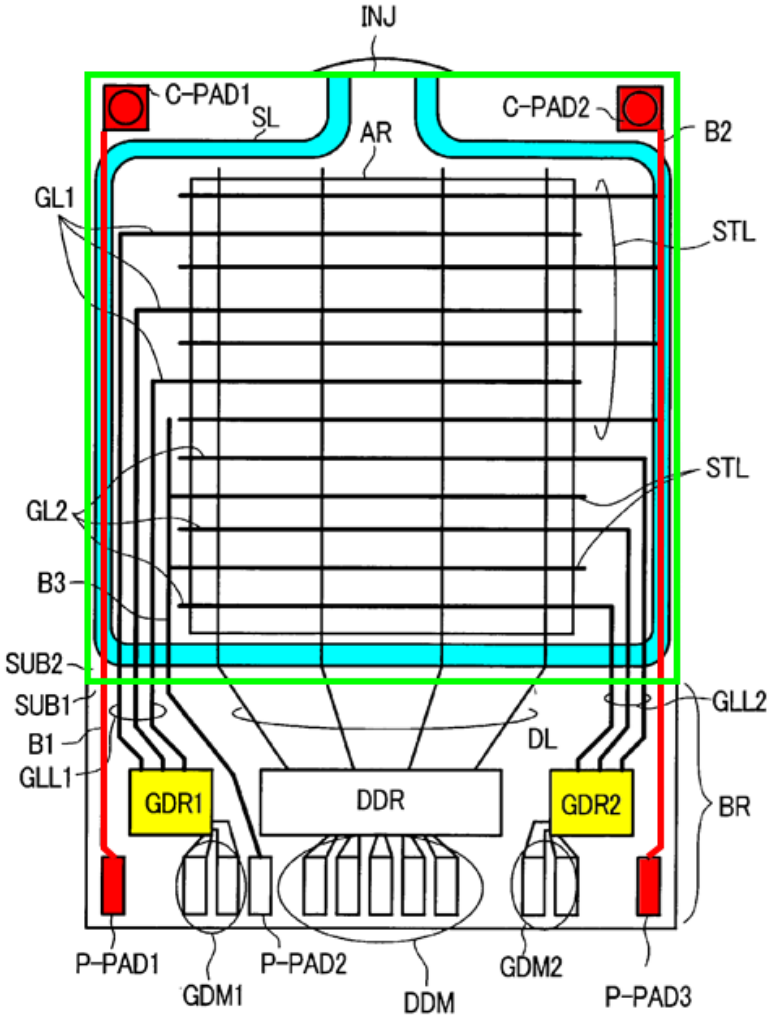
Ex. 1006, Fig. 3 (emphasis added), ¶[0014], ¶[0018].

81. *Sunao* thus does not disclose where "counter electrode potential wirings 27" or "connection pad 33" reside relative to any other terminals or wiring lines that supply scanning line or data line driving circuits. It describes only one line outside the display region. Ex. 1006, Fig. 3, ¶[0014], ¶[0018].

C. Overview of *Komeno*

82. *Komeno* describes an LCD device in which scanning line driving circuits and data line driving circuits all reside in the peripheral region on the same side (the bottom side) of the substrate. Ex. 1009, ¶[0103]-[0104], Fig. 1. *Komeno*, like *Muraide*, places its scanning line driving circuits ("gate line driving circuits" "GDR1" and "GDR2," highlighted in yellow, below) outside the LCD seal ("sealing member SL," highlighted in blue). *Id.* Komeno's counter substrate ("second substrate SUB2," outlined in green) aligns with its sealing member. *Id.* As a result, *Komeno*'s vertical conductive terminals ("counter electrode connection pads C-PAD1, C-PAD2," highlighted in red) must reside in the same planar region as the seal to connect to the counter substrate. *Id.*, ¶[0108], ¶[0110], Fig. 1. *Komeno* provides "common lines B1, B2" (also red) to carry an electrical potential from "feeding pads P-PAD1, P-PAD3" (red) to "counter electrode connection pads C-PAD1, C-PAD2." *Id.*

FIG. 1



Id., ¶¶[0103]-[0104], ¶[0108], ¶[0110], Fig. 1 (emphasis added).

D. The teachings of *Muraide* alone in combination with the teachings of *Sunao* or *Komeno* would not satisfy all elements of claim 1 of the '390 patent.

i. *Muraide* does not teach the material used to make the wiring line used to supply a counter potential LCCOM to the counter substrate.

83. Dr. Sechen contends that *Muraide* teaches the limitation "the plurality of main wiring lines being made of a same conductive film" in claim 1 of the '390 patent. Ex. 1002, ¶¶68-69. Dr. Sechen does not contend that a POSITA would need to combine *Muraide* with any other reference or otherwise modify *Muraide* to satisfy this claim limitation. *Id.*

84. Dr. Sechen contends that the claim limitation "a plurality of main wiring lines each having one end coupled to each of the plurality of external circuit connection terminals, and peripheral driving circuits coupled to the other ends of the main wiring lines" is disclosed in *Muraide* by, in Figure 4, "wiring lines coupled to the external connection terminals 102 at one end and coupled to peripheral circuits, including data line driving circuit 101, and scanning line driving circuit 104, at the other." Ex. 1002, ¶59 (relying on Ex. 1005, ¶¶[0078]-[0080], Fig. 4).

85. Dr. Sechen contends that the claim limitation "a counter electrode potential line that supplies counter electrode potential to the counter electrode,

which is at least one of the plurality of main wiring lines" is disclosed in *Muraide* by "wiring 400 (LCCOM), that supplies potential from the external input terminal 102 to the vertical conduction terminal 106 and then to the counter electrode 21 on the counter substrate 20." Ex. 1002, ¶¶63-66 (citing Ex. 1005, ¶[0085], Fig. 4).

86. Dr. Sechen does not, however, opine that "wiring lines coupled to the external connection terminals 102 at one end and coupled to peripheral circuits, including data line driving circuit 101, and scanning line driving circuit 104, at the other" and "wiring 400 (LCCOM)" are "made of a same conductive film," as recited in claim 1 of the '390 patent. Ex. 1002, ¶¶68-69.

87. Dr. Sechen instead opines only that *Muraide* teaches the limitation "the plurality of main wiring lines being made of a same conductive film" on the sole basis that "*Muraide* discloses main wiring lines, such as 'the wirings 400 (VID1) to 400 (VID12)' that are image signal lines and made of the same conductive film." Ex. 1002, ¶68 (quoting Ex. 1005, ¶[0087]).

88. A POSITA would recognize that *Muraide*'s description of "wirings 400 (VID1) to 400 (VID12) that are image signal lines [and] are made of the same conductive film" refers only to the image signal lines labeled, in Figure 4, VID1, VID2, VID3, VID4, VID5, VID6, VID7, VID8, VID9, VID10, VID11, and VID12. Ex. 1005, ¶[0087], Fig. 4.

89. Several disclosures in *Muraide* would indicate to a POSITA that *Muraide*'s description of the conductive film used to make "wirings 400 (VID1) to 400 (VID12)" does not extend to any other "wirings 400," including "wiring 400 (LCCOM)."

90. First, *Muraide* consistently uses specific nomenclature to refer to different "wirings 400" and explains that convention explicitly, stating "[i]n the following description of FIG. 4, for ease of description, wirings 400 of signals input via a plurality of external input terminals 102 provided along a lower side of the TFT array substrate 1 are referred to by attaching same alphabet symbols as signal names after the wiring 400 in parentheses (for example, a signal wiring of 'clock signal CLX' is referred to as 'wiring 400 (CLX)')." Ex. 1005, ¶[0079].

91. Second, the paragraph in which *Muraide* describes "wirings 400 (VID1) to 400 (VID12)" refers to Figures 5-10. Ex. 1005, ¶[0079]. The preceding paragraph explains that "FIGS. 5 to 10 are cross-sectional views showing structures of various specific examples of the shield in cross-section taken along B-B' of FIG. 4." *Id.*, ¶[0078]. The line B-B' in Figure 4 crosses only three wiring lines: VID2, VID4, and VID6. *Id.*, Fig. 4. It does not cross any other line, including LCCOM or any line connected to scanning line driving circuit 104. *Id.*

92. Third, *Muraide* expressly describes making different "wirings 400" out of different materials. In particular, *Muraide* describes making image signal

lines "the wiring 400 (VID1), the wiring 400 (VID2)," and so forth out of different materials than other "wirings 400." Ex. 1005, ¶[0104]. For example, *Muraide* describes making "control signal lines" such as "the wiring 400 (CLX), [and] the wiring 400 (CLY)" from a different conductive film than the image signal lines. *Id.*

93. In view of these disclosures from *Muraide*, which Dr. Sechen does not address, a POSITA would not and could not conclude that *Muraide*'s description of the material used for "wirings 400 (VID1) to 400 (VID12)" discloses, either expressly or by necessary implication, what material is used to make "wiring (400) LCCOM" or any wiring line connected to scanning line driving circuit 104.

94. A POSITA also would recognize that *Muraide* does not include any teaching of the material used to make "wiring (400) LCCOM" or any of the wiring lines connected to "scanning line driving circuit 104."

95. Based on these teachings, not addressed by Dr. Sechen, a POSITA would recognize that *Muraide* does not teach the limitation, from '390 claim 1, "the plurality of main wiring lines being made of a same conductive film."

96. Because the combinations asserted by the Petition and Dr. Sechen do not satisfy all elements of claim 1 of the '390 patent, they also do not satisfy all limitations of claims 2-13, which depend from claim 1. Neither Ground 1 nor Ground 2 asserted in the Petition and by Dr. Sechen, therefore, teach all elements of any challenged '390 claim.

ii. Modifying *Muraide* to place the wiring line used to supply a counter potential LCCOM nearer the edge of the TFT substrate than other wiring lines would result in intersections among main wiring lines.

97. Dr. Sechen does not assert that *Muraide* discloses the limitation "the counter electrode potential line being closest to edges of the element substrate, among the plurality of main wiring lines" in '390 claim 1. Ex. 1002, ¶¶70-77. Instead, Dr. Sechen contends that "the location of the counter electrode potential line is a mere design choice," and therefore a POSITA would find this limitation obvious based on *Muraide* alone or combined with *Sunao* or *Komeno*. *Id.* Dr. Sechen further contends that "[t]he other obvious design choice is to locate the counter electrode potential line and conduction pads nearer to the edge of the substrate with respect to the scanning line drive circuit. This is a basic design choice that would not change any properties or characteristics of the wiring layout." *Id.* ¶70.

98. As to *Sunao*, Dr. Sechen contends that "a POSITA would understand *Sunao* to disclose a counter electrode potential line that has been designed to run along the outer edge of an array substrate." Ex. 1002, ¶71.

99. As to *Komeno*, Dr. Sechen contends that "a POSITA would understand *Komeno* to disclose a counter electrode potential line that has been designed to run along the outer edge of an array substrate." Ex. 1002, ¶75.

100. Dr. Sechen suggests modifying *Muraide*'s display device solely by locating a counter electrode potential line "closest to edges of the element substrate with *Muraide*'s display device." Ex. 1002, ¶70, ¶74, ¶76.

101. Dr. Sechen does not address several teachings from *Muraide*, *Sunao*, and *Komeno* that would indicate to a POSITA that relocating *Muraide*'s counter electrode potential line to be "closest to edges of the element substrate" would not satisfy the limitations of '390 claim 1.

102. In particular, claim 1 of the '390 patent recites that "the plurality of main wiring lines," including "a counter electrode potential line," must be "planarly laid out so as not to intersect each other in the peripheral region." Ex. 1001, 22:1-12. Claim 1 also recites that "the counter electrode potential line" must be "closest to edges of the element substrate, among the plurality of main wiring lines." *Id.*

103. Modifying *Muraide* by relocating *Muraide*'s counter electrode potential line to be "closest to edges of the element substrate" would not satisfy these limitations, because other elements of *Muraide*'s design, which Dr. Sechen does not address, would result in the claimed "main wiring lines" crossing in the modified design.

104. Dr. Sechen does not address *Muraide*'s teachings that (1) the boundary of the counter substrate in *Muraide* is aligned with the LCD seal

separating the pixel display region from a peripheral region; and (2) the scanning line driving circuits in *Muraide* are placed entirely outside the LCD seal in plan view. Ex. 1005, Fig. 4, ¶¶[0076]-[0078], ¶[0085], ¶¶[0105]-[0106], Fig. 11, Fig. 12. That is, the counter substrate in *Muraide* does not extend, in plan view, over the scanning line driving circuits. *Id.*

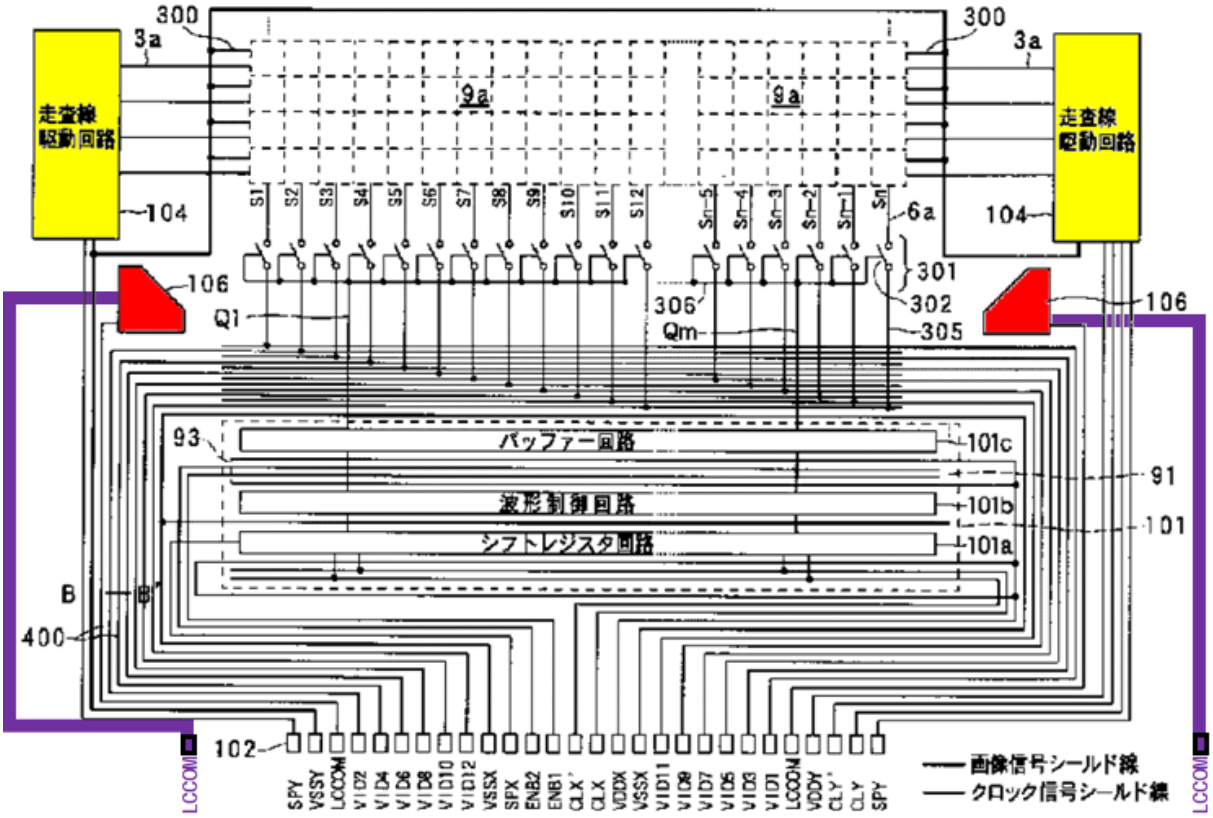
105. The counter substrate in *Muraide* must have an electrical connection to the TFT substrate (the opposite substrate on which wires and circuitry such as the scanning line driving circuit, data line driving circuit, and TFTs driving pixel electrodes are formed), because the input signals and voltages are provided to terminals on the TFT substrate. Ex. 1005, ¶[0079], ¶[0085], ¶[0106], Fig. 4, Fig. 11, Fig. 12. For the counter electrode to carry an electrical potential, it needs to receive it from the TFT substrate and so needs to connect electrically to the TFT substrate. *Id. Muraide* accomplishes this with vertical conductive terminals that provide the electrical connection to carry an electrical potential (a "counter potential") from the TFT substrate to the counter substrate. *Id.*, ¶[0085], Fig. 4.

106. In *Muraide* the counter substrate extends only to the edge of the LCD seal and not as far as the scanning line driving circuits in the peripheral region. Ex. 1005, ¶¶[0105]-[0106], Fig. 11, Fig. 12. The vertical terminals to carry a counter potential to the counter substrate in both references therefore must also be within the LCD seal region and cannot be placed in the peripheral region, such as closer

to the edge of the TFT substrate than the scanning line driving circuits. *Id.*, ¶¶[0076]-[0078], ¶[0085], ¶¶[0105]-[0106], Fig. 4, Fig. 11, Fig. 12.

107. The necessary placement of the vertical conductive terminals in *Muraide*—nearer to the center of the TFT substrate than the entirety of the scanning line driving circuits—means that modifying *Muraide* to include a counter potential line closer to the edge of the TFT substrate than any of the lines for supply the scanning line driving circuits would require those lines to cross. Ex. 1005, ¶¶[0076]-[0078], ¶[0085], ¶¶[0105]-[0106], Fig. 4, Fig. 11, Fig. 12. For example, in the hypothetical modified *Muraide* figure (Figure 4) below, the counter potential terminal and line LCCOM are (hypothetically, for illustration) placed nearer the edge of the TFT substrate than the lines supplying the scanning line driving circuits 104—SPY, VSSY, VDDY, CLY', and CLY. In this arrangement, LCCOM must cross all those lines to reach the vertical conductive terminals 106. *Id.*

【図4】



Id., Fig. 4 (yellow and red emphasis added; purple modifications added). Even if LCCOM was placed closer to the edge of the substrate than one of the supply lines for the scanning line driving circuit, such as VSSY, LCCOM would still have to cross that line to reach the vertical conductive terminal 106. *Id.*

108. Dr. Sechen does not address the teachings from *Muraide* about the location of the counter substrate that necessitate placement of the vertical conductive terminals closer to the center of the TFT substrate than the scanning line driving circuit. Dr. Sechen assumes, without any evidence, that "to locate the

counter electrode potential line and conduction pads nearer to the edge of the substrate with respect to the scanning line drive circuit" is "an obvious design choice." Ex. 1002, ¶70. Dr. Sechen further assumes, without evidence, that "[t]his is a basic design choice that would not change any properties or characteristics of the wiring layout." *Id.*

109. Dr. Sechen does not address at all whether the proposed modification of *Muraide* by moving the counter potential line LCCOM would still satisfy the limitation of '390 claim 1 "the plurality of main wiring lines . . . being planarly laid out so as not to intersect each other in the peripheral region." Ex. 1002, ¶¶68-77. Dr. Sechen instead relies only on *Muraide*'s existing disclosure in which lines do not intersect, *id.* ¶¶68-69, and, apparently, assumes without evidence or analysis that the lines still would not intersect even after moving them around.

110. I disagree with Dr. Sechen's assumptions and conclusions, based on the teachings of *Muraide* discussed above, which Dr. Sechen does not address. Simply moving *Muraide*'s counter electrode potential line LCCOM and its corresponding conductive terminal 102 closer to the edge of the TFT substrate would require LCCOM to cross at least one wiring line for the scanning line driving circuit to supply a counter potential to the counter substrate. That change would certainly "change . . . properties or characteristics of the wiring layout," in a way that does not satisfy claim 1 of the '390 patent because the modified layout

would not satisfy the limitation "the plurality of main wiring lines . . . being planarly laid out so as not to intersect each other in the peripheral region."

111. In addition, *Sunao* does not teach the location of a counter potential line relative to any other wiring lines, including wiring lines supplying scanning line driving circuits or a data line driving circuit. Ex. 1006, ¶[0018], Fig. 3. *Sunao* illustrates only one line: "counter electrode potential wirings 27." *Id.* It does not illustrate any other lines. *Id.* A POSITA therefore would recognize that *Sunao* does not disclose, as Dr. Sechen suggests, "a counter electrode potential line that has been designed to run along the outer edge of an array substrate," Ex. 1002, ¶71, because this assumes the relative locations of other lines that *Sunao* does not disclose.

112. Also, *Komeno*, like *Muraide*, describes a counter electrode that extends only to the edges of the LCD seal and scanning line driving circuits (called "gate line driving circuits" "GDR1" and "GDR2") fully outside the LCD seal in a peripheral region of the TFT substrate. Ex. 1009, ¶¶[0103]-[0104], Fig. 1. Dr. Sechen does not address this teaching. *Komeno* therefore does not suggest modifying *Muraide*'s placement of scanning line driving circuits outside the LCD seal, and accordingly outside the vertical conductive terminals.

113. Based on these teachings, not addressed by Dr. Sechen, a POSITA would recognize that *Muraide* alone or the combination of *Muraide* with alleged

disclosures of counter electrode potential lines closest to the edge of the TFT substrate (either as an alleged "mere design choice" or as allegedly disclosed in *Sunao* and *Komeno*) would not satisfy the limitations, from '390 claim 1, "the plurality of main wiring lines . . . being planarly laid out so as not to intersect each other in the peripheral region" and "the counter electrode potential line being closest to edges of the element substrate, among the plurality of main wiring lines."

114. Because the combinations asserted by the Petition and Dr. Sechen do not satisfy all elements of claim 1 of the '390 patent, they also do not satisfy all limitations of claims 2-13, which depend from claim 1. Neither Ground 1 nor Ground 2 asserted in the Petition and by Dr. Sechen, therefore, teach all elements of any challenged '390 claim.

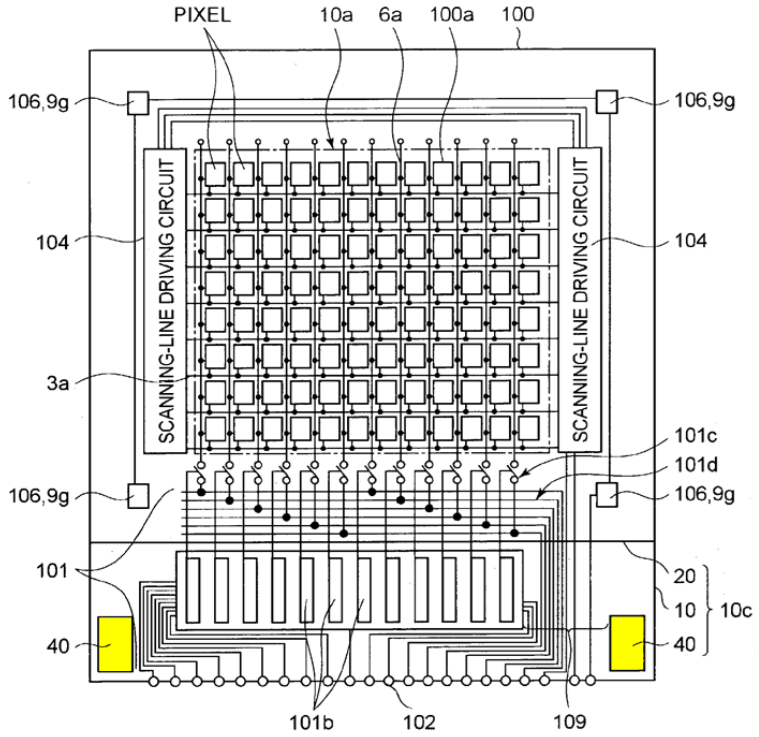
VIII. ANALYSIS OF *FUJIKAWA* (GROUND 3)

115. Dr. Sechen opines that *Fujikawa* discloses all elements of claims 1-5, 7, 8, 11, and 13 of the '390 patent and therefore anticipates them (Ground 3). I disagree with Dr. Sechen's conclusions regarding *Fujikawa* for the reasons discussed below.

A. Overview of *Fujikawa*

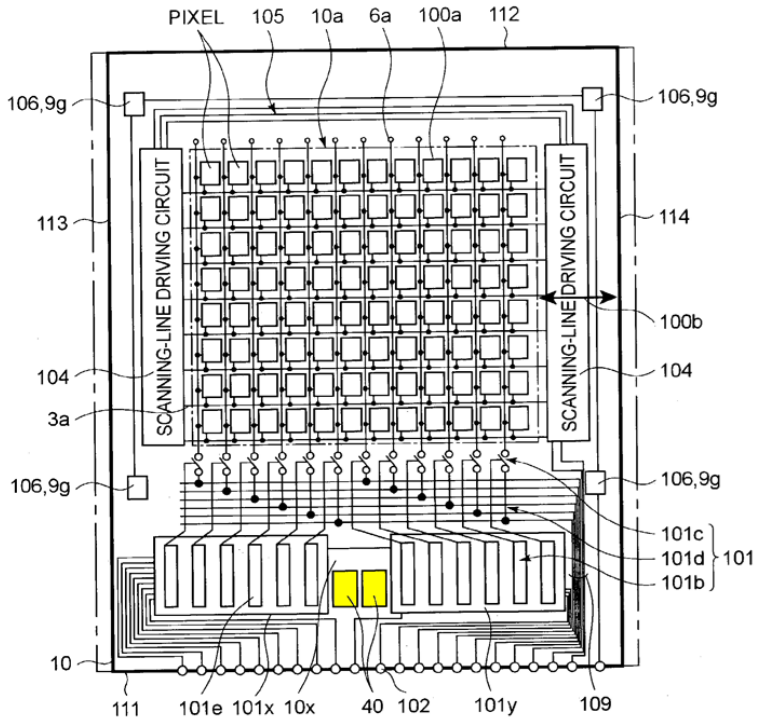
116. *Fujikawa* relates to the layout of an LCD device to facilitate the placement of "identification marks" indicating the part numbers of the device and used for quality control during production. Ex. 1007, ¶¶[0009]-[0011]. *Fujikawa*

seeks to reduce the space in the LCD peripheral region required for such identification marks, which can measure 2 millimeters by 2 millimeters. *Id.* *Fujikawa*'s Figure 19 illustrates "identification marks 40" (highlighted yellow) requiring space in the peripheral region:



Id., Fig. 19 (emphasis added), ¶¶[0009]-[0011].

117. *Fujikawa* addresses relocating the identification marks so they do not require as much additional space for the peripheral region. Ex. 1007, ¶¶[0009]-[0011]. For example, *Fujikawa*'s Figure 2 illustrates placing "identification marks 40" near the center of the substrate, instead of at the edge, and adjusting the wiring layout accordingly:



Id., Fig. 2 (emphasis added), ¶¶[0081]-[0083].

B. A POSITA would recognize that the teachings of *Fujikawa* do not satisfy all elements of claim 1 of the '390 patent.

i. *Fujikawa* does not teach the material used to make the wiring line used to supply a counter potential DCCOM to the counter substrate.

118. Dr. Sechen contends that *Fujikawa* teaches the limitation "the plurality of main wiring lines being made of a same conductive film" in claim 1 of the '390 patent. Ex. 1002, ¶¶147-148.

119. Dr. Sechen contends that the claim limitation "a plurality of main wiring lines each having one end coupled to each of the plurality of external circuit connection terminals, and peripheral driving circuits coupled to the other ends of

the main wiring lines" is disclosed in *Fujikawa* by its description of "[a] plurality of lines 109 made of, for example, a low-resistance metal film, such as an aluminum film, for driving a scanning-line driving circuit 101 and data-line driving circuits 104," which "are routed from [] terminals 102." Ex. 1002, ¶¶134-137.

120. Dr. Sechen contends that the claim limitation "a counter electrode potential line that supplies counter electrode potential to the counter electrode, which is at least one of the plurality of main wiring lines" is disclosed in *Fujikawa* by its description of a wiring line connected to "[c]onductive electrodes 9g and conductive materials 106" by which "a constant voltage (DCCOM) supplied to the terminals 102 of the TFT array substrate 10 can be supplied to the counter electrodes of the counter substrate 20." Ex. 1002, ¶¶140-143 (citing and quoting Ex. 1007, ¶[0008], ¶[0046], ¶[0047], ¶[0050], ¶[0055], ¶[0072], Fig. 12, Fig. 19).

121. Dr. Sechen opines that *Fujikawa* teaches the limitation "the plurality of main wiring lines being made of a same conductive film" on the basis that *Fujikawa* states "[a] plurality of lines 109 made of, for example, a low-resistance metal film, such as an aluminum film, for driving a scanning-line driving circuit 101 and data-line driving circuits 104, are routed from these terminals 102." Ex. 1002, ¶147 (quoting Ex. 1007, ¶[0055]). Dr. Sechen also identifies Figures 12 and 19 from *Fujikawa*, but does not explain whether, how, or why those figures

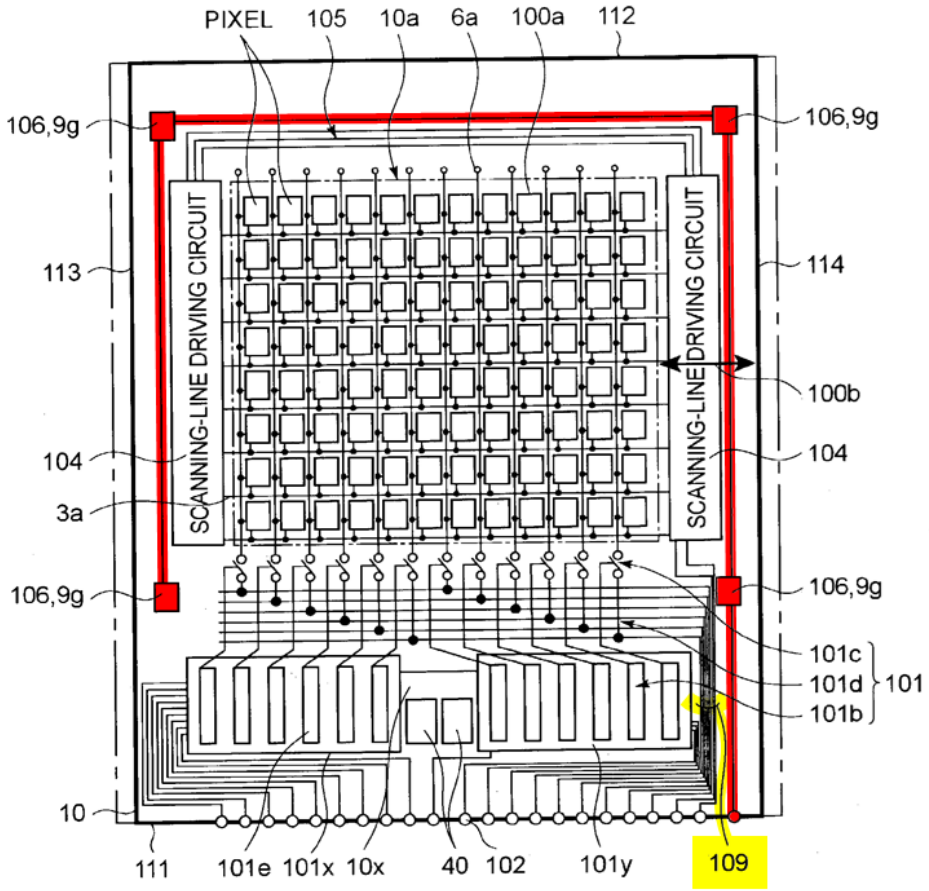
describe the material of which the line providing the counter potential DCCOM is made. *Id.* (citing Ex. 1007, Fig. 12, Fig. 19).

122. Dr. Sechen does not address that *Fujikawa*, in the sole quote Dr. Sechen relies on for the limitation "the plurality of main wiring lines being made of a same conductive film" in '390 claim 1, describes only "lines 109 . . . for driving a scanning-line driving circuit 101 and data-line driving circuits 104." Ex. 1007, ¶[0055]. This statement describes only those lines connected to the data-line driving circuit 101 and scanning-line driving circuits 104 (*Fujikawa* appears to erroneously invert the numbers 101 and 104 in its quote, as the rest of the disclosure consistently refers to the data-line driving circuit as "101" and the scanning-line driving circuits as "104"). *Id.* The statement relied on by Dr. Sechen does not describe any material used to make the wiring line connected to "[c]onductive electrodes 9g and conductive materials 106" that carries an electrical potential DCCOM. *Id.*

123. In fact, *Fujikawa* does not describe the material used to make the wiring line connected to connective electrodes 9g and conductive materials 106 anywhere in its disclosure.

124. Dr. Sechen also does not address Figure 2, which *Fujikawa* is describing in ¶[0055], and which Dr. Sechen relies on for this claim limitation. The prior paragraph of *Fujikawa* explains that it is describing Figure 2. Ex. 1007,

¶[0054]. *Fujikawa*'s written disclosure for Figure 2 expressly describes only "lines 109 made of, for example, a low-resistance metal film, such as an aluminum film, for driving a scanning-line driving circuit 101 and data-line driving circuits 104," and Figure 2 confirms that *Fujikawa* intends to describe only those lines, because it limits "lines 109" to lines connected to the data-line driving circuit 101 and scanning-line driving circuits 104:



Ex. 1007, Fig. 2 (emphasis added), ¶¶[0054]-[0055].

125. A POSITA would therefore recognize that *Fujikawa* teaches using a common material to make only the wiring lines connected to the data-line driving

circuit 101 and scanning-line driving circuits 104. A POSITA would recognize that *Fujikawa* does not teach what material to use to make the wiring line connected to connective electrodes 9g and conductive materials 106 to provide a counter potential DCCOM.

126. A POSITA would not interpret the indicator labeled "109" in Figures 12 or 19 of *Fujikawa* to imply making the wiring line providing a counter potential DCCOM of the same material *Fujikawa* describes for the wiring lines connected to the data-line driving circuit 101 and scanning-line driving circuits 104. *Fujikawa*'s written description of Figure 12 does not describe any material used to make any of the wiring lines. Ex. 1007, ¶¶[0087]-[0091]. It does not describe any material for the wiring line providing a counter potential DCCOM. *Id.* A POSITA therefore would not interpret the arc labeled "109" to broaden *Fujikawa*'s express teaching, with respect to Figure 2, of using a common material only for the wiring lines connected to the data-line driving circuit 101 and scanning-line driving circuits 104. *Fujikawa* describes Figure 19 as prior art that its alleged invention improves upon, *id.*, ¶¶[0003]-[0010], and therefore a POSITA would not interpret *Fujikawa*'s description of its alleged invention with respect to Figure 2 to also describe the content of the prior art illustrated in Figure 19.

127. A POSITA would recognize that other figures in *Fujikawa* indicate that *Fujikawa*'s descriptions of "lines 109" apply only to the wiring lines

connected to the data-line driving circuit 101 and scanning-line driving circuits 104. In particular, Figures 13, 14, and 15 of *Fujikawa* plainly identify, as "109," only lines connected to the data-line driving circuit 101 and scanning-line driving circuits 104. Ex. 1007, Figs. 13, 14, 15.

128. Dr. Sechen does not address these disclosures from *Fujikawa* or provide any evidence or reasoning to extend *Fujikawa*'s teaching of the material used to make the wiring lines connected to the data-line driving circuit 101 and scanning-line driving circuits 104 to also apply to the wiring line connected to connective electrodes 9g and conductive materials 106 to provide a counter potential DCCOM. Ex. 1002, ¶¶147-148.

129. Based on these teachings, not addressed by Dr. Sechen, a POSITA would recognize that *Fujikawa* does not satisfy the limitation, from '390 claim 1, "the plurality of main wiring lines being made of a same conductive film," because *Fujikawa* does not teach what material to use to make the wiring line providing a counter potential DCCOM.

130. Because *Fujikawa* does not satisfy all elements of claim 1 of the '390 patent, it also does not satisfy all limitations of claims 2-5, 7, 8, 11, and 13, which depend from claim 1. Ground 3 asserted in the Petition and by Dr. Sechen, therefore, does not teach all elements of any challenged '390 claim.

IX. ANALYSIS OF *MURADE II* AND THE COMBINATION OF *MURADE II* WITH EITHER *SUNAO* OR *KOMENO* (GROUNDS 4, 5)

131. Dr. Sechen opines that *Murade II* in combination with *Sunao* or *Komeno* renders obvious claims 1, 4-11, and 13 of the ’390 patent (Ground 4). I disagree with Dr. Sechen's conclusions regarding the combination of *Murade II* with either *Sunao* or *Komeno* for the reasons discussed below. These combinations do not teach all elements of claim 1 of the ’390 patent, and therefore they do not teach all elements of claims 4-11 and 13, which depend from claim 1.

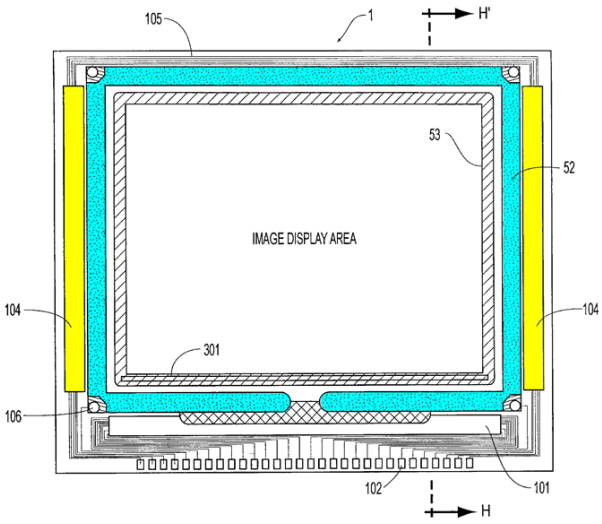
132. Dr. Sechen also opines that *Murade II* in combination with *Sunao* or *Komeno* and in further combination with *Murade III* renders obvious claims 2-3 and 12 (Ground 5). I disagree with Dr. Sechen’s conclusions regarding these combinations for at least the same reasons discussed below regarding the combination of *Murade II* with either *Sunao* or *Komeno*. These combinations do not teach all elements of claim 1 of the ’390 patent, and therefore they do not teach all elements of claims 2-3 and 12, which depend from claim 1.

A. Overview of *Murade II*

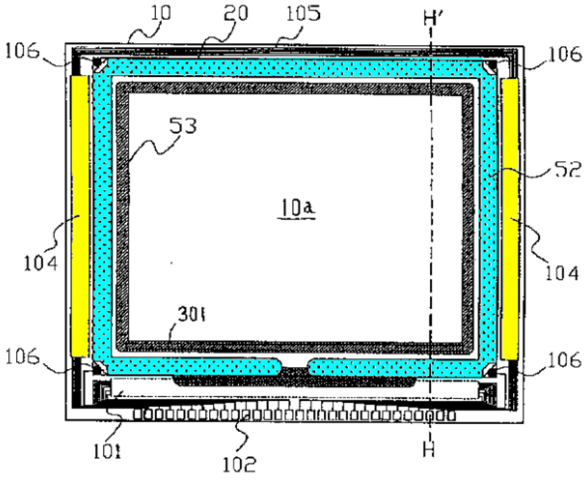
133. *Murade II* describes an LCD layout substantially the same as *Muraide* in terms of components relied on by the Petition and Dr. Sechen. Like *Muraide*, *Murade II* locates its scanning line driving circuits nearer the edge of the substrate

than the LCD seal and the vertical conductive terminals supplying a potential to a counter substrate.

***Murade II*, Fig. 12 (Ex. 1008)**



***Muraide*, Fig. 11 (Ex. 1005)**



Ex. 1008, Fig. 1, Fig. 2, Fig. 4, Fig. 5, Fig. 12 (emphasis added), Fig. 13, 13:61-67, 14:4-10, 14:35-39, 30:64-31:15, 31:39-58; Ex. 1005, Fig. 4, Fig. 11 (emphasis added), Fig. 12, ¶[0106].

134. Like *Muraide*, the edge of *Murade II*'s counter substrate (called "opposite substrate") aligns with the edge of the LCD seal, and so the vertical conductive terminals must reside nearer the pixel display region than the scanning line driving circuits outside the seal. Ex. 1008, Fig. 1, Fig. 2, Fig. 4, Fig. 5, Fig. 12, Fig. 13, 13:61-67, 14:4-10, 14:35-39, 30:64-31:15, 31:39-58.

***Murade II*, Fig. 13 (Ex. 1008)**

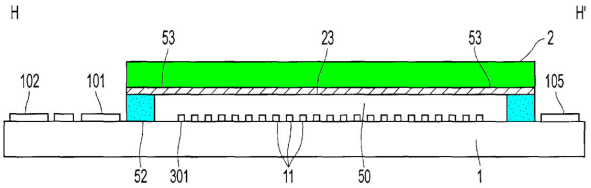
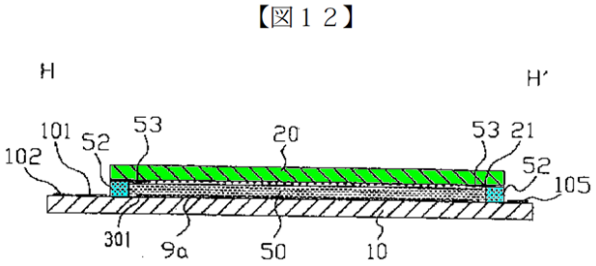


FIG. 13

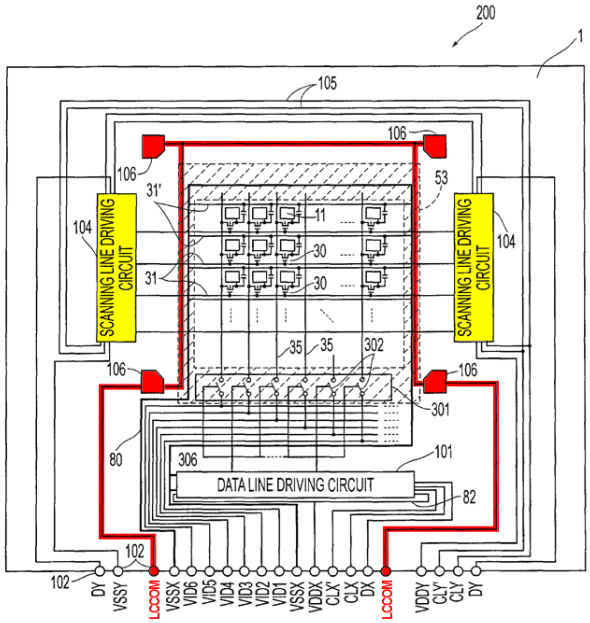
***Muraide*, Fig. 12 (Ex. 1005)**



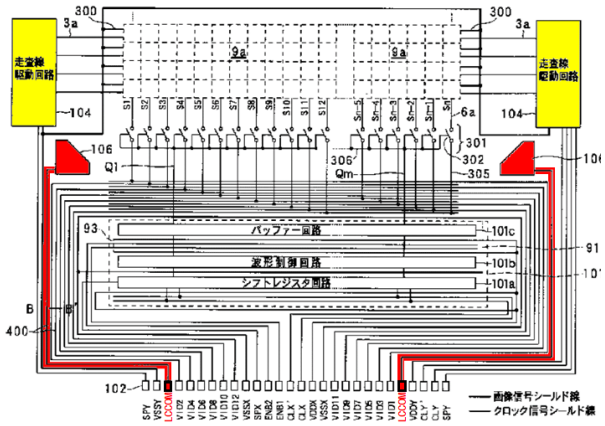
Id., Fig. 1 (emphasis added), Fig. 2, Fig. 4, Fig. 5, Fig. 12, Fig. 13 (emphasis added), 13:61-67, 14:4-10, 14:35-39, 30:64-31:15, 31:39-58; Ex. 1005, Fig. 4 (emphasis added), Fig. 11, Fig. 12 (emphasis added), ¶[0106].

135. Accordingly, like *Muraide*, *Murade II* locates its counter potential terminal LCCOM and corresponding wiring line farther from the edge of the substrate than the lines supplying the scanning line driving circuits, including DY, VSSY, VDDY, CLY', and CLY.

***Murade II*, Fig. 1 (Ex. 1008)** ***Muraide*, Fig. 4 (Ex. 1005)**



【図4】



Ex. 1008, Fig. 1, Fig. 2, Fig. 4, Fig. 5, Fig. 12, Fig. 13, 13:61-67, 14:4-10, 14:35-39, 30:64-31:15, 31:39-58.

B. The teachings of *Murade II* alone or a combination of the teachings of *Murade II* with the teachings of *Sunao* or *Komeno* would not satisfy all elements of claim 1 of the '390 patent.

i. Modifying *Murade II* to place the wiring line used to supply a counter potential LCCOM nearer the edge of the TFT substrate than other wiring lines would result in intersections among main wiring lines.

136. Dr. Sechen relies on his analysis for *Muraide*, alone or in combination with *Sunao* or *Komeno*, discussed above, for his analysis of *Murade II* and similar combinations. Ex. 1002, ¶¶190-195. Dr. Sechen does not introduce any new

evidence or analysis from *Murade II*, compared to *Muraide*, for this claim limitation. *Id.*

137. Thus, for the reasons I discuss above with respect to *Muraide*, *Sunao*, and *Komeno*, a POSITA would recognize that *Murade II* alone or the combination of *Murade II* with alleged disclosures of counter electrode potential lines closest to the edge of the TFT substrate (either as an alleged "mere design choice" or as allegedly disclosed in *Sunao* and *Komeno*) would not satisfy the limitations, from '390 claim 1, "the plurality of main wiring lines . . . being planarly laid out so as not to intersect each other in the peripheral region" and "the counter electrode potential line being closest to edges of the element substrate, among the plurality of main wiring lines."

138. Dr. Sechen does not assert that *Murade II* discloses the limitation "the counter electrode potential line being closest to edges of the element substrate, among the plurality of main wiring lines" in '390 claim 1. Ex. 1002, ¶¶190-195. Instead, Dr. Sechen contends that "[i]t is a simple design choice to locate the counter electrode potential line nearer to the edge than the scanning line drive circuit that does not change any property or characteristics of the wiring layout" *Id.* ¶190.

139. Dr. Sechen suggests modifying *Murade II*'s display device solely by locating a counter electrode potential line "closest to the edge of the substrate with

Murade II's display device." Ex. 1002, ¶192 (relying on modification based on *Sunao*), ¶194 (relying on modification based on *Komeno*).

140. Dr. Sechen does not address several teachings from *Murade II* that would indicate to a POSITA that relocating *Murade II*'s counter electrode potential line to be "closest to edges of the element substrate" would not satisfy the limitations of '390 claim 1.

141. In particular, claim 1 of the '390 patent recites that "the plurality of main wiring lines," including "a counter electrode potential line," must be "planarly laid out so as not to intersect each other in the peripheral region." Ex. 1001, 22:1-12. Second, claim 1 recites that "the counter electrode potential line" must be "closest to edges of the element substrate, among the plurality of main wiring lines." *Id.*

142. Modifying *Murade II* by relocating *Murade II*'s counter electrode potential line to be "closest to edges of the element substrate" would not satisfy these limitations, because other elements of *Murade II*'s design, which Dr. Sechen does not address, would result in the claimed "main wiring lines" crossing in the modified design.

143. Dr. Sechen does not address *Murade II*'s teachings that (1) the boundary of the counter substrate in *Murade II* is aligned with the LCD seal separating the pixel display region from a peripheral region; and (2) the scanning

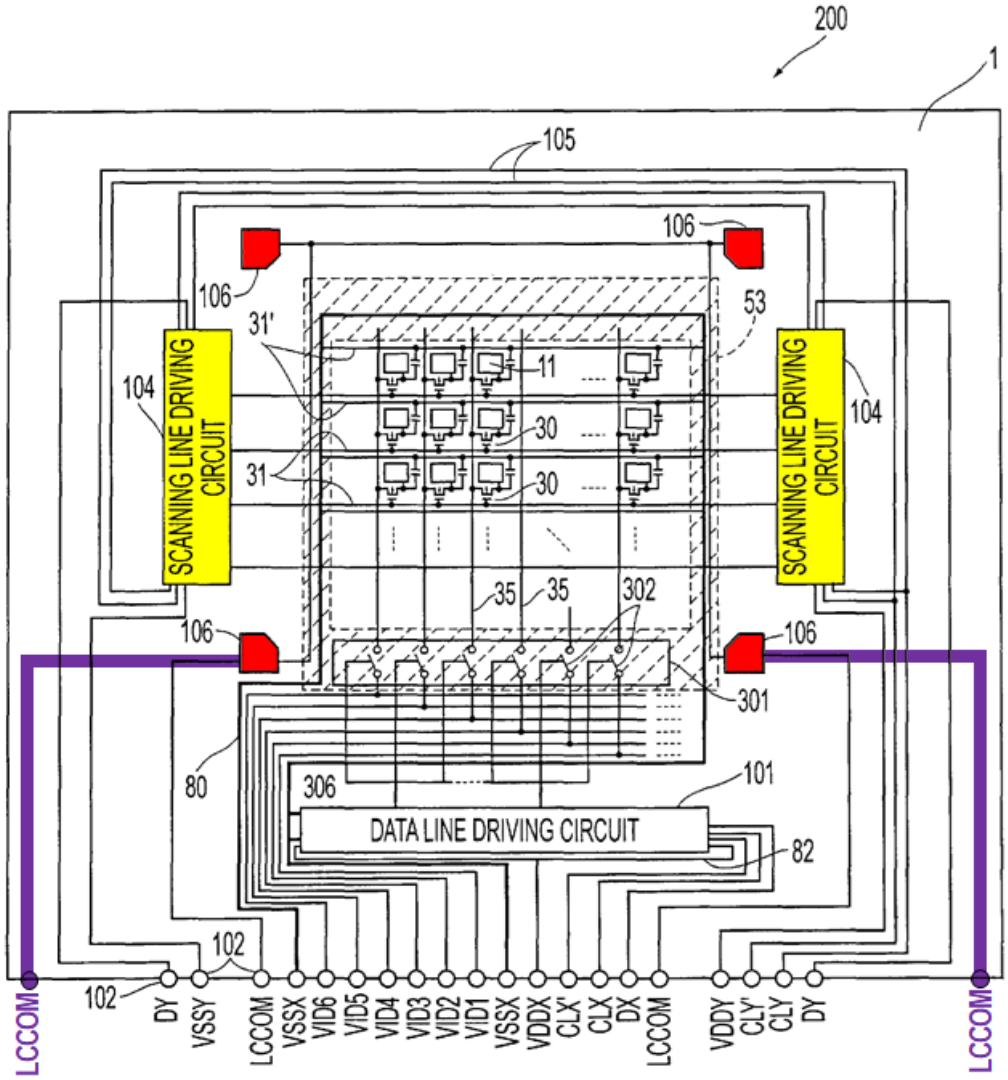
line driving circuits in *Murade II* are placed entirely outside the LCD seal in plan view. Ex. 1008, Fig. 1, Fig. 2, Fig. 4, Fig. 5, Fig. 12, Fig. 13, 13:61-67, 14:4-10, 14:35-39, 30:64-31:15, 31:39-58. That is, the counter substrate in *Murade II* does not extend, in plan view, over the scanning line driving circuits. *Id.*

144. The counter substrate in *Murade II* must have an electrical connection to the TFT substrate (the opposite substrate on which wires and circuitry such as the scanning line driving circuit, data line driving circuit, and TFTs driving pixel electrodes are formed), because the input signals and voltages are provided to terminals on the TFT substrate. Ex. 1008, Figs. 1-3, 19:45-50. For the counter electrode to carry an electrical potential, it needs to receive it from the TFT substrate and so needs to connect electrically to the TFT substrate. *Id. Murade II* accomplishes this with vertical conductive terminals ("upper-to-lower conducting elements 106") that provide the electrical connection to carry an electrical potential from the TFT substrate to the counter substrate. *Id.*

145. In *Murade II* the counter substrate extends only to the edge of the LCD seal and not as far as the scanning line driving circuits in the peripheral region. Ex. 1008, Fig. 12, Fig. 13, 30:64-31:15, 31:39-58. The vertical terminals to carry a counter potential to the counter substrate in both references therefore must also be within the LCD seal region and cannot be placed in the peripheral region, such as closer to the edge of the TFT substrate than the scanning line driving

circuits. *Id.*, Fig. 1, Fig. 2, Fig. 4, Fig. 5, Fig. 12, Fig. 13, 13:61-67, 14:4-10, 14:35-39, 30:64-31:15, 31:39-58.

146. The necessary placement of the vertical conductive terminals in *Murade II*—nearer to the center of the TFT substrate than the entirety of the scanning line driving circuits—means that modifying *Murade II* to include a counter potential line closer to the edge of the TFT substrate than any of the lines for supply the scanning line driving circuits would require those lines to cross. Ex. 1008, Fig. 1, Fig. 2, Fig. 4, Fig. 5, Fig. 12, Fig. 13, 13:61-67, 14:4-10, 14:35-39, 30:64-31:15, 31:39-58. For example, in the hypothetical modified *Murade II* figure (Figure 1) below, the counter potential terminal and line LCCOM are (hypothetically, for illustration) placed nearer the edge of the TFT substrate than the lines supplying the scanning line driving circuits 104—DY, VSSY, VDDY, CLY', and CLY. In this arrangement, LCCOM must cross all those lines to reach the vertical conductive terminals 106. *Id.*



Ex. 1008, Fig. 1 (yellow and red emphasis added; purple modifications added).

Even if LCCOM was placed closer to the edge of the substrate than one of the supply lines for the scanning line driving circuit, such as VSSY, LCCOM would still have to cross that line to reach the vertical conductive terminal 106. *Id.*

147. Dr. Sechen does not address the teachings from *Murade II* about the location of the counter substrate that necessitate placement of the vertical

conductive terminals closer to the center of the TFT substrate than the scanning line driving circuit. Dr. Sechen assumes, without any evidence, that "to locate the counter electrode potential line nearer to the edge than the scanning line drive circuit" is "a simple design choice." Ex. 1002, ¶190. Dr. Sechen further assumes, without evidence, that this modification "does not change any property or characteristics of the wiring layout." *Id.*

148. Dr. Sechen does not address at all whether the proposed modification of *Murade II* by moving the counter potential line LCCOM would still satisfy the limitation of '390 claim 1 "the plurality of main wiring lines . . . being planarly laid out so as not to intersect each other in the peripheral region." Ex. 1002, ¶¶187-195. Dr. Sechen instead relies only on *Murade II*'s existing disclosure in which lines do not intersect, *id.* ¶¶187-189, and, apparently, assumes without evidence or analysis that the lines still would not intersect even after moving them around.

149. I disagree with Dr. Sechen's assumptions and conclusions, based on the teachings of *Murade II* discussed above, which Dr. Sechen does not address. Simply moving *Murade II*'s counter electrode potential line LCCOM and its corresponding conductive terminal 102 closer to the edge of the TFT substrate would require LCCOM to cross at least one wiring line for the scanning line driving circuit to supply a counter potential to the counter substrate. That change would certainly "change any property or characteristics of the wiring layout," in a

way that does not satisfy claim 1 of the '390 patent because the modified layout would not satisfy the limitation "the plurality of main wiring lines . . . being planarly laid out so as not to intersect each other in the peripheral region."

150. In addition, *Sunao* does not teach the location of a counter potential line relative to any other wiring lines, including wiring lines supplying scanning line driving circuits or a data line driving circuit. Ex. 1006, ¶[0018], Fig. 3. *Sunao* illustrates only one line: "counter electrode potential wirings 27." *Id.* It does not illustrate any other lines. *Id.* A POSITA therefore would recognize that *Sunao* does not disclose, as Dr. Sechen suggests, "a counter electrode potential line that has been designed to run along the outer edge of an array substrate," Ex. 1002, ¶71, ¶¶191-192, because this assumes the relative locations of other lines that *Sunao* does not disclose.

151. Also, *Komeno*, like *Murade II*, describes a counter electrode that extends only to the edges of the LCD seal and scanning line driving circuits (called "gate line driving circuits" "GDR1" and "GDR2") fully outside the LCD seal in a peripheral region of the TFT substrate. Ex. 1009, ¶¶[0103]-[0104], Fig. 1. Dr. Sechen does not address this teaching. *Komeno* therefore does not suggest modifying *Murade II*'s placement of scanning line driving circuits outside the LCD seal, and accordingly outside the vertical conductive terminals.

152. Based on these teachings, not addressed by Dr. Sechen, a POSITA would recognize that *Murade II* alone or the combination of *Murade II* with alleged disclosures of counter electrode potential lines closest to the edge of the TFT substrate (either as an alleged "mere design choice" or as allegedly disclosed in *Sunao* and *Komeno*) would not satisfy the limitations, from '390 claim 1, "the plurality of main wiring lines . . . being planarly laid out so as not to intersect each other in the peripheral region" and "the counter electrode potential line being closest to edges of the element substrate, among the plurality of main wiring lines."

153. Because the combinations asserted by the Petition and Dr. Sechen do not satisfy all elements of claim 1 of the '390 patent, they also do not satisfy all limitations of claims 2-13, which depend from claim 1. Neither Ground 4 nor Ground 5 asserted in the Petition and by Dr. Sechen, therefore, teach all elements of any challenged '390 claim.

X. ADDITIONAL REMARKS

154. I reserve any right that I may have to supplement this declaration if further information becomes available or if I am asked to consider additional information or to submit an additional declaration if *inter partes* review is instituted. Furthermore, I reserve any right that I may have to consider and comment on any additional expert statements and testimony of Petitioner's witnesses in this matter.

155. I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

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Date: June 7, 2023



Michael Lebby, Ph.D.

Appendix A

ATS Expert Witness Search
408.828.9000
experts@atsexpertsearch.com

Michael Lebby, D. Eng.

EDUCATION:

2004, Doctor of Engineering (D. Eng.)
University of Bradford, United Kingdom
Citation, "*Technical Contributions to Optoelectronics"*
(NB: This is a higher doctorate awarded on technical contribution to the field)

1987, Ph.D.
University of Bradford, United Kingdom
Thesis, "*Characterization and Fabrication of the HFET and BICFET"*

1985, MBA
University of Bradford, United Kingdom
Thesis, "*Small Business Planning for a Start-up"*

1984, Bachelors (B. Eng. – Honours)
University of Bradford, United Kingdom
Thesis, "*Computer Aided Testing of Semiconductor Devices"*

SUMMARY OF TECHNICAL EXPERTISE:

Industry roles (majority of career): Dr, Lebby has founded and led several companies in various positions including CEO and CTO (Ignis Optics, Oculi, One Chip Photonics, OIDA, Translucent Photonics, and Lightwave Logic). Dr. Lebby is currently Chairman & CEO of a public company (Lightwave Logic Inc. NASDAQ:LWLG). As CEO, Dr. Lebby led LWLG from an OTCQB company to OTCQX, and then to up-list on NASDAQ, organically, without raising financing (which is extremely rare), on 1st September 2021. Subsequently, Dr. Lebby was invited to 'ring the bell' and close the NASDAQ stock market for ethe week on 10th September 2021. The event was carried live on Fox, CNBC, Bloomberg, and BNN networks. On 1st September 2022, Lebby was elected Chairman of Lightwave Logic Inc.

Academia role (minor part of career): Dr. Lebby has been a full professor (part-time) in optoelectronics at Glyndŵr University, Wales, UK (2013-15). Dr. Lebby has over 60 publications and has a google scholar h-index = 46 (which includes issued patents and published patent applications), i10-index = 165, with over 8400 citations.

Key professional bodies: Dr. Lebby is a chong of the National Academy of Inventors (NAI), the IEEE (Institute of Electrical and Electronic Engineers), and the OSA (Optical Society of America). Dr. Lebby is a Chartered Engineer of the British Institute of Electrical Engineers (roughly equivalent to the professional engineer status in USA).

Dr. Lebby started work in telecommunications industry and has generated over 40 years of experience in a number of technical disciplines and technologies. Dr. Lebby is well versed in electronics, semiconductor physics, optoelectronics, optics, materials, packaging, module design, ICs and electrical engineering in general. Dr. Lebby has experience in commercial and industrial research of technologies such as silicon, compound semiconductors, manufacturing, fabrication, design, simulation, testing, evaluation, reliability, qualification of new ideas, concepts and products.

Dr. Lebby is co-inventor of the world's first 'oxide VCSEL' (this is a type of semiconductor laser) that is now being utilized for consumer applications (*Face ID of Apple's iPhone as an example, laser mice for PCs as another example*). US Patent #5359618 "High Efficiency VCSEL and Method of Fabrication" issued 25th October 1994. Estimated commercial volumes of this semiconductor device exceed many billions of units.

Dr. Lebby has over 230 issued utility patents with the USPTO in subjects such as electronics, optoelectronics, photonics, packaging, transceiver modules, optical sub-assemblies, materials, epitaxial growth, device design, assembly, and various active and passive components (both electronic and optoelectronic). Dr. Lebby regularly

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receives invites to speak at technical conferences as well as banking and financial conferences. Dr. Lebby has appeared in panels and interviews many times and regularly is communicating with the public on various platforms. Dr. Lebby is currently chairman of the International PIC conference based in Europe (since it's conception in 2015). Dr. Lebby is inventor or co-inventor of ~230 issued USPTO utility patents (or over 450 if international derivatives are included), as well as over 80 published patent applications.

Dr. Lebby has participated in over 130 patent litigation cases as a technical expert witness, including over 20 trials and over 50 depositions. Dr. Lebby has authored numerous expert reports and is familiar with State (District), Federal (ITC) and PTAB-IPR court processes for expert witness testimony. Dr. Lebby has been cited in patent litigation case history (ITC investigation in the matter of: Certain Active Optical Cables and Products Containing the Same (ITC Inv #337-TA-1233)). See details below in Expert Witness Experience.

The types of products that Dr. Lebby understands and includes but are not limited to; Light Emitting Diodes (LEDs), Laser Diodes (LDs), photodetectors (PDs), optical waveguides, fiber optics, displays (LCD, LED, OLED), lighting luminaires, plastic photonics, optical polymers, sensors, LIDAR, solar cells, lighting, data communication, CMOS, and even new opportunities such as medical and life science applications for photonics. Dr. Lebby is internationally known for his work with integrated photonics, PICs (Photonic Integrated Circuits), silicon photonics, and semiconductor technologies such as InP, GaAs, III-GaN, silicon, as well as SiGe and silicon ICs (MOSFETs, FinFETs, bipolar), power FETs, RF FETs, various display technologies such as LCD, OLED, LED, cameras, as well as micro-fluidics and nanostructures/wires etc. Dr. Lebby has worked with DC current as well as AC current, high frequency design, microwave design, and multi-wavelength, visible wavelengths, in addition to 850nm/1310nm/1500nm/NIR fiber optic communications. Dr. Lebby has worked extensively in fiber optics which includes Fiber based systems, chassis', trays, modules, adapters, splice devices, connectors, transceivers, packaging as well as architecture and optical communication standards/protocols.

Dr. Lebby is currently CEO of a public company (Lightwave Logic Inc. NASDAQ:LWLG). As CEO, Dr. Lebby took LWLG from an OTCQX company to up-list on NASDAQ, organically, without raising financing (which is extremely rare). LWLG was listed on NASDAQ 1st September 2021, and Dr. Lebby was invited to close the NASDAQ stock market on 10th September 2021 and "ring the bell". The event was carried on Fox, CNBC, Bloomberg, and BNN networks.

BIOGRAPHY:

Biography: Michael S. Lebby joined Lightwave Logic as a member of the Board of Directors in 2015. In May 2017, Dr. Lebby assumed the role of CEO, and in September 2022, Chairman and CEO of Lightwave Logic Inc (NASDAQ:LWLG). Lightwave Logic is a technological company commercializing Electro-Optical polymers and successfully up listed the company to NASDAQ on 1st September, 2021. Dr. Lebby was invited to close the NASDAQ stock market on 10th September 2021. The event was carried on Fox, CNBC, Bloomberg, BNN networks.

Dr. Lebby (born 1961, London, UK) is an Anglo-American entrepreneur and intrapreneur in the fields of optoelectronics/photonics electronics and semiconductors. Dr. Lebby's career started with the British Government in 1977 in telecommunications and he did research at their research labs (RSRE Malvern) in the early 1980s. Dr. Lebby worked at AT&T's research labs: Bell Labs (1985-1989) in photonics, and subsequently drove the development (and co-authored the first patent) of the oxide VCSEL diode laser at Motorola in the 1990s (which is now used in laser mice, 3D structured light sensing/FaceID in mobile phones, optical interconnects; where volumes of the laser are over 1B units today). From 2005-2010 he led the USA trade association in optoelectronics (OIDA) and represented the optoelectronics and photonics industry on Capitol Hill.

Dr. Lebby has led and run technical start-ups and commercialized optoelectronic and photonics technology into volume manufacturing. Dr. Lebby has also had roles as a Venture Capitalist specializing in Optical Communications. He is currently a technical expert to the European Commission. He is a Fellow member of NAI (National Academy of Inventors), IEEE, and OSA, and has been voted PIC (Photonic Integrated Circuit) business leader of the year by the PIC International Conference in 2018.

Dr. Lebby holds over 450 issued international patents in photonics and electronics, that have been derived from over 230 issued USPTO utility patents, mostly in the field of optoelectronics, photonics, and semiconductors. He has been cited by the USPTO to be in the most prolific 75 inventors in USA from 1988-1997.

Dr. Lebby is passionate about photonics and has focused his efforts over the last 30years to drive new photonics manufacturing programs in USA and Europe as well as industry-based photonics technology roadmaps.

Dr. Lebby is also passionate about optics and philately, and has been elected to both the London Guild of Spectacle Makers as well as the Royal Philatelic Society London.

WORK HISTORY:

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2003 – Present **Oculi LLC,** *CEO and CTO (part-time consulting)*

Oculi LLC provides consulting in expert witness, trial, deposition, expert reports, infringement, invalidity, and various patent and IP litigation in photonics, optoelectronics, semiconductors, and fiber optic telecommunication technology segments. Engaged patent agencies have included: IMS Expert Services, Thomson Reuters Expert Witness Services (now Round Table Group), LitXpert Expert Witness Group, Teklicon Expert Witness Agency, Beche Expert Services Group, Forensis Group: Expert Witness Services, and Expertconnect. Oculi LLC also provides consulting to Ambature Inc. in superconductivity.

2015 – Present **Lightwave Logic (NASDAQ:LWLG)***, Chairman, CEO, & Director, Board of Directors*

In 2015 Dr. Lebby became a director of Lightwave Logic to assist in the company for competitive optical modulator products and associated packaging, manufacturing, and technology roadmaps/marketing. In May 2017, Dr. Lebby became CEO of Lightwave Logic. On 1st September 2021, Dr. Lebby successfully guided Lightwave Logic to up-list to NASDAQ, and was invited to ring the closing bell on 10th September 2021. The NASDAQ up-list was organic i.e. no reverse split, no raised funds. The organic up-list is considered very rare in the financial industry. In September 2022, Lebby became Chairman and CEO of Lightwave Logic Inc.

2014 – 2016 **University Southern California,** *Director CFR (Corp & Foundation Relations)*

Dr. Lebby assisted USC Viterbi Engineering to foster tighter faculty-industry relationships in high technology, IT, social media, graphic arts, electronics, photonics (solar, display, medical) and fiber communications segments.

2013 – Present **European Commission***, Technical Expert*

In 2013 Dr. Lebby became a technical expert for the Photonics Unit of the European Commission. Dr. Lebby has participated in organizing workshops, lectures, evaluating photonics proposals, and advising the Commission on funded projects. Dr. Lebby currently is an advisor on 7 photonics pilot lines (MIRPHAB, PI-SCALE, PIX4LIFE, PIXAPP, InPULSE, Phabulous, PhotonHub) and photonics based cardiovascular disease programs (CARDIS and InSide). More recently, Dr. Lebby has been consulting on larger framework (multi-country) projects that include electronics (power/RF) as well as photonic based technologies. Work includes displays, LEDs, lighting/LED luminaires, OLEDs, micro-optics, InP/Silicon photonics, near infra-red technologies, fiber optics, sensing, medical photonics, and medical imaging, technology roadmapping, electronics, IC design etc.

2013 – 2015 **OneChip Photonics Corporation***, President and CEO*

In 2008 Dr. Lebby was elected independent board member for One Chip Photonics Inc. He was elected CEO in 2013. One Chip Photonics focused on technical and business operational strategy for communications based InP Photonic Integrated Circuit (PIC) and optoelectronic Integrated Circuit (OEIC) platforms.

2013 – 2015 **Glyndŵr University***, Professor, Chair of Optoelectronics*

In 2013 Dr. Lebby became full Professor of Optoelectronics (part-time) to assist Glyndwr University to position itself as a leader in optoelectronics and photonics. Areas of focus include design, simulation, and testing of photonic integrated circuits (PICs) and optoelectronics integrated circuits (OEICs), laser diodes, displays, optics, and solar cells.

2010 – 2013 **Translucent, Inc.,** *GM and CTO*

Dr. Lebby positioned Translucent on the product development and manufacture of epitaxial semiconductor wafers for the solar, power and lighting industries. Dr. Lebby led the R&D and development of MBE based rare earth oxide single crystal epitaxial layers deposited onto large silicon wafers. On top of these wafers both

MBE and MOCVD Gallium Nitride epitaxial device layers were grown for devices. The use of GaN-on-Si is expected to be a strong catalyst for change in the power electronics and LED lighting industries. In a parallel program at Translucent, Dr. Lebby led the development efforts to develop and productize Germanium-Tin (GeSn) template wafers onto large format silicon wafers (Ge-on-Si) to enable cost effective, and ultra-high efficiency multi-junction solar cells for the CPV industry. Areas of advanced interconnect using new and novel material compounds were explored.

2005 – 2010 **OIDA** (Optoelectronic Industry Development Association)**,** *Executive Director, President, and CEO (Board Member)*

Dr. Lebby represented the optoelectronics industry and organized technical conferences/workshops/forecasts with industry roadmaps. Initiated green photonics metrics. Dr. Lebby positioned OIDA as a national resource in the field of optoelectronics and has represented industry in many capacities ranging from talks, papers, expert witness, testimony, market and technical reports. Dr. Lebby created ***new industry-based initiatives*** in fiber optics broadband as well as the green photonics movement (solar technologies, displays, LED lighting technologies) that is now occurring globally.

2003 – 2005 **OCLARO,** *VP Technology and Business Development*

Telecommunication optoelectronic components, San Jose, Ca. Focus on technology strategy for components and sub-systems.

2001–- 2003 **Ignis Optics,** *President and CEO (Founder/Board Member)*

Venture-backed start-up, San Jose, California manufacturing 10Gbps and OC192/OC48 fiber optic transceivers with micro-controllers using the XFP form-factor.

1999 – 2001 **Intel Capital,** *Director Business Development/Investor (w/Board observer positions on Investment)*

Intel Capital, Santa Clara, California. In 1999, Dr. Lebby joined Intel as a corporate investor and was responsible for sourcing, negotiating, and closing private placement equity deals in the optical networking, component, display, projection technologies, LED lighting, LED luminaires, and semiconductor arenas.

1998 – 1999 **TE Connectivity,** *Director Technology/BD (Fiber Optics)*

Global Optoelectronics Division: Technology strategy for optical communications products.

1989 – 1998 **Motorola,** *R&D Manager*

Corporate R&D Labs, Tempe, Arizona. Optoelectronics: VCSEL based product solutions (OPTOBUS); materials, devices, packaging, systems. Other technologies included displays, field emission, LED, LCD, OLED, virtual/micro and projection. At the time, Dr. Lebby was also the lead inventor in Motorola's history with over 150 issued utility patents. Dr. Lebby worked in the silicon and compound semiconductor fabrication plants (fabs) to become proficient in deposition/etching/alignment tooling as well as design and simulation.

1985 – 1989 **AT&T,** *Researcher*

AT&T Bell Labs - Photonics Research Dept (Dept 11366), Holmdel, NJ. Dr. Lebby designed and fabricated new GaAs and InP optoelectronic and electronic devices that were grown both by MOCVD and MBE for projects that included optical computing and fiber optic communications.

1977 – 1984 **UK Ministry of Defense,** *Apprenticeship/Journeyman + Electronics Engineer (REME – Royal Electrical and Mechanical Engineers, and RSRE – Royal Signals and Radar Establishment)*

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Dr. Lebby started his career at the Royal Electrical and Mechanical Engineer (REME) division of the Ministry of Defence in the UK. Lebby was a telecommunications apprentice, and repaired all types of radio/RF communications equipment. Lebby qualified as a fully qualified Journeyman or Apprentice specializing in telecommunications in 1980. Dr. Lebby moved to the Royal Signal and Radar Establishment (RSRE) to study material and characterization issues of GaAs and InP devices.

SELECTED PROFESSIONAL ACTIVITIES & AWARDS:

- Elected Chairman of Lightwave Logic Inc., NASDAQ:LWLG 1st September 2022
- Elected to the Corporate Engagement Council (newly formed OIDA to represent the global optical industry) for Optica in June 2022.
- Invited to ring the closing bell of NASDAQ (with associated TV interviews) on 10th September, 2021
- Elected Fellow of the **National Academy of Inventors** (NAI) in 2020.
- Voted winner at the PIC Conference (Photonic Integrated Circuits) as PIC **Entrepreneur and Business Leader of the Year** (March 2018).
- Dr. Lebby is **co-inventor of the oxide VCSEL** (semiconductor laser) that is now being utilized for consumer applications (*Face ID of Apple's iPhone as an example*). US Patent #5359618 "High Efficiency VCSEL and Method of Fabrication" issued 25th October 1994.
- Dr. Lebby was recognized professionally as a **Fellow of IEEE (2005) and OSA (2007)** with his technical contributions to the field of optoelectronics.
- Dr. Lebby is a member of the Fellows review committee of IEEE.
- As an inventor Dr. Lebby has achieved **>230 issued utility patents with the USPTO.**
- As an inventor Dr. Lebby has ~80 published utility patent applications with the USPTO
- As an inventor Dr. Lebby has over 450 issued patents world-wide if international derivatives are counted.
- Dr. Lebby's novel laser-based device, packaging, modules designs led Motorola to sell their patent portfolio independently where a number of the patents have "very high licensing coefficients." Dr. Lebby was given a special award from the Chairman of Motorola for exemplary patent invention accomplishments in 1998 and **# 1 prolific inventor in Motorola's history**.
- **Over 60 publications**
- **Over 300 public media activities** (that include: Books, Chapters, Reports, Abstracts, Videos, Lectures, Speeches, Reviews, Courses, Talks, Invited Talks, Keynote Talks, Plenary Talks, Webinars, Interviews, Articles, etc.).
- Author of OIDA's **annual market optoelectronics report** and forecast (2009 version is over 600 pages), which receives international exposure and recognition. Regularly interacts with government agencies in Washington DC on photonics-based projects (DARPA, ARPA-E, NIH, NSF, DOE, NIST, DoD etc.). Typical chapters included: LEDs, laser diodes, fiber optic communications, sensors, displays, solar, green photonics, military photonics, and applications of photonics such as solid-state lighting (LED luminaires), automotive, medical, etc.
- Is the recipient of a **2nd doctorate** (higher) from Bradford University, UK, and only the second in the universities history to receive a D.Eng from industry (rest being academia).
- **Intrepreneur** at: (i) Motorola: Co-founded Optobus division – VCSEL laser based parallel optical interconnect solution, and (ii) Intel: Co-founded the Intel optics division for silicon photonics where over $300M was initially invested for the division.
- **Entrepreneur**: Founded (and CEO) Ignis Optics Inc., a venture backed company (>$30M) that designed and manufactured 10Gbps fiber optic transceivers. Sold the company to Bookham (NASDAQ: BKHM) in 2003. Restructured OneChip Photonics (as CEO) through bankruptcy, and new VC-based funding. Assisted in the raising of >$50M VC funding as a member of BoD. Founded Oculi LLC and Obsidian Motors LLC.
- IEEE CPMT **Board of Governors** ('98- '02); IEEE Phoenix Waves and Devices Junior Engineer of the Year (1993); CPMT Distinguished lecturer (2000), CPMT technical committee (TC-10 & ECTC) 1991 to 2011
- Advised at **Board of Director** level for a number of technical start-ups
- **Chartered Engineer** (C.Eng) from IEE (UK). The chartered engineering status is equivalent to the US PE (professional engineer)

EXPERT WITNESS EXPERIENCE

Summary:
Depositions (total-to-date) >50
Trial/Hearing/Court appearances >20 (with IPR/PTAB 'paper trial', this total increases to >25)

Cited patent litigation case history: In essence, the following case history means that the expert doesn't have to disclose every minute detail in his expert report. He is allowed to disclose theories in the report and expand on them in his witness statement.

See also In The Matter Of Certain Light-Emitting Diode Products, Systems, And Components Thereof, Inv. No. 337-TA-1168, Order No. 34, 2020 WL 1026335 (Feb. 14, 2020) (denying motion *in limine* to preclude testimony where: "[t]he invalidity theories at issue were previously disclosed at least in Dr. Lebby's expert report, and LSG had the opportunity to test these theories at Dr. Lebby's deposition.")

See case # 81 below

Patent litigation cases engaged:

1. Active case work: 1Q2009 (March 24th 2009); *Testimony: US-China Economic and security review commission on the optoelectronics industry. US Congress, Capitol Hill;* Written statement on the status of the USA optoelectronics industry with aural cross-examination by the commission. Trial experience.
    a. Deposition: 0 (Cumulative total: 0)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 1)
    c. Technology: Optoelectronics (optical storage, fiber optic communications, sensors, high power lasers, LED lighting, LED luminaires etc.).
2. Active case work: 3Q2010-1Q2011; *Finisar Corp. v. Optical Communication Products Inc.*, No. 10-CV-05617 and No. 11-cv-00104 (retained by plaintiff - Morgan, Lewis & Bockius LLP).
    a. Deposition: 0 (Cumulative total: 0)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 1)
    c. Technology: semiconductor lasers/VCSELs, fiber optic transceiver modules
3. Active case work: 1Q2011; *Ziptronix, Inc. v. OmniVision Technologies, Inc., Taiwan Semiconductor Manufacturing Company Ltd., and TSMC North America Corp.,* No. 11-CV-5235 (retained by plaintiff – Alston Bird LLP).
    a. Deposition: 0 (Cumulative total: 0)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 1)
    c. Technology: CMOS image sensors; design and fabrication
4. Active case work: 3Q2011 to 3Q2012; *Certain Light-Emitting Diodes and Products Containing Same*, Inv. No. 337-TA-798 (USITC filed July 15, 2011) (retained by respondent Samsung – Covington & Burling LLP). Deposition (x2) and trial experience.
    a. Deposition: 3 (Cumulative total: 3)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 2)
    c. Technology: LEDs, device design, color gamut, packaging, optical lensing, lead frames, surface mount packaging.
5. Active case work: 3Q2011 to 2Q2015; *Cheetah Omni, LLC v. Alcatel-Lucent USA Inc.*, No. 11-CV-390 (E.D. Tex. filed July 29, 2011) (retained by plaintiff – Brooks Kushman). Deposition experience (x2).
    a. Deposition: 1 (Cumulative total: 4)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 2)
    c. Technology: Fiber optic networks, optical switches, ROADMs and optical filters (dielectric based).
6. Active case work: 4Q2012 to 3Q2014**;** *Finisar Corp. v. Cheetah Omni, LLC*, No. 11-CV-15625 (E.D. Mich. filed Dec. 23, 2011) (retained by defendant – Brooks Kushman). Deposition experience (x1).
    a. Deposition: 1 (Cumulative total: 5)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 2)
    c. Technology: Wavelength optical switches, optical filters, and optical components, liquid crystal technology.
7. Active case work: 4Q2012 to 3Q2013**;** *Certain Optoelectronic Devices for Fiber Optic Communications, Components Thereof, and Prods. Containing the Same*, Inv. No. 337-TA-860 (USITC filed Sept. 24, 2012) (retained by respondent – Mellanox, IPtronics and FCI Inc and counsel Alston & Bird LLP). Deposition (x2) and trial experience.
    a. Deposition: 2 (Cumulative total: 7)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 3)

c. Technology: IC design, layout, and operation; especially laser driver chips for VCSELs. High speed laboratory testing.

8. Active case work: 3Q2014 to 2Q2015**;** *Microscan Sys., Inc. v. Cognex Corp.*, No. 14-CV-6952 (S.D.N.Y. filed Aug. 27, 2014) (retained by plaintiff – Morrison & Foerster LLP). Deposition (x1) and trail experience.
    a. Deposition: 1 (Cumulative total: 8)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 4)
    c. Technology: Bar code scanners and associated optics such as imagers, lasers, LEDs, molded optics. Laboratory testing.
9. Active case work: 2Q2014 to 1Q2016**;** *Avago Techs. Fiber IP (Singapore) PTE Ltd. v. IPtronics Inc.*, No. 10-CV-2863 (N.D. Cal. filed June 29, 2010) (retained by respondent – Alston & Bird LLP).
    a. Deposition: 0 (Cumulative total: 8)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
    c. Technology: IC design, layout, and operation; especially laser driver chips for VCSELs. High speed laboratory testing.
10. Active case work: 1Q2015 to 3Q2015; *Regarding certain optical disc drives*, Inv. No. 337-TA-897 (USITC filed Oct. 21, 2013) (retained by respondent – O'Melveny & Myers LLP).
    a. Deposition: 0 (Cumulative total: 8)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
    c. Technology: CD, CVD, BluRay optical disk drives, optical components, laser diodes, and optical beam patterns. Laboratory testing of visible optics.
11. Active case work: 1Q2015 to 2Q2015; *BMW of N. Am., LLC v. Innovative Display Techs., LLC*, No. IPR2015-00933, IPR2015-00934 (P.T.A.B. filed Mar. 24, 2015) (retained by plaintiff – Crowell Moring LLP).
    a. Deposition: 0 (Cumulative total: 8)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
    c. Technology: LED backlights for vehicles; LED package and optical module/LED luminaire design.
12. Active case work: 1Q2015 to 2Q2015; *BMW of N. Am., LLC v. Innovative Display Techs., LLC*, No. IPR2015-00934 (P.T.A.B. filed Mar. 24, 2015) (retained by plaintiff – Crowell Moring LLP).
    a. Deposition: 0 (Cumulative total: 8)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
    c. Technology: LED backlights for vehicles; LED package and optical module/luminaire design.
13. Active case work: 1Q2015 to 3Q2016; *OneChip Photonics Inc.,* Pre-litigation IP Case No. TBD; (retained by plaintiff – Patent Monetization Inc. (PMI)).
    a. Deposition: 0 (Cumulative total: 8)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
    c. Technology: Photonic Integrated Circuits using InP (Indium Phosphide); lasers, detectors, waveguides, mux/demux, spot size converters.
14. Active case work: 2Q2016; *IDT v. Hyundai Motor Co.,* No. 14-CV-201 (E.D. Tex. filed May 4, 2015) (retained by defendant – DLA Piper LLP).
    a. Deposition: 0 (Cumulative total: 8)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
    c. Technology: LED devices, packages and modules/luminaires for vehicles.
15. Active case work: 1Q2015 to 3Q2015; *Cree Inc., v. Honeywell Int'l Inc.,* No. 3:14-CV-737 (W.D. Wisc. filed Oct. 28, 2014) (retained by defendant - Arnold & Porter LLP). Deposition experience (x1).
    a. Deposition: 1 (Cumulative total: 9)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
    c. Technology: LEDs for mobile phones; LED epitaxial layers, device designs, optical lensing, packaging. Laboratory reverse engineering using TEM/SEM/EDAX etc.
16. Active case work: 2Q2015 to 4Q2015; *Trs. of Boston Univ. v. Everlight Elecs. Co.*, Nos. 12-CV-11935, 12-CV-12326, 12-CV-12330 (D. Mass. filed Oct. 17, 2012) (retained by plaintiff - Shore Chan DePumpo LLP). Deposition (x1) and trial experience.
    a. Deposition: 1 (Cumulative total: 10)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 5)
    c. Technology: GaN buffer layers for LEDs, and associated technical marketing, sales and import process into USA.
17. Active case work: 3Q2015 to 3Q2016; *LG Elecs. Inc. v. Toshiba Samsung Storage Tech. Corp.*, No. 12-CV-1063 (D. Del. filed Aug. 22, 2012) and IPR2015-01659 (PTAB filed Jul. 31st 2015 (retained by plaintiff – DLA Piper & Nixon Law). IPR deposition (i.e. trial) experience (x1).
    a. Deposition: 1 (Cumulative total: 11)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 1)
    d. Technology: Optical storage using laser diodes, photodetectors and optical materials
18. Active case work: 3Q2015 to 3Q2016; *LG Elecs. Inc. v. Toshiba Samsung Storage Tech. Corp.*, No. 12-CV-1063 (D. Del. filed Aug. 22, 2012) and IPR2015-01642 (PTAB filed Jul. 30th 2015) (retained by plaintiff – DLA Piper & Nixon Law).
    a. Deposition: 0 (Cumulative total: 11)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 1)

d. Technology: Optical storage using laser diodes, photodetectors and optical materials

19. Active case work: 3Q2015 to 3Q2016; *LG Elecs. Inc. v. Toshiba Samsung Storage Tech Corp.*, IPR2016-01677 (PTAB filed Aug. 24th 2016 (retained by plaintiff – DLA Piper & Nixon Law).
    a. Deposition: 0 (Cumulative total: 11)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 1)
    d. Technology: Optical storage using laser diodes, photodetectors and optical materials
20. Active case work: 3Q2015 to 3Q2016; *LG Elecs. Inc. v. Toshiba Samsung Storage Tech. Corp.*, IPR2015-01678 (PTAB filed Aug. 24th 2016) (retained by plaintiff – DLA Piper & Nixon Law).
    a. Deposition: 0 (Cumulative total: 11)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 1)
    d. Technology: Optical storage using laser diodes, photodetectors and optical materials
21. Active case work: 3Q2015 to 3Q2016; *LG Elecs. Inc. v. Toshiba Samsung Storage Tech. Corp.*, IPR2015-01644 (PTAB filed Jul. 30th 2015) (retained by plaintiff – DLA Piper & Nixon Law).
    a. Deposition: 0 (Cumulative total: 11)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 1)
    d. Technology: Optical storage using laser diodes, photodetectors and optical materials
22. Active case work: 3Q2015 to 3Q2016; *LG Elecs. Inc. v. Toshiba Samsung Storage Tech. Corp.*, IPR2015-01653 (PTAB filed Jul. 31st 2015) (retained by plaintiff – DLA Piper & Nixon Law).
    a. Deposition: 0 (Cumulative total: 11)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 1)
    d. Technology: Optical storage using laser diodes, photodetectors and optical materials
23. Active case work: 3Q2015; *Heptagon* Pre-litigation IPR petition; (retained by plaintiff – Proskaurer Rose LLP).
    a. Deposition: 0 (Cumulative total: 11)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 1)
    d. Technology: Proximity sensors using LEDs, photodetectors and innovative semiconductor packaging.
24. Active case work: 1Q2016 to 2Q2017; *Dentsply v. Am. Orthodontics Inc.,* No. 15-CV-1706 (D. Pa. filed Sept. 1, 2015) and IPR2016-01652 (PTAB filed Aug. 19th 2016) (retained by defendant – Godfrey Kahn LLP). IPR deposition (x1) experience.
    a. Deposition: 1 (Cumulative total: 12)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 2)
    d. Technology: High power lasers (YAG, CO2) to engrave and scribe dental orthodontic brackets.
25. Active case work: 2Q2016 to 2Q2017; *Koninklijke Philips N.V. v. Elect-tech Int'l (H.K.),* No. 14-CV-2737 (N.D. Cal. filed Aug. 12, 2015) (retained by plaintiff – Reed Smith LLP).
    a. Deposition: 0 (Cumulative total: 12)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 2)
    d. Technology: Trade secret MOCVD epitaxial growth techniques for high power GaN/InGaN LED technology, luminaires, modules and packaging.
26. Active case work: 2Q2016 to 4Q2016; *Bluestone Innovations llc. v. E. Mishan & Co. Inc.,* Pre-litigation IP Case No. TBD; (retained by defendant - Notaro, Michalos, & Zaccaria P.C.).
    a. Deposition: 0 (Cumulative total: 12)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 2)
    d. Technology: GaN/InGaN LEDs on structured substrates with reverse engineering laboratory analysis.
27. Active case work: 3Q2016-1Q2017; *511 Innovations Inc. v. HTC Am., Inc.*, No. 15-CV-1524 (E.D. Tex. Filed June 30, 2016) (retained by plaintiff – The Davis Firm). Deposition (x2)
    a. Deposition: 2 (Cumulative total: 14)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 2)
    d. Technology: Proximity sensors for mobile phones.
28. Active case work: 3Q2016-4Q2016; *Mellanox Techs. Ltd. v. Methode Elecs. Inc.,* No. 15-CV-3730 (N.D. Cal. filed Aug. 16, 2015) (retained by plaintiff – Alston & Bird).
    a. Deposition: 0 (Cumulative total: 14)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 2)
    d. Technology: Fiber optic transceiver modules.
29. Active case work: 4Q2016-1Q2017; *Novanta Inc., v Iradion Inc*., No. 15-CV-01033 (D. Del. filed Nov. 9, 2015) (retained by defendant – Barnes and Thornburg LLP).
    a. Deposition: 0 (Cumulative total: 14)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 2)

d. Technology: High power gas laser design and operation.

30. Active case work: 1Q2017-1Q2017; *Optolum Inc., v Cree Inc*., No. 16-CV-03828; (D. Az. filed Nov. 3, 2016) (retained by defendant – Jones Day).
    a. Deposition: 0 (Cumulative total: 14)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 2)
    d. Technology: LED packaging for illumination. LED luminaires.
31. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI)., v Willlis Electric Co., Ltd.,* 15-CV-00552 (W.D. NC. Filed: Apr 21st 2016), (retained by plaintiff - Troutman Sanders LLP). Deposition experience (x2)
    a. Deposition: 2 (Cumulative total: 16)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 3)
    d. Technology: Electrical connector, IC, and LED light product design including luminaires.
32. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI)., v Willlis Electric Co., Ltd.,* IPR2017-00309 (PTAB filed Nov. 21st 2017), (retained by plaintiff - Troutman Sanders LLP).
    a. Deposition: 0 (Cumulative total: 16)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Electrical connector, IC, and LED light product design including luminaires.
33. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI)., v Willlis Electric Co., Ltd.,* IPR2017-00330 (PTAB filed Nov. 24th 2017), (retained by plaintiff - Troutman Sanders LLP).
    a. Deposition: 0 (Cumulative total: 16)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Electrical connector, IC, and LED light product design including luminaires.
34. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI)., v Willlis Electric Co., Ltd.,* IPR2017-00331 (PTAB filed Nov. 24th 2017), (retained by plaintiff - Troutman Sanders LLP).
    a. Deposition: 0 (Cumulative total: 16)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Electrical connector, IC, and LED light product design including luminaires.
35. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI)., v Willlis Electric Co., Ltd.,* IPR2017-00332 (PTAB filed Nov. 25th 2017), (retained by plaintiff - Troutman Sanders LLP).
    a. Deposition: 0 (Cumulative total: 16)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Electrical connector, IC, and LED light product design including luminaires.
36. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI)., v Willlis Electric Co., Ltd.,* IPR2017-00334 (PTAB filed Nov. 25th 2017), (retained by plaintiff - Troutman Sanders LLP).
    a. Deposition: 0 (Cumulative total: 16)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Electrical connector, IC, and LED light product design including luminaires.
37. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI)., v Willlis Electric Co., Ltd.,* IPR2017-00335 (PTAB filed Nov. 25th 2017), (retained by plaintiff - Troutman Sanders LLP).
    a. Deposition: 0 (Cumulative total: 16)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Electrical connector, IC, and LED light product design including luminaires.
38. Active case work: 1Q2017-4Q2017; *Macom Technology Solutions Holdings Inc., and Nitronex, LLC., v. Infineon Technologies AG and Infineon Technologies North American Corp.*, 16-CV-02859 (C.D. Ca. filed Apr 26, 2016) (retained by plaintiff – Baker Botts LLP).
    a. Deposition: 0 (Cumulative total: 16)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: High performance GaN based RF FET device design and operation.
39. Active case work: 1Q2017-1Q2017; *Quanergy Systems, Inc. v. Velodyne LiDAR, Inc.* (16-cv-05251; N.D. Ca. filed: Sep 13th 2016 (retained by plaintiff Velodyne) - Latham & Watkins LLP
    a. Deposition: 0 (Cumulative total: 16)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Laser/photodetector based LIDAR design and operation for self-driving vehicles.
40. Active case work: 1Q2017-2Q2017; *The Chamberlain Group Inc., v. Techtronic Industries Co., Ltd, Techtronic Industries North America et al.,* Challenge to U.S Patent No. 7,862,209 (retained by plaintiff – The Chamberlain Group) – Morgan, Lewis & Brockius, LLP.
    a. Deposition: 0 (Cumulative total: 16)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)

c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
d. Technology: LED based luminaire design for lighting.

41. Active case work: 1Q2017-1Q2018; *Uber Technologies Inc., Ottomottto LLC., Otto Trucking LLC., v. Waymo LLC (Google),* 17-CV-00939 (N.D. Ca filed: Mar 10th, 2017), (retained by defendant Uber Technologies Inc.) – Morrison and Foerster LLP. Deposition experience (x3) and trial experience (case settled at trial).
    a. Deposition: 3 (Cumulative total: 19)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Optical and electrical device, optics, and package designs for LIDAR based self-driving vehicles.
42. Active case work: 2Q2017-2Q2017; *Heptagon v. ST Mircoelectronics* IPR petition; (retained by plaintiff Heptagon) – Proskaurer Rose LLP).
    a. Deposition: 0 (Cumulative total: 19)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Optoelectronic based proximity sensors using LEDs and photodetectors.
43. Active case work: 2Q2017-2Q2018; *AT&T Inc., v. Sycamore Holdings LLC.,* 16-CV-00588 (E. D. Tx filed: Jun 6th 2016); (retained by defendant AT&T Inc.) - Kirkland and Ellis LLP. Deposition experience (x1)
    a. Deposition: 1 (Cumulative total: 20)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Coding designs of optical digital signals for high performance optical networks.
44. Active case work: 2Q2017 – 4Q2017; *Clearfield Inc., v. CommScope, ADC, Tyco, and TE Connectivity,* 17-CV-00307 (D.C. Minn. filed Jan 31st 2017); (retained by defendant Clearfield, Inc.) – Pepper Hamilton LLP
    a. Deposition: 0 (Cumulative total: 20)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Fiber optic connectors, panels, and distribution switches using optoelectronic components.
45. Active case work: 2Q2017 – 4Q2017; *Clearfield Inc., v. CommScope, ADC, Tyco, and TE Connectivity,* IPR2017-02122 (PTAB filed Sep. 15th 2017); (retained by defendant Clearfield, Inc.) – Pepper Hamilton LLP
    a. Deposition: 0 (Cumulative total: 20)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Fiber optic connectors, panels, and distribution switches using optoelectronic components.
46. Active case work: 2Q2017 – 4Q2017; *Clearfield Inc., v. CommScope, ADC, Tyco, and TE Connectivity,* IPR2018-00003 (PTAB filed Oct. 6th 2017); (retained by defendant Clearfield, Inc.) – Pepper Hamilton LLP
    a. Deposition: 0 (Cumulative total: 20)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Fiber optic connectors, panels, and distribution switches using optoelectronic components.
47. Active case work: 2Q2017 – 4Q2017; *Clearfield Inc., v. CommScope, ADC, Tyco, and TE Connectivity,* IPR2018-00154 (PTAB filed Nov. 7th 2017); (retained by defendant Clearfield, Inc.) – Pepper Hamilton LLP
    a. Deposition: 0 (Cumulative total: 20)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Fiber optic connectors, panels, and distribution switches using optoelectronic components.
48. Active case work: 4Q2016-2Q2017; *Antunes Inc.,* Pre-litigation IP patent review; Case No. TBD; (retained by plaintiff – Antunes Inc. and Chapman Spingola LLP).
    a. Deposition: 0 (Cumulative total: 20)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: High power grating surface emitter laser diodes, and associated packaging and device design for laser-based cooking ovens.
49. Active case work: 1Q2017-2Q2017; *Core Optical Technologies LLC. v. Fujitsu Network Communications, Inc.,* 16-CV-00437 (C. D. Ca filed: Mar 7th 2016); (retained by defendant Fujitsu Network Communications) – Morrison & Foerster LLP.
    a. Deposition: 0 (Cumulative total: 20)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Fiber optic based optical communications for coherent technologies
50. Active case work: 3Q2017-4Q2018; *Oyster Optics LLC v. Coriant America, et al*, 16-CV-01302 (E. D. Tx filed: Nov 24th 2016); (retained by plaintiff Oyster Optics LLC) – Russ August & Kabat LLP.
    a. Deposition: 1 (Cumulative total: 21)

b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
d. Technology: Fiber optic based optoelectronic semiconductor component design and operation.

51. Active case work: 3Q2017-4Q2018; *Oyster Optics LLC v. Infinera, Alcatel-Lucent, Fujitsu, Cisco Systems, Huawei,* 16-CV-01295, 16-CV-01297, 16-CV-01299, 16-CV-01301, 16-CV-01303 (E. D. Tx filed: Nov 24th 2016); (retained by plaintiff Oyster Optics LLC) – Russ August & Kabat LLP. Deposition experience (x1).
    a. Deposition: 1 (Cumulative total: 22)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Fiber optic based optoelectronic semiconductor component design and operation. Including both direct detect and coherent communications, and encoding techniques such as PSK, QPSK, AM, FM etc.
52. Active case work: 3Q2017-4Q2017; *Olympus*, Pre-litigation IP and Due Diligence; Case No. TBD; (retained by plaintiff – Olympus and Fish & Richardson P.C.)
    a. Deposition: 0 (Cumulative total: 22)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: High volume, low cost optical lens and optics technology.
53. Active case work: 3Q2017-1Q2018; *Honeywell International, Inc et al v. Code Corporation et al.*, ITC No 337-TA-1061 (filed Jun 28th 2017), "Certain barcode readers, scan engines, products containing the same, and components thereof," (retained by respondent – Honeywell and Alston and Bird LLP
    a. Deposition: 1 (Cumulative total: 23)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Bar-code scanners and associated optical/optoelectronic component performance and operation.
54. Active case work: 4Q2017-1Q2019; *Godo Kaisha IP Bridge 1 v. Intel Corp.*, 17-CV-00676 (filed Sep 29th 2017), (retained by plaintiff – Godo Kaisha IP Bridge 1) - Ropes and Gray, LLP.
    a. Deposition: 0 (Cumulative total: 23)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Fabrication, design, and reverse engineering of silicon-based FET ICs.
55. Active case work: 4Q2017-3Q2018; *Maxim Integrated Products, Inc. and Volterra Semiconductor LLC., v. Silicon Mitus Inc., and Silicon Mitus Technology Inc.*, 17-CV-03507 (N. D. Ca: filed Jun 16th 2017), (retained by defendant Silicon Mitus) – Pillsbury Winthrop Shaw Pittman, LLP. (Deposition and trial experience X1)
    a. Deposition: 1 (Cumulative total: 24)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 7)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Fabrication, design, characterization, and packaging of silicon-based FET ICs for power applications
56. Active case work: 2Q2018-3Q2018; *Cree, Inc., v. Document Security Systems Inc.,* 17-CV-4263 (C.D. Ca filed: Apr 17th 2017), (retained by defendant Cree Inc.) - Jones Day, LLP
    a. Deposition: 0 (Cumulative total: 24)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 7)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Design and packaging of high brightness GaN based LEDs for luminaires.
57. Active case work: 2Q2018-2Q2018; Weisen v., Ram Telecom International (RTI)., CGC-16-554331 (Sup Ca: filed 3rd May 2017) (retained by plaintiff Weisen, J) - Yetter Coleman, LLP. Deposition experience (x1) and trial experience (x1).
    a. Deposition: 1 (Cumulative total: 25)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Submarine and subsea fiber optic cables: technology, markets, economic impact, and history.
58. Active case work: 2Q2018-3Q2018; *Seoul Semiconductor., v. Document Security Systems Inc.,* 17-CV-00981 (C.D. Ca filed: Apr 17th 2017), (retained by defendant Seoul Semiconductor) - Latham and Watkins LLP
    a. Deposition: 1 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: Design and packaging of high brightness GaN based LEDs for luminaires.
59. Active case work: 3Q2018-4Q2018; *NEC Display Solutions Inc., and NEC Display Solutions of America, Inc., v. Ultravision.,* ITC Case# 337-TA-1114 (filed 24th May 2018), "Certain Modular LED Display Panels and Components Thereof," (retained by respondent Jones Day, LLP)
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)

d. Technology: Large LED Panels, LED displays, LED modular panel design, LED thermal engineering and color displays for outdoor environments.

60. Active case work: 3Q2018-3Q2018; IFT (Innovative Foundry Technologies) (pre-lit), retained by plaintiff Mintz Levin, Cohen, Ferris, Glovsky, and Popeo PC.)
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
    d. Technology: CMOS device (inc FinFETs) and IC fabrication techniques at 40, 28, 20, 16nm nodes.
61. Active case work: 4Q2018-2Q2019; *Eidolon Optical LLC., v. Haag-Streit AG.,* IPR2018-01311, (retained by patent owner Eidolon Optical LLC) - McInnes & McLane LLP
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 4)
    d. Technology: High brightness InGaAlP, GaP, AlGaAs, and GaN/InGaN based LEDs for use in medical instruments
62. Active case work: 3Q2018-3Q2018; *Voxtel Inc., v. Joseph Lachapelle & Luminar Technologies Inc.,* 18-CV-27356 (D. Or. filed: Dec 18th 2017), (retained by plaintiff Voxtel Inc.) - Ater Wynne LLP
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: LIDAR optical and electronic component and system technology
63. Active case work: 3Q2018-1Q2019; *Alta Devices, v. LG Electronics Inc.,* 18-CV-00404 (N.D. Ca. filed: May 7th 2018), (retained by defendant LG Electronics Inc.) - Hogan Lovells LLP
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Trade Secret GaAs based solar cell design, fabrication, manufacturing, and device performance
64. Active case work: 3Q2018-3Q18; *Opterna AM Inc., v. Commscope Technologies Inc.,* Pre-litigation preparation, (retained by defendant Opterna AM Inc.) - Sterne Kessler LLP
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Fiber optic connectors, panels, and distribution switches using optoelectronic components.
65. Active case work: 4Q2018 – 1Q2019; *U.D. Electronic Corp., v. Pulse Electronics, Inc.,* Preparation for IPR filing: IPR2019-00508 (PTAB filed Dec 26th 2018); and support for 18-CV-00373 (S.D. Ca. filed: Feb 16th 2018) (retained by petitioner U. D. Electronic Corp.) – Procopio, Cory, Hargreaves and Savitch LLP
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Electrical and fiber optic connectors, panels, and distribution switches using both electronic and optoelectronic components.
66. Active case work: 4Q2018 – 1Q2019; *U.D. Electronic Corp., v. Pulse Electronics, Inc.,* Preparation for IPR filing: IPR2019-00515 (PTAB filed Dec 31st 2018); and support for 18-CV-00373 (S.D. Ca. filed: Feb 16th 2018) (retained by petitioner U. D. Electronic Corp.) – Procopio, Cory, Hargreaves and Savitch LLP
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Electrical and fiber optic connectors, panels, and distribution switches using both electronic and optoelectronic components.
67. Active case work: 4Q2018 – 1Q2019; *U.D. Electronic Corp., v. Pulse Electronics, Inc.,* Preparation for IPR filing: IPR2019-00262 (PTAB filed Nov 9th 2018); and support for 18-CV-00373 (S.D. Ca. filed: Feb 16th 2018) (retained by petitioner U. D. Electronic Corp.) – Procopio, Cory, Hargreaves and Savitch LLP
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Electrical and fiber optic connectors, panels, and distribution switches using both electronic and optoelectronic components.
68. Active case work: 4Q2018 – 1Q2019; *U.D. Electronic Corp., v. Pulse Electronics, Inc.,* Preparation for IPR filing: IPR2019-00511 (PTAB filed Dec 28th 2018); and support for 18-CV-00373 (S.D. Ca. filed: Feb 16th 2018) (retained by petitioner U. D. Electronic Corp.) – Procopio, Cory, Hargreaves and Savitch LLP
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Electrical and fiber optic connectors, panels, and distribution switches using both electronic and optoelectronic components.

69. Active case work: 4Q2018 – 1Q2019; *Semiconductor Energy Laboratory Co. Ltd., v. Bluehouse Global Ltd.,* Preparation for IPR filing: IPR2018-01405 (PTAB filed Jul 18th 2018); (retained by patent owner SEL Co Ltd.) – Robinson Intellectual Law Office, P.C. (Counsel represented by Fish and Richardson LLP).
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Semiconductor displays using active matrix LCD and thin film transistor technology. Design, fabrication, and circuit layout.
70. Active case work: 4Q2018 – 1Q2019; *Semiconductor Energy Laboratory Co. Ltd., v. Bluehouse Global Ltd.,* Preparation for IPR filing: IPR2018-01393 (PTAB filed Jul 13th 2018); (retained by patent owner SEL Co Ltd.) – Robinson Intellectual Law Office, P.C. (Counsel represented by Fish and Richardson LLP)
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Semiconductor displays using active matrix LCD and thin film transistor technology. Design and fabrication technology.
71. Active case work: 4Q2018 - 1Q2019; *The Sloan Company dba SloanLED, v. Principle Lighting Group, LLC.,* 18-CV-06449 (C.D. Ca. filed: Jul 26th 2018), (retained by defendant Sloan LED.) - Ferguson Case Orr Paterson LLP
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 9)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: LED lighting, LED luminaires, LED performance, electrical and mechanical design and construction.
72. Active case work: 1Q2019 - 1Q2019; *HTC Corporation, v. Lemire Illumination Technologies.,* 18-CV-00021 (E.D. Tx. filed: Jan 21st 2018), (retained by defendant HTC Corporation) - Perkins Coie LLP
    a. Deposition: 0 (Cumulative total: 26)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: LEDs for mobile phones
73. Active case work: 1Q2019 - 2Q2019; *Frys Electronics, v. Seoul Semiconductor Co, and Seoul Viosys Co.,,* 2:18-CV-00386-JRG (E. D. Tx. filed: Nov 20th 2018), (retained by defendant Frys Electronics) - Lamkin IP Defense
    a. Deposition: 0 (Cumulative total: 26),
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: LED chips, LED packaging, LED lenses, LED luminaires, backlights, displays, and televisions/monitors
74. Active case work: 2Q2019 – 4Q2019; *Hanwha Q CELLS & Advance Materials Corporation, v. JinkoSolar, LONGi Solar, REC Solar,* ITC 337-TA-1151 (filed: Apr 4th 2019), ("Certain Photovoltaic Cells and Products Containing Same,"), retained by patent owner and plaintiff Hanwha Q CELLS) - Covington and Burling LLP
    a. Deposition: 2 (Cumulative total: 28)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
75. Active case work: 2Q2019-3Q2019; *Hanwha Q CELLS & Advance Materials Corporation, v. JinkoSolar and affiliates,* 19-CV-00450 (D. Del. filed: Jan 21st 2018), (retained by patent owner and plaintiff Hanwha Q CELLS) - Covington and Burling LLP
    a. Deposition: 0 (Cumulative total: 28)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Silicon solar cells and materials analysis of passivation layers
76. Active case work: 2Q2019-2Q2019; *Oyster Optics LLC v. Infinera Inc,* 2:18-CV-00206 (E. D. Tx filed: May 15th 2018); (retained by plaintiff Oyster Optics LLC) – Russ August & Kabat LLP.
    a. Deposition: 0 (Cumulative total: 28)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Fiber optic based optoelectronic semiconductor component and transceiver design/ operation.
77. Active case work: 2Q2019 – 2Q2019; *Nichia Corporation & Osram Opto Semiconductors Inc., v. Lighting Science Group Corp.,* IPR filing: IPR2019-01259 (PTAB filed Jun 28th 2019); (retained by petitioner Nichia and Osram Opto.) – Shearman and Sterling, LLP
    a. Deposition: 0 (Cumulative total: 28)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: LED chips, LED packaging and ceramic thermal heat sinking technology.
78. Active case work: 2Q2019 – 3Q2019; *Nichia Corporation v. Lighting Science Group Corp.,* 2:17-CV-08849 (C. D. Ca filed Jul 12th 2017); (retained by defendant Nichia) – Shearman and Sterling, LLP
    a. Deposition: 0 (Cumulative total: 28)

b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
d. Technology: LED chips, LED packaging and ceramic thermal heat sinking technology

79. Active case work: 3Q2019-3Q2019; *Applied Optoelectronics Inc v. Class Action Lawsuit,* 4:17-CV-02399 (S. D. Tx filed: Mar 6th 2018); (retained by plaintiff Class Action Lawsuit) – Levi and Korsinsky, LLP
    a. Deposition: 0 (Cumulative total: 28)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Fiber optic based optoelectronic semiconductor components, transceivers, and sub-systems.
80. Active case work: 3Q2019-3Q2019; *DNA Motor v. Kuen Hwa Traffic Industrial Co.,* 18-CV-05664 (C. D. Ca filed: Jan 15th 2019); (defendant DNA Motor) – Elizabeth Yang, Law and Mediation Office
    a. Deposition: 0 (Cumulative total: 28)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: LED design patent, and the design of an aftermarket LED based headlight assembly for an automobile.
81. Active case work: 3Q2019 – 1Q2020; *Nichia Corporation, Osram Opto Semiconductors Inc., Philips Lumileds, GE Consumer Lighting, Cree, and Signify v. Lighting Science Group Corp.,* ITC 337-TA-1168 (filed: Apr 30th 2019), ("Certain Light-Emitting-Diode products, systems, and components thereof (III)") (retained by respondents Nichia, Osram Optoelectronics, Philips Lumileds, GE Consumer Lighting, Cree Hong Kong., Signify Corp.) – Shearman and Sterling, LLP
    a. Deposition: 1 (Cumulative total: 29)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 10)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: LED chips, LED packaging and ceramic thermal heat sinking technology (LTCC).
82. Active case work: 4Q2019 – 1Q2020; *Amazon.com Inc, Bed, Bath and Beyond, IKEA, Target, and Walmart Inc., v. Regents of the University of California,* ITC 337-TA-1172 (filed: July 30th 2019), ("Certain Filament Light-Emitting-Diodes and products containing same") (retained by respondents Amazon.com Inc, Bed, Bath and Beyond, IKEA, Target, and Walmart Inc.) – Morrison and Foerster, LLP
    a. Deposition: 2 (Cumulative total: 31)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: LED chips, LED packaging and light bulb filaments with transparent sub-mounts.
83. Active case work: 4Q2019 – 4Q2019; *U.D. Electronic Corp., v. Pulse Electronics, Inc.,* IPR2019-00511 (PTAB filed Dec 28th 2018), (retained by petitioner U. D. Electronic Corp.) – Procopio, Cory, Hargreaves and Savitch LLP
    a. Deposition: 0 (Cumulative total: 31)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Electrical and fiber optic connectors, panels, and distribution switches using both electronic and optoelectronic components.
84. Active case work: 1Q2020 – 2Q2020; *IKEA, v. Regents of the University of California,* ITC 337-TA-1172 (filed: July 30th 2019), ("Certain Filament Light-Emitting-Diodes and products containing same") (retained by respondents IKEA) – Flaster and Greenberg, LLP
    a. Deposition: 2 (Cumulative total: 31)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: LED chips, LED packaging and light bulb filaments with transparent sub-mounts.
85. Active case work: 1Q2020-1Q2020; *Hanwha Solutions Corporation, v. Longi Green Energy, Longi Solar Technology, Longi Trading et al.,* IPR2019-01072 (PTAB filed 13th May 2019), (retained by patent owner Hanwha Solutions Corporation) - Covington and Burling LLP
    a. Deposition: 0 (Cumulative total: 31)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Silicon solar cells and materials analysis of passivation layers
86. Active case work: 1Q2020-1Q2020; *Hanwha Solutions Corporation, v. REC Solar Pte. Ltd. and JinkSolar (U.S.) Inc.* IPR2019-01145 (PTAB filed 6th March 2019), (retained by patent owner Hanwha Solutions Corporation) - Covington and Burling LLP
    a. Deposition: 0 (Cumulative total: 31)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Silicon solar cells and materials analysis of passivation layers
87. Active case work: 4Q2019 – 2Q2020; *Viavi Solutions Inc., v Optrontec Inc.,* ITC 337-TA-1187 (filed: 18th November 2019), ("Certain Electronic devices with Optical Filters and Optical Sensor Systems and Components Thereof") (retained by complainant Viavi Solutions Inc.,) – Venable, LLP
    a. Deposition: 0 (Cumulative total: 31)

b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
d. Technology: Optical filters and optical sensor systems, design and fabrication of dielectric materials for passband filters in applications such as optical communications, imaging, sensing, medical, automotive.

88. Active case work: 2Q2020 – 4Q2020; *Leviton Manufacturing Co., v. Corning Optical Communications LLC.,* ITC 337-TA-1194 (filed: 19th March 2020), ("Certain High-Density Fiber Optic Equipment and Components Thereof") (retained by respondent Leviton Manufacturing Co.,) – Morrison & Foerster, LLP
    a. Deposition: 1 (Cumulative total: 32)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 11)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Fiber optic adapters, fiber optic connectors (simplex, duplex, quad, multi-fiber), fiber trays, racks, and fiber cabinet equipment.
    e. Technology: LED chips, LED packaging and light bulb filaments with transparent sub-mounts.
89. Active case work: 2Q2020 – 2Q2020; subject to PO/NDA and engagement letter *xxx v. yyy,* Post Grant Review petition for proceedings (US Patent # zzz), retained by Morrison and Foerster, LLP
    a. Deposition: 0 (Cumulative total: 31)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Optoelectronics, LEDs, lead frame packaging, optics, optical lenses, GaN (Gallium Nitride), optical transparency
90. Active case work: 1Q2020-3Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc.,* IPR2020-00560 (PTAB filed 16th Feb 2020), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
    a. Deposition: 0 (Cumulative total: 32)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 11)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Silicon CMOS image sensors, drive electronics, smart pixels and CCD technology
91. Active case work: 2Q2020-2Q2020; *Panasonic, v. 3M Innovative Properties Company.,* Preparation for IPR filing, (retained by defendant Panasonic) – retained by Westerman Hattori Daniels & Adrian LLP
    a. Deposition: 0 (Cumulative total: 32)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 11)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
    d. Technology: Touch sensor (resistive, optical, and capacitive) technology for mobile displays. Analysis of display, electronic, and optical technologies.
92. Active case work: 2Q2020-3Q2020; *Longi Green Energy Technology Co, Longi Solar Technology Co, Long Solar Technology (H.K., Kuching, Taizhou, Zhejiang, Hefei, US) v. Hanwha Solutions Corporation.*, IPR 2019-01072, (retained by patent owner Hanwha Solutions Corporation) – Quinn Emanuel Urquhart & Sullivan, LLP
    a. Deposition: 1 (Cumulative total: 33)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 11)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 5)
    d. Optoelectronics; solar cell design, fabrication, device performance, packaging, and interface issues relating to passivation (both chemical and electric field enhanced).
93. Active case work: 3Q2020-3Q2020; *Oyster Optics LLC v. Ciena Corp,* 4:17-CV-05920 (N. D. CA filed: April 22nd 2020); (retained by plaintiff Oyster Optics LLC) – Russ August & Kabat LLP.
    a. Deposition: 0 (Cumulative total: 33)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 12)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 5)
    d. Technology: Fiber optic based optoelectronic semiconductor component design and operation, especially phase shift keying (PSK, QPSK) and phase based coherent communications.
94. Active case work: 3Q2020-2Q2021; *Capella Photonics Inc., v. Infinera Corporation, Tellabs, Tellabs Operations Inc., Coriant American Inc., and Coriant USA Inc., 2*:20-CV-00077 (E. D. TX filed: March 16th 2020); (retained by defendant Infinera Inc.) – Baker Botts LLP.
    a. Deposition: 1 (Cumulative total: 34)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 12)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 5)
    d. Technology: Fiber optic wavelength selective switches (WSS), reconfigurable add-drop multiplexors (ROADMs), and their design. Technical issues include polarization, wavelength selection, coupling, mux/demux and operation in optical networks.
95. Active case work: 3Q2020-3Q2020; *Longi Green Energy Technology Co, Longi Solar Technology Co, Long Solar Technology (H.K., Kuching, Taizhou, Zhejiang, Hefei, US) v. Hanwha Solutions Corporation.*, IPR 2020-00353, (retained by patent owner Hanwha Solutions Corporation) – Quinn Emanuel Urquhart & Sullivan, LLP
    a. Deposition: 0 (Cumulative total: 34)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 12)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 6)
    d. Optoelectronics: solar cell design, fabrication, device performance, packaging, and interface issues relating to passivation (both chemical and electric field enhanced).

96. Active case work: 3Q2020-2Q2021; *Appotronics Corporation Ltd. v. Delta Electronics Inc., 2*:19-CV-00466 (E. D. Va filed: July 22nd 2020); (retained by defendant Delta Corporation Inc) – Pillsbury Winthorp Shaw Pitman LLP.
    a. Deposition: 1 (Cumulative total: 35)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 12)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: Light projectors for display and the color wheel, phosphor technology, high power visible lasers for projection, and the associated packaging of the modules/projectors for efficient cost design..
97. Active case work: 3Q2020 – 2Q2021; *Ideal Industries Lighting LLC (dba Cree Lighting) v. RAB Lighting Inc.,* ITC 337-TA-1213 (filed: 15th July 2020), ("Certain Light-emitting Diode Products, Fixtures, and Components thereof"), (retained by plaintiff Ideal Industries Lighting LLC (dba Cree Lighting) – Quinn Emanuel Urquhart an Sullivan, LLP
    a. Deposition: 1(Cumulative total: 36)
    b. Trial/Hearing/Court appearance: 2(twice at the stand); (Cumulative total: 14)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: Visible GaN based LEDs and various packaging optical lens designs for directing and re-directing LED light output with applications in street lighting.
98. Active case work: 3Q2020-3Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc., ex parte* declaration entitled, 'Hand-held computers incorporating reduced area imaging devices', for U.S. Patent 6,982,742 (control number 90/014,453), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
    a. Deposition: 0 (Cumulative total: 36)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: Hand-held silicon CMOS image sensors, drive electronics, smart pixels and CCD technology. Technical history of CCD v. CMOS image sensors in the 1990s and associated performance criteria.
99. Active case work: 3Q2020-3Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc., ex parte* declaration entitled, 'Communication devices incorporating reduced area imaging devices', for U.S. Patent 6,452,626 (control number 90/014,455), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
    a. Deposition: 0 (Cumulative total: 36)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: Hand-held silicon CMOS image sensors, drive electronics, smart pixels and CCD technology. Technical history of CCD v. CMOS image sensors in the 1990s and associated performance criteria.
100. Active case work: 4Q2020-4Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc.,* IPR declaration for U.S. Patent 9,198,565 (IPR2020-00476), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
    a. Deposition: 0 (Cumulative total: 36)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: Hand-held silicon CMOS image sensors, drive electronics, smart pixels and CCD technology. Technical history of CCD v. CMOS image sensors in the 1990s and associated performance criteria.
101. Active case work: 4Q2020-4Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc.,* IPR declaration for U.S. Patent 9,667,896 (IPR2020-00477), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
    a. Deposition: 0 (Cumulative total: 36)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: Hand-held silicon CMOS image sensors, drive electronics, smart pixels and CCD technology. Technical history of CCD v. CMOS image sensors in the 1990s and associated performance criteria.
102. Active case work: 4Q2020 – 1Q2021; *U.D. Electronic Corp., v. Pulse Electronics, Inc.,* 3:18-CV-00373 (Filed Fed 16th 2018), (retained by petitioner U. D. Electronic Corp.) – retained by defendant Perkins Coie LLP.
    a. Deposition: 1 (Cumulative total: 37)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: Electrical and fiber optic connectors, panels, and distribution switches using both electronic and optoelectronic components. Noise suppression using EMI between electrical components and connectors.
103. Active case work: 4Q2020-4Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc.,* IPR declaration for U.S. Patent 9,186,052 (IPR2020-00512), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
    a. Deposition: 1 (Cumulative total: 38)

b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
d. Technology: Hand-held silicon CMOS image sensors, drive electronics, smart pixels and CCD technology. Technical history of CCD v. CMOS image sensors in the 1990s and associated performance criteria.

104. Active case work: 4Q2020-4Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc.,* IPR declaration for U.S. Patent 9,186,052 (IPR2020-00475), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
    a. Deposition: 1 (Cumulative total: 39)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: Hand-held silicon CMOS image sensors, drive electronics, smart pixels and CCD technology. Technical history of CCD v. CMOS image sensors in the 1990s and associated performance criteria.
105. Active case work: 3Q2020 – 1Q2021; *Huawei Technologies Co. Ltd. v. Verizon Communications, Inc., et al.,* 20-CV-030-JRG (TX E. D. Filed 2nd April 2020), (retained by plaintiff Huawei Technologies Co. Ltd.) – retained by plaintiff Caldwell Cassady Curry P.C.
    a. Deposition: 0 (Cumulative total: 39)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: Analysis of coding for fiber optic communications, specifically in relation to the standardization process for the Telecommunication Standardization Sector of the International Telecommunications Union ("ITU-T"), including the ITU-T's G.709: Interfaces for the optical transport network standard ("G.709" or "the G.709 Standard"). In particular, the technical issues that relate to OTN hierarchy; functionality of the overhead in support of multi-wavelength optical networks; frame structures, bit rates, and formats for mapping client signals.
106. Active case work: 1Q2021 – 3Q2021; *IKEA et al., v. Regents of the University of California,* ITC 337-TA-1220 (filed: 29th September 2020), ("Certain filament light-emitting diodes and products containing same (II)"), (retained by respondent JDG: IKEA, Global Value Lighting, Signify, Home Depot, GE, Satco) – retained by Flaster Greenberg PC, Kirkland and Ellis, GT Law, Alston and Bird, Jones Day and Goodwin Law as JDG counsel.
    a. Deposition: 2 (Cumulative total: 41)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 15)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: LED chips, LED packaging and light bulb filaments with transparent sub-mounts.
107. Active case work 4Q2020 – 1Q2021; *Uber Technologies Inc., v. Anthony Scott Levandowski*; Case No. 20-30242 (HLB) and 20-03050 (filed 16th September 2020), retained by defendant Uber Technologies Inc., retained by Jenner and Block LLP.
    a. Deposition: 0 (Cumulative total: 41)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 15)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: LIDAR technology for motor vehicles that includes fiber amplifiers, LIDAR hardware, laser diodes, photodetectors, fiber links, and free space communications.
108. Active case work: 1Q2021 – 3Q2021; *CoSemi Technologies, v. Everpro Technologies, Fibbr Technologies, Logitech, and Facebook Technologies,* ITC 337-TA-1233 (filed: 29th October 2020), "Certain active optical cables and products containing same", (retained by claimant Cosemi Technologies) – retained by Rutan & Tucker LLP.
    a. Deposition: 1 (Cumulative total: 42)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 15)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: Active optical cables with embedded silicon modulator ICs, copper cable, fiber optic cable, VCSEL laser diodes, photodetectors and cable sheathing for consumer applications such as gaming, HDMI, USB, etc.
109. Active case work: 2Q2021 – 3Q2021; *Acuity Brands Lighting ,Inc. v. Heavy Duty Lighting (HDL), LLC.,* 20-CV-03648-SCJ (GA N. D. Filed 2nd September 2020), (retained by defendant Acuity Brands Lighting) – retained by defendant Duane Morris LLP.
    a. Deposition: 1 (Cumulative total: 43)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 15)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: LED lighting, LED chips, LED packages and LED packaging technologies such as molding, glob-top, substrates, die mounting, optical reflectors, and electrical interconnect layouts.
110. Active case work: 2Q2021 – 4Q2021; *Jiaxing Super Lighting Electric Appliance Co., LTD and Obert Inc. v. CH Lighting Technology co., LTD., Elliott Electric Supply Inc., and Shaoxing Ruising Lighting co., Ltd.,* 20-CV-00018-ADA (TX W D. Filed 16th March 2020), (retained by defendant CH Lighting et al) – retained by defendant Holland and Knight LLP.
    a. Deposition: 1 (Cumulative total: 44)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 16)

c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
d. Technology: LED lighting and LED packaging technologies for T8 and T12 form factor tube lighting. Technologies such as LED luminaire/tube packaging, mechanical structure, thermal heat dissipation, electronic circuitry, printed circuit boards, and LED chips.

111. Active case work: 3Q2021 – 1Q2022; ASUSTEK Computer Inc, *v. KT Imaging USA LLC,* 20-CV-00300-ADA (TX W D. Filed 20th April 2020, (retained by defendant ASUSTEK Computer Inc) – retained by defendant Turner Boyd LLP.
    a. Deposition: 0 (Cumulative total: 44)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 16)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: Image sensor modules, cameras in PCs/laptops, consumer products, tear downs, optical lenses, optical packaging, optical alignment.
112. Active case work: 3Q2021 – 3Q2021; *Jiaxing Super Lighting Electric Appliance Co., LTD and Obert Inc. v. Maxlite Inc.,* 19-CV-04047 (CA C.D. Filed 8th May 2019), (retained by defendant Maxlite Inc) – retained by defendant Holland and Knight LLP.
    a. Deposition: 0 (Cumulative total: 44)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 16)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: LED lighting and LED packaging technologies for T8 and T12 form factor tube lighting. Technologies such as LED luminaire/tube packaging, mechanical structure, thermal heat dissipation, electronic circuitry, printed circuit boards, and LED chips.
113. Active case work: 3Q2021 – 1Q2023; *Feit Electric Company Inc., v. Nichia Corporation,* 20-CV-00359-GW, (CA C. D. Filed 13th January 2020), (retained by defendant Feit Electric Company) – retained by Benesch Friedlander Coplan &Aronoff LLP
    a. Deposition: 2 (Cumulative total: 46)
    b. Trial/Hearing/Court appearance: 2 (Cumulative total: 18)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: LED lighting, LED chips, LED packages and LED packaging technologies such as lead-frames, molding, glob-top, substrates, die mounting, optical reflectors, and electrical interconnect layouts.
114. Active case work: 2Q2021 – 2Q2022; *Samsung Corporation vs TBD*, Pre-patent litigation, (retained by plaintiff Samsung Corporation), - retained by Quinn Emanuel Urquhart & Sullivan, LLP).
    a. Deposition: 0 (Cumulative total: 46)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: TV displays, OLEDs, LCDs, color gamut, and quality of RGB/white color as per CIE charts and colorimetry (NTSC, sRGB, AdobeRGB etc,.). Analysis of CHL (constant hue locus), quantum dots, nano-crystals, nano-devices, nano-structures to improve light quality output.
115. Active case work 2Q2021 – 2Q2021, *Holochip Corporation v, Edmund Optics, Optotune AG and others TBD*, Pre-patent litigation for ITC, (retained by plaintiff Holochip Corporation), - retained by King and Spalding LLP).
    a. Deposition: 0 (Cumulative total: 46)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
    d. Technology: Fluid lenses, and optical lenses with controlled focus facilities. Packaging of fluid lenses using piezoelectric actuators, and hermetic chambers. Deformable surfaces using micro-fluidics.
116. Active case work: 2Q2021-3Q2021; *Home Depot USA Inc., v. Lynk Labs, Inc.,* IPR declaration for U.S. Patent 10,757,783 (IPR2021-01368), (retained by petitioner Home Depot USA, Inc) – retained by DLA Piper LLP
    a. Deposition: 1 (Cumulative total: 47)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 7)
    d. Technology: LED products, LED circuits, including both DC and AC circuit design. LED color emission, white light, color mixing, CIE charts, and black body radiators for color temperature.
117. Active case work: 2Q2021-3Q2021; *Home Depot USA Inc., v. Lynk Labs, Inc.,* IPR declaration for U.S. Patent 10,492,251 (IPR2021-01369), (retained by petitioner Home Depot USA, Inc) – retained by DLA Piper LLP
    a. Deposition: 1 (Cumulative total: 48)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 8)
    d. Technology: LED products, LED circuits, including both DC and AC circuit design. LED color emission, white light, color mixing, CIE charts, and black body radiators for color temperature.
118. Active case work: 3Q2021-3Q2021; *Home Depot USA Inc., v. Lynk Labs, Inc.,* IPR declaration for U.S. Patent 10,091,842 (IPR2021-01540), (retained by petitioner Home Depot USA, Inc) – retained by DLA Piper LLP
    a. Deposition: 1 (Cumulative total: 49)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 9)
    d. Technology: LED products, LED circuits, including both DC and AC circuit design. LED color emission, white light, color mixing, CIE charts, and black body radiators for color temperature.

119. Active case work: 4Q2021-4Q2021; *Home Depot USA Inc., v. Lynk Labs, Inc.,* IPR declaration for U.S. Patent 10,517,149 (IPR2022-000023), (retained by petitioner Home Depot USA, Inc) – retained by DLA Piper LLP
    a. Deposition: 1 (Cumulative total: 50)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 10)
    d. Technology: LED products, LED circuits, including both DC and AC circuit design. LED color emission, white light, color mixing, CIE charts, and black body radiators for color temperature.
120. Active case work: 4Q2021-Present; *Everlight Elecs. Co. Ltd. v. Amazon.com, Inc. et al.,* 6:21-CV-00906 (W. D. TX filed: August 31st 2021); (retained by defendant Amazon.com) – Morrison and Foerster LLP.
    a. Deposition: 0 (Cumulative total: 50)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 10)
    d. Technology: LED chips, LED packaging with metallic electrodes, flip-chip solder bumping, and doping of semiconductors for electrical conduction.
121. Active case work: 4Q2021-2Q2021; *Hanwha Solutions Corporation and affiliated companies including Q-Cells, Boviet Renewable Power, Boviet Solar, Canadian Solar International v. Advanced Silicon Group Technologies,* ITC 337-TA-1271 (filed: 14th October 2020) "Certain silicon photovoltaic cells and modules with nanostructures, and products containing the same." (retained by joint defense group consisting of Quinn Emanual Urquhart & Sullivan, LLP., Morgan Lewis and Bockius, LLP., and Sidley Austin LLP.).
    a. Deposition: 2 (Cumulative total: 52)
    b. Trial/Hearing/Court appearance: 1 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 10)
    d. Technology: Silicon based solar/photovoltaic cells and modules that include fabrication techniques such as deposition, diffusion, wet/dry etching of nanostructures, nanowires, and nano-structures, nano-features, black silicon, monocrystalline wafers, and polysilicon fabrication.
122. Active case work: 4Q2021-2Q2022; *Dell Computer Inc, v. KT Imaging USA LLC,* Declaration for IPR with patent number 6,876,544 as petitioner, (to be filed), (retained by defendant Dell Computer Inc) – retained by petitioner Farella, Braun, and Martel.
    a. Deposition: 0 (Cumulative total: 52)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 10)
    d. Technology: Image sensor modules, cameras in PCs/laptops, consumer products, tear downs, optical lenses, optical packaging, optical alignment.
123. Active case work: 1Q2022-2Q2022; *Cree Lighting, Wolfspeed, Ideal Industries Lighting, v. CAO Lighting,* Declaration for IPR with patent number 6,465,961 as petitioner, (filed 8th April 2022), (retained by defendant Cree Lighting) – retained by Kilpatrick Townsend & Stockton LLP.
    a. Deposition: 1 (Cumulative total: 53)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 11)
    d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, active regions, cladding layers, optical mirrors, DBRs
124. Active case work: 1Q2022-2Q2022; *Cree Lighting, Wolfspeed, Ideal Industries Lighting, v. CAO Lighting,* Declaration for IPR with patent numbers 6,634,770 as petitioner, (filed 8th April 2022), (retained by defendant Cree Lighting) – retained by Kilpatrick Townsend & Stockton LLP.
    a. Deposition: 1 (Cumulative total: 54)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 12)
    d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, active regions, cladding layers, optical mirrors, DBRs
125. Active case work: 1Q2022-2Q2022; *Cree Lighting dba Ideal Industries Lighting, v. CAO Lighting,* 1:21-cv-00634 (MD NC filed 12th Aug 2021,), (retained by defendant Cree Lighting) – retained by Kilpatrick Townsend & Stockton LLP.
    a. Deposition: 0 (Cumulative total: 54)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 12)
    d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, active regions, cladding layers, optical mirrors, DBRs
126. Active case work: 1Q2022-2Q2022; *Lite-On Technology Corporation and Genesis Photonics Inc., v. Sensor Electronic Technology Inc., (SETi),* 6:21-cv-00322 (WD Tex filed 12th Aug 2021,), (retained by plaintiff LiteOn and Genesis) – retained by Pillsbury Winthrop Shaw Pittman LLP.
    a. Deposition: 0 (Cumulative total: 54)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 12)

d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LEDcladding layers, optical mirrors, DBRs

127. Active case work: 1Q2022-2Q2022; *Lite-On Technology Corporation and Genesis Photonics Inc., v. Sensor Electronic Technology Inc., (SETi),* Declaration for IPR (IPR2022-00395) as patent owner, (retained by plaintiff LiteOn and Genesis) – retained by Pillsbury Winthrop Shaw Pittman LLP.
    a. Deposition: 2 (Cumulative total: 56)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 2 (Cumulative total: 14)
    d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LED cladding layers, optical mirrors, DBRs
128. Active case work: 1Q2022-2Q2022; *Lite-On Technology Corporation and Genesis Photonics Inc., v. Sensor Electronic Technology Inc., (SETi),* Declaration for IPR (IPR2022-00396) as patent owner, (retained by plaintiff LiteOn and Genesis) – retained by Pillsbury Winthrop Shaw Pittman LLP.
    a. Deposition: 0 (Cumulative total: 56)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 14)
    d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LED cladding layers, optical mirrors, DBRs
129. Active case work: 1Q2022-2Q2022; *Lite-On Technology Corporation and Genesis Photonics Inc., v. Sensor Electronic Technology Inc., (SETi),* Declaration for IPR (IPR2022-00397) as patent owner, (retained by plaintiff LiteOn and Genesis) – retained by Pillsbury Winthrop Shaw Pittman LLP.
    a. Deposition: 0 (Cumulative total: 56)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 14)
    d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LED cladding layers, optical mirrors, DBRs
130. Active case work: 1Q2022-2Q2022; *Lite-On Technology Corporation and Genesis Photonics Inc., v. Sensor Electronic Technology Inc., (SETi),* Declaration for IPR (IPR2022-00406) as patent owner, (retained by plaintiff LiteOn and Genesis) – retained by Pillsbury Winthrop Shaw Pittman LLP.
    a. Deposition: 0 (Cumulative total: 56)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 14)
    d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LED cladding layers, optical mirrors, DBRs
131. Active case work: 1Q2022-2Q2022; *Lite-On Technology Corporation and Genesis Photonics Inc., v. Sensor Electronic Technology Inc., (SETi),* Declaration for IPR (IPR2022-00419) as patent owner, (retained by plaintiff LiteOn and Genesis) – retained by Pillsbury Winthrop Shaw Pittman LLP.
    a. Deposition: 1 (Cumulative total: 57)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 1 (Cumulative total: 15)
    d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LED cladding layers, optical mirrors, DBRs
132. Active case work: 1Q2022-3Q2022; *Panasonic Corporation, v. Magna International Inc.,* 21-cv-00319 (WD Tex filed 31st Mar 2021,), (retained by plaintiff Panasonic) – retained by Sidley Austin LLP.
    a. Deposition: 0 (Cumulative total: 57)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: Automotive sensors, cameras, electronic circuitry, controls, packaging, surround view camera systems.
133. Active case work: 2Q2022 – Present; *Jiaxing Super Lighting Electric Appliance Co., LTD and Obert Inc. v. Maxlite Inc.,* 19-CV-04047 (CA C.D. Filed 8th May 2019), (retained by defendant Maxlite Inc) – retained by defendant Procopio, Cory, Hargreaves and Savitch LLP.
    a. Deposition: 0 (Cumulative total: 57)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)

d. Technology: LED lighting and LED packaging technologies for T8 and T12 form factor tube lighting. Technologies such as LED luminaire/tube packaging, mechanical structure, thermal heat dissipation, electronic circuitry, printed circuit boards, and LED chips.

134. Active case work: 1Q2022 – 4Q2022; *Advanced Engineering Services LLC., v. Lumasense Technologies Inc., and DOES* 1-50, 21-CV-03279-WHO combined with 20-CV-07905-WHO (CA N.D. Filed 23rd Feb 2022), (retained by plaintiff Advanced Engineering Services LLC) – retained by plaintiff SAC Attorneys LLP
    a. Deposition: 1 (Cumulative total: 58)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: Thermal, gas, and flow sensing for use in designing and manufacturing equipment used in semiconductor chip manufacturing. In particular, review of data relating to the simulation of finite element analysis ("FEA") and computational fluid dynamics ("CFD") data for gases, temperature, and stress with actual sensor data that could be intelligently integrated, customized, installed, tested, verified, and validated.
135. Active case work: 2Q2022-3Q2022; *Frontier Communications v. Charter Communications*, Pre-litigation IP and Due Diligence; Case No. TBD; Retained by Frontier Communications, (retained by Mayer Brown LLP)
    a. Deposition: 0 (Cumulative total: 58)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: Optical PON for high-speed data FTTH evaluation, testing, and analysis.
136. Active case work: 2Q2022-3Q2022; *Russ, August & Kabat*, Pre-litigation IP and Due Diligence; Case No. TBD; (retained by plaintiff – Russ, August & Kabat LLP)
    a. Deposition: 0 (Cumulative total: 58)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: High volume fiber optic transceivers for EPON/GPON with: CDR circuits, 'Intelligence-in-the-Module' and 'M-ary' families.
137. Active case work: 2Q2022-3Q2022; *Signify Holding B.V. v. GE Lighting Solutions LLC.,* Declaration for IPR (IPR2022-XXX – in draft form for US patent #7,497,973) as petitioner, (retained by petitioner Signify Holding B.V.) – retained by Alston and Bird LLP
    a. Deposition: 0 (Cumulative total: 58)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: LED based light bulbs, LED chips that emit in the UV and visible, LED arrays, LED packaging including phosphors and encapsulants, and the type of phosphors utilized for different emission. In particular, phosphors that are activated by dopants such as Europium (Eu), Manganese (Mn) and the associated ions for these materials e.g. Mn2+, Mn3+, Mn4+, Mn6+, etc. Included analysis of InGaN and AlGaN based epitaxial material systems, and the use of phosphors in high pressure mercury vapor lamps.
138. Active case work: 3Q22 – Present; *Canon, Inc., and Canon USA Inc v. WSOU Investments, LLC d/b/a Brazos Licensing and Development.*, Declaration for IPR ((IPR2022-XXX) for US patent #7,493,030 as petitioner, (retained by Canon Inc) – retained by Orrick LLP
    a. Deposition: 0 (Cumulative total: 58)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: Digital camera operation including optical focus, image sensing, optical train, depth of field, exposure time, different focus and focal areas of a portion of the image, general photography and optical principles.
139. Active case work: 3Q22 – Present; *Canon, Inc., and Canon USA Inc v. WSOU Investments, LLC d/b/a Brazos Licensing and Development.*, 21-CV- 00166-ADA-DTG (W.D. TX.) Filed 29th Sept 2022. (retained by defendant Canon Inc) – retained by Orrick LLP
    a. Deposition: 1 (Cumulative total: 59)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: Digital camera operation including optical focus, image sensing, optical train, depth of field, exposure time, different focus and focal areas of a portion of the image, general photography and optical principles.
    e.
140. Active case work: 3Q22 – Present; *Fujifilm Sonosite., v. Butterfly Network, Inc.,* 1-22-CV-00309 (D.Del) Filed 29th Mar 2022), (retained by defendant Butterfly Network, Inc.,) – retained by defendant Akin Gump LLP
    a. Deposition: 0 (Cumulative total: 59)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: Ultra-sonic equipment that includes displays, especially OLED displays. The electronic circuits and how displays are electronically controlled.

141. Active case work: 3Q22 – Present; *LedComm LLC., v. IKEA US Retail LLC et al,* 6-22-CV-00302-ADA (W.D. Tx.) Filed 21st Mar 2022), (retained by defendant IKEA US Retail LLC et al.) – retained by defendant Flaster Greenberg LLP
    a. Deposition: 0 (Cumulative total: 59)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: LED surface mount packaging, LED GaN/InGaN chips, and associated LED lighting performance specifications.
142. Active case work: 2Q22 – 3Q2022; *NXP Semiconductors N.V. and NXP USA Inc., v. MediaTek Inc,, Amazon.com Inc., Belkin International Inc, Linksys USA Inc., et al,* ITC Investigation 337-TA-1287 entitled "Certain integrated circuits, and electronic devices and products containing the same" (Filed 1st Dec 2021), (retained by respondents Amazon.com Inc.,) – retained by respondent Morrison Foerster LLP
    a. Deposition: 0 (Cumulative total: 59)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: LED surface mount packaging, LED GaN/InGaN chips, and associated LED lighting performance specifications. LED Luminaires.
143. Active case work: 3Q22 – 4Q22; *Amazon.com Inc., v. Epistar Corp.,* 6-22-CV-00526-ADA (W.D. Tx.) Filed 24th May 2022), (retained by defendant Amazon.com Inc..) – retained by defendant Morrison Foerster LLP
    a. Deposition: 0 (Cumulative total: 59)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: LED surface mount packaging, LED GaN/InGaN chips, GaN/InGaN epitaxial growth, fabrication, device design and packaging. LED luminaires.
144. Active case work: 4Q22 – Present; *Amazon.com Inc., v. Epistar Corp.,* 6-22-CV-00526-ADA (W.D. Tx.) Filed 24th May 2022), (retained by defendant Amazon.com Inc..) – retained by defendant Perkins Coie LLP
    a. Deposition: 0 (Cumulative total: 59)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: LED surface mount packaging, LED GaN/InGaN chips, GaN/InGaN epitaxial growth, fabrication, device design and packaging. LED Luminaires.
145. Active case work: 4Q22 – Present; *Qorvo., v. Akoustis Technologies Inc.,* 1-21-CV-1417-JPM (C.A.) Filed 4th Oct 2021), (retained by defendant Akoustis.) – retained by defendant Pillsbury LLP
    a. Deposition: 0 (Cumulative total: 59)
    b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
    c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
    d. Technology: acoustic wave filters, BAW filters (bulk-acoustic-wave) filters for RF applications, devices, fabrication, and characterization
    e.

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PUBLISHED PATENT APPLICATIONS: *Current total = 84*

Recent USPTO published patent applications:

PUB. APP. NO.	Title	
1	20220187638	HYBRID EO POLYMER MODULATOR WITH ALD SEALANT LAYER
2	20220187637	HYBRID EO POLYMER MODULATOR WITH SILICON PHOTONICS
3	20220113566	TFP OPTICAL TRANSITION DEVICE AND METHOD
4	20220052249	A-axis Josephson Junctions with Improved Smoothness

As per USPTO website the current list of published patent applications:

PUB. APP. NO.	Title	
1	20210141251	ACTIVE REGION-LESS MODULATOR AND METHOD
2	20210141250	ACTIVE REGION-LESS MODULATOR AND METHOD
3	20210005720	ELECTRONIC DEVICE WITH 2-DIMENSIONAL ELECTRON GAS BETWEEN POLAR-ORIENTED RARE-EARTH OXIDE LAYER GROWN OVER A SEMICONDUCTOR
4	20200285085	DIRECT DRIVE REGION-LESS POLYMER MODULATOR METHODS OF FABRICATING AND MATERIALS THEREFOR

As per USPTO website 80 patent applications that have been published:

PUB. APP. NO.	Title	
1	20200183245	ELECTRO-OPTIC POLYMER DEVICES HAVING HIGH PERFORMANCE CLADDINGS, AND METHODS OF PREPARING THE SAME
2	20200183201	ACTIVE REGION-LESS POLYMER MODULATOR INTEGRATED ON A COMMON PIC PLATFORM AND METHOD
3	20200161417	III-N TO RARE EARTH TRANSITION IN A SEMICONDUCTOR STRUCTURE
4	20200150363	CONDUCTIVE MULTI-FIBER/PORT HERMETIC CAPSULE AND METHOD
5	20200119516	HERMETIC CAPSULE AND METHOD
6	20200091398	JOSEPHSON JUNCTION USING MOLECULAR BEAM EPITAXY
7	20200088941	PROTECTION LAYERS FOR POLYMER MODULATORS/WAVEGUIDES
8	20200088939	GUIDE TRANSITION DEVICE AND METHOD

9	20200083668	GUIDE TRANSITION DEVICE WITH DIGITAL GRATING DEFLECTORS AND METHOD
10	20190353843	FABRICATION PROCESS OF POLYMER BASED PHOTONIC APPARATUS AND THE APPARTUS
11	20190305039	EPITAXIAL AIN/cREO STRUCTURE FOR RF FILTER APPLICATIONS
12	20190278036	EMBEDDED HERMETIC CAPSULE AND METHOD
13	20190237930	HERMETIC CAPSULE AND METHOD
14	20190227233	RE-based Integrated Photonic and Electronic Layered Structures
15	20190221993	POROUS DISTRIBUTED BRAGG REFLECTORS FOR LASER APPLICATIONS
16	20190204506	PROTECTION LAYERS FOR POLYMER MODULATORS/WAVEGUIDES
17	20190172923	Integrated Epitaxial Metal Electrodes
18	20190148913	GUIDE TRANSITION DEVICE WITH DIGITAL GRATING DEFLECTORS AND METHOD
19	20190139761	Pnictide Buffer Structures and Devices for GaN Base Applications
20	20190122885	GROUP III SEMICONDUCTOR EPITAXY FORMED ON SILICON VIA SINGLE CRYSTAL REN AND REO BUFFER LAYERS
21	20190079243	GUIDE TRANSITION DEVICE AND METHOD
22	20190074365	Integrated Epitaxial Metal Electrodes
23	20190064436	POLYMER MODULATOR AND LASER INTEGRATED ON A COMMON PLATFORM AND METHOD
24	20190028081	LAYER STRUCTURES FOR RF FILTERS FABRICATED USING RARE EARTH OXIDES AND EPITAXIAL ALUMINUM NITRIDE
25	20180259798	DIRECT-DRIVE POLYMER MODULATOR METHODS OF FABRICATING AND MATERIALS THEREFOR
26	20180138284	Integrated Epitaxial Metal Electrodes
27	20180013053	Josephson Junction using Molecular Beam Epitaxy
28	20180012858	RARE EARTH INTERLAYS FOR MECHANICALLY LAYERING DISSIMILAR SEMICONDUCTOR WAFERS
29	20170353002	Rare Earth Pnictides for Strain Management
30	20170141750	LAYER STRUCTURES FOR RF FILTERS FABRICATED USING RARE EARTH OXIDES AND EPITAXIAL ALUMINUM NITRIDE
31	20160133708	STRAIN COMPENSATED REO BUFFER FOR III-N ON SILICON
32	20150014676	III-N MATERIAL GROWN ON REN EPITAXIAL BUFFER ON Si SUBSTRATE
33	20140357014	HIGH EFFICIENCY SOLAR CELL USING IIIB MATERIAL TRANSITION LAYERS
34	20140239307	REO GATE DIELECTRIC FOR III-N DEVICE ON Si SUBSTRATE
35	20140231818	AlN CAP GROWN ON GaN/REO/SILICON SUBSTRATE STRUCTURE
36	20140231817	III-N MATERIAL GROWN ON ALO/ALN BUFFER ON SI SUBSTRATE
37	20140225123	REO/ALO/AlN TEMPLATE FOR III-N MATERIAL GROWTH ON SILICON
38	20140167057	REO/ALO/AlN TEMPLATE FOR III-N MATERIAL GROWTH ON SILICON
39	20140077339	DELTA DOPING AT Si-Ge INTERFACE
40	20140077338	Si-Ge-Sn ON REO TEMPLATE

41	20140077240	IV MATERIAL PHOTONIC DEVICE ON DBR
42	20140076390	III-V SEMICONDUCTOR INTERFACE WITH GRADED GeSn ON SILICON
43	20140053894	GRADED GeSn ON SILICON
44	20140008644	OXYGEN ENGINEERED SINGLE-CRYSTAL REO TEMPLATE
45	20130334536	SINGLE-CRYSTAL REO BUFFER ON AMORPHOUS SiOx
46	20130248853	NUCLEATION OF III-N ON REO TEMPLATES
47	20130214282	III-N ON SILICON USING NANO STRUCTURED INTERFACE LAYER
48	20130153918	REO-Si TEMPLATE WITH INTEGRATED REO LAYERS FOR LIGHT EMISSION
49	20130099357	STRAIN COMPENSATED REO BUFFER FOR III-N ON SILICON
50	20130071960	INTEGRATED RARE EARTH DEVICES
51	20130062610	LATTICE MATCHED CRYSTALLINE REFLECTOR
52	20130062609	III-N FET ON SILICON USING FIELD SUPPRESSING REO
53	20130032858	RARE EARTH OXY-NITRIDE BUFFERED III-N ON SILICON
54	20120280276	Single Crystal Ge On Si
55	20120256232	Multilayer Rare Earth Device
56	20120183767	HEXAGONAL REO TEMPLATE BUFFER FOR III-N LAYERS ON SILICON
57	20120147906	LASER COOLING OF MODIFIED SOI WAFER
58	20120145243	SOLAR CELLS WITH MAGNETICALLY ENHANCED UP-CONVERSION
59	20120104567	IIIOxNy ON REO/Si
60	20120104443	IIIOxNy ON SINGLE CRYSTAL SOI SUBSTRATE AND III n GROWTH PLATFORM
61	20120090672	REO-Ge Multi-Junction Solar Cell
62	20120085399	REO-Ge Multi-Junction Solar Cell
63	20120073648	Photovoltaic conversion using rare earths plus Group IV Sensitizers
64	20120019902	INTERGRATED PUMP LASER AND RARE EARTH WAVEGUIDE AMPLIFIER
65	20110290313	SOLAR CELLS WITH ENGINEERED SPECTRAL CONVERSION
66	20110220173	ACTIVE SOLAR CONCENTRATOR WITH MULTI-JUNCTION DEVICES
67	20110203666	HIGH EFFICIENCY SOLAR CELL USING IIIB MATERIAL TRANSITION LAYERS
68	20110188533	INTEGRATED RARE EARTH DEVICES
69	20110108908	MULTILAYERED BOX IN FDSOI MOSFETS
70	20100122720	Passive Rare Earth Tandem Solar Cell
71	20100116315	Active rare earth tandem solar cell
72	20100112736	FULL COLOR DISPLAY
73	20100109047	Multijunction rare earth solar cell
74	20100084680	SPONTANEOUS/STIMULATED LIGHT EMITTING .mu.-CAVITY DEVICE
75	20090291535	STACKED TRANSISTORS AND PROCESS
76	20080135924	Multilayered box in FDSOI MOSFETS
77	20080093670	SIGNAL AND/OR GROUND PLANES WITH DOUBLE BURIED INSULATOR LAYERS AND FABRICATION PROCESS

78	20070018203	Strain inducing multi-layer cap
79	20070018166	Stacked transistors and process
80	20060246691	Signal and/or ground planes with double buried insulator layers and fabrication process

PATENTS ISSUED: *Current total = 231*

As per the USPTO website the following are *recent* utility patents:

	PAT. NO.	Title
1	11,262,605	Active region-less polymer modulator integrated on a common PIC platform and method

As per the USPTO website the following are published utility patents:

	PAT. NO.	Title
1	11,201,451	Porous distributed Bragg reflectors for laser applications
2	11,201,278	Josephson Junction using molecular beam epitaxy
3	11,067,748	Guide transition device and method
4	11,063,114	III-N to rare earth transition in a semiconductor structure
5	11,042,051	Direct drive region-less polymer modulator methods of fabricating and materials therefor
6	10,989,871	Protection layers for polymer modulators/waveguides
7	10,886,694	Hermetic capsule and method
8	10,825,912	Integrated epitaxial metal electrodes
9	10,754,093	Fabrication process of polymer based photonic apparatus and the apparatus

As per the USPTO website the following are 230 utility patents issued:

	PAT. NO.	Title
1	10,615,141	Pnictide buffer structures and devices for GaN base applications
2	10,605,987	Re-based integrated photonic and electronic layered structures
3	10,591,755	Direct-drive polymer modulator methods of fabricating and materials therefor
4	10,574,025	Hermetic capsule and method for a monolithic photonic integrated circuit
5	10,573,686	Epitaxial AIN/cREO structure for RF filter applications
6	10,566,944	Layer structures for RF filters fabricated using rare earth oxides and epitaxial aluminum nitride
7	10,527,786	Polymer modulator and laser integrated on a common platform and method
8	10,520,673	Protection layers for polymer modulators/waveguides
9	10,511,146	Guide transition device with digital grating deflectors and method
10	10,509,164	Guide transition device and method

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11	10,431,729	Josephson junction using molecular beam epitaxy
12	10,332,857	Rare earth pnictides for strain management
13	10,162,111	Multi-fiber/port hermetic capsule sealed by metallization and method
14	10,128,350	Integrated epitaxial metal electrodes
15	10,075,143	Layer structures for RF filters fabricated using rare earth oxides and epitaxial aluminum nitride
16	9,496,132	Nucleation of III-N on REO templates
17	9,443,939	Strain compensated REO buffer for III-N on silicon
18	9,236,249	III-N material grown on REN epitaxial buffer on Si substrate
19	9,105,471	Rare earth oxy-nitride buffered III-N on silicon
20	8,889,978	III-V semiconductor interface with graded GeSn on silicon
21	8,878,188	REO gate dielectric for III-N device on Si substrate
22	8,872,308	AlN cap grown on GaN/REO/silicon substrate structure
23	8,835,955	IIIO.sub.xN.sub.y on single crystal SOI substrate and III n growth platform
24	8,823,055	REO/ALO/A1N template for III-N material growth on silicon
25	8,823,025	III-N material grown on AIO/AIN buffer on Si substrate
26	8,794,010	Laser cooling of modified SOI wafer
27	8,748,900	Re-silicide gate electrode for III-N device on Si substrate
28	8,680,507	A1N inter-layers in III-N material grown on DBR/silicon substrate
29	8,637,763	Solar cells with engineered spectral conversion
30	8,636,844	Oxygen engineered single-crystal REO template
31	8,633,569	AlN inter-layers in III-N material grown on REO/silicon substrate
32	8,623,747	Silicon, aluminum oxide, aluminum nitride template for optoelectronic and power devices
33	8,559,097	Integrated pump laser and rare earth waveguide amplifier
34	8,553,741	Integrated rare earth devices
35	8,542,437	Earth abundant photonic structures
36	8,501,635	Modification of REO by subsequent III-N EPI process
37	8,455,756	High efficiency solar cell using IIIB material transition layers
38	8,394,194	Single crystal reo buffer on amorphous SiO.sub.x
39	8,331,413	Integrated rare earth devices
40	8,331,410	Spontaneous/stimulated light emitting .mu.-cavity device
41	8,049,100	Multijunction rare earth solar cell
42	8,039,738	Active rare earth tandem solar cell
43	8,039,737	Passive rare earth tandem solar cell
44	7,968,384	Stacked transistors and process
45	7,967,653	Full color display
46	7,821,066	Multilayered BOX in FDSOI MOSFETS
47	7,643,526	Spontaneous/stimulated light emitting .mu.-cavity device
48	7,605,531	Full color display including LEDs with rare earth active areas and different radiative transistions
49	7,579,623	Stacked transistors and process
50	7,538,016	Signal and/or ground planes with double buried insulator layers and fabrication process

51	7,388,230	Selective colored light emitting diode
52	7,365,357	Strain inducing multi-layer cap
53	7,355,269	IC on non-semiconductor substrate
54	7,323,396	Signal and/or ground planes with double buried insulator layers and fabrication process
55	6,999,644	Discrete optoelectric package
56	6,966,703	Self eject latch mechanism for an optical transceiver module
57	6,795,461	Optoelectric module
58	6,663,296	Optoelectric module
59	6,412,989	Directable laser transmission module
60	6,243,056	Transceiver with miniature virtual image display
61	6,228,440	Perishable media information storage mechanism and method of fabrication
62	6,161,106	Perishable media system and method of operation
63	6,158,884	Integrated communicative watch
64	6,156,582	Method of fabricating top emitting ridge VCSEL with self-aligned contact and sidewall reflector
65	6,131,017	Dual system portable electronic communicator
66	6,122,023	Non-speckle liquid crystal projection display
67	6,121,068	Long wavelength light emitting vertical cavity surface emitting laser and method of fabrication
68	6,115,618	Portable electronic device with removable display
69	6,111,839	Optical pickup head including a coherent first order mode laser light source
70	6,097,748	Vertical cavity surface emitting laser semiconductor chip with integrated drivers and photodetectors and method of fabrication
71	6,097,528	Microscanner for portable laser diode displays
72	6,096,666	Holographic textile fiber
73	6,091,754	VCSEL having integrated photodetector for automatic power control
74	6,084,697	Integrated electro-optical package
75	6,080,690	Textile fabric with integrated sensing device and clothing fabricated thereof
76	6,069,593	Display carrier and electronic display control for multiple displays in a portable electronic device
77	6,064,780	Interconnect substrate with a single contact accessible in an upper and an end surface
78	6,061,485	Method for wavelength division multiplexing utilizing donut mode vertical cavity surface emitting lasers
79	6,061,380	Vertical cavity surface emitting laser with doped active region and method of fabrication
80	6,029,073	Display carrier with binocular viewing for a portable electronic device
81	6,026,111	Vertical cavity surface emitting laser device having an extended cavity
82	6,022,760	Integrated electro-optical package and method of fabrication
83	6,021,147	Vertical cavity surface emitting laser for high power single mode operation and method of fabrication

84	6,021,146	Vertical cavity surface emitting laser for high power single mode operation and method of fabrication
85	6,008,067	Fabrication of visible wavelength vertical cavity surface emitting laser
86	5,978,398	Long wavelength vertical cavity surface emitting laser
87	5,974,071	VCSEL with integrated photodetectors for automatic power control and signal detection in data storage
88	5,966,399	Vertical cavity surface emitting laser with integrated diffractive lens and method of fabrication
89	5,959,315	Semiconductor to optical link
90	5,956,364	Vertical cavity surface emitting laser with shaped cavity mirror and method of fabrication
91	5,956,363	Long wavelength vertical cavity surface emitting laser with oxidation layers and method of fabrication
92	5,953,355	Semiconductor laser package with power monitoring system
93	5,946,121	IrDA data link with VCSEL light source
94	5,943,359	Long wavelength VCSEL
95	5,943,357	Long wavelength vertical cavity surface emitting laser with photodetector for automatic power control and method of fabrication
96	5,939,773	Semiconductor laser package including a lead frame and plastic resin housing
97	5,936,929	Optical submodule and method for making
98	5,923,696	Visible light emitting vertical cavity surface emitting laser with gallium phosphide contact layer and method of fabrication
99	5,914,973	Vertical cavity surface emitting laser for high power operation and method of fabrication
100	5,906,004	Textile fabric with integrated electrically conductive fibers and clothing fabricated thereof
101	5,905,750	Semiconductor laser package and method of fabrication
102	5,903,586	Long wavelength vertical cavity surface emitting laser
103	5,898,722	Dual wavelength monolithically integrated vertical cavity surface emitting lasers and method of fabrication
104	5,886,972	Recording information in a phase change optical medium with a vertical cavity surface emitting laser
105	5,883,912	Long wavelength VCSEL
106	5,881,084	Semiconductor laser for package with power monitoring system
107	5,848,086	Electrically confined VCSEL
108	5,838,707	Ultraviolet/visible light emitting vertical cavity surface emitting laser and method of fabrication
109	5,838,703	Semiconductor laser package with power monitoring system and optical element
110	5,835,521	Long wavelength light emitting vertical cavity surface emitting laser and method of fabrication
111	5,831,960	Integrated vertical cavity surface emitting laser pair for high density data storage and method of fabrication
112	5,821,571	Dual sided integrated electro-optical package
113	5,818,404	Integrated electro-optical package

114	5,815,524	VCSEL including GaTlP active region
115	5,796,769	Red light vertical cavity surface emitting laser
116	5,789,733	Smart card with contactless optical interface
117	5,774,486	Waveguide power monitoring system for vertical cavity surface emitting lasers
118	5,764,671	VCSEL with selective oxide transition regions
119	5,757,836	Vertical cavity surface emitting laser with laterally integrated photodetector
120	5,757,829	Flip chip power monitoring system for vertical cavity surface emitting lasers
121	5,757,741	CD ROM head with VCSEL or VCSEL array
122	5,751,757	VCSEL with integrated MSM photodetector
123	5,751,471	Switchable lens and method of making
124	5,748,665	Visible VCSEL with hybrid mirrors
125	5,748,161	Integrated electro-optical package with independent menu bar
126	5,742,630	VCSEL with integrated pin diode
127	5,741,724	Method of growing gallium nitride on a spinel substrate
128	5,739,800	Integrated electro-optical package with LED display chip and substrate with drivers and central opening
129	5,732,103	Long wavelength VCSEL
130	5,719,893	Passivated vertical cavity surface emitting laser
131	5,719,892	Hybrid mirror structure for a visible emitting VCSEL
132	5,710,441	Microcavity LED with photon recycling
133	5,708,280	Integrated electro-optical package and method of fabrication
134	5,706,306	VCSEL with distributed Bragg reflectors for visible light
135	5,703,664	Integrated electro-optic package for reflective spatial light modulators
136	5,699,073	Integrated electro-optical package with carrier ring and method of fabrication
137	5,661,075	Method of making a VCSEL with passivation
138	5,654,228	VCSEL having a self-aligned heat sink and method of making
139	5,644,369	Switchable lens/diffuser
140	5,638,392	Short wavelength VCSEL
141	5,636,298	Coalescing optical module and method for making
142	5,633,886	Short wavelength VCSEL with Al-free active region
143	5,625,734	Optoelectronic interconnect device and method of making
144	5,574,744	Optical coupler
145	5,563,900	Broad spectrum surface-emitting led
146	5,557,626	Patterned mirror VCSEL with adjustable selective etch region
147	5,555,341	Waveguide with an electrically conductive channel
148	5,550,941	Optoelectronic interface module
149	5,546,413	Integrated light emitting device
150	5,545,359	Method of making a plastic molded optoelectronic interface
151	5,543,958	Integrated electro-optic package for reflective spatial light modulators
152	5,540,799	Method of fabricating optical waveguide from a laminate
153	5,539,554	Integrated electro-optic package for reflective spatial light

154	5,539,200	Integrated optoelectronic substrate
155	5,538,919	Method of fabricating a semiconductor device with high heat conductivity
156	5,534,888	Electronic book
157	5,530,715	Vertical cavity surface emitting laser having continuous grading
158	5,521,992	Molded optical interconnect
159	5,517,348	Voltage controlled transparent layer for a bi-directinal device
160	5,511,138	Interlocking waveguide and method of making
161	5,498,883	Superluminescent edge emitting device with apparent vertical light emission and method of making
162	5,493,437	External communication link for a credit card pager
163	5,491,491	Portable electronic equipment with binocular virtual display
164	5,486,946	Integrated electro-optic package for reflective spatial light modulators
165	5,485,318	Dual image manifestation apparatus with integrated electro-optical package
166	5,482,891	VCSEL with an intergrated heat sink and method of making
167	5,482,658	Method of making an optoelectronic interface module
168	5,478,774	Method of fabricating patterned-mirror VCSELs using selective growth
169	5,473,716	Fiber bundle interconnect and method of making same
170	5,469,185	Remote sensory unit and driver
171	5,468,656	Method of making a VCSEL
172	5,468,582	Fused optical layer and method of making
173	5,467,215	Integrated electro-optic package for reflective spatial light modulators
174	5,466,633	Optical reading head and method for making same
175	5,452,387	Coaxial optoelectronic mount and method of making same
176	5,446,752	VCSEL with current blocking layer offset
177	5,437,092	Method of making contact areas on an optical waveguide
178	5,432,809	VCSEL with Al-free cavity region
179	5,432,630	Optical bus with optical transceiver modules and method of manufacture
180	5,428,704	Optoelectronic interface and method of making
181	5,422,901	Semiconductor device with high heat conductivity
182	5,416,870	Optoelectronic interface device and method with reflective surface
183	5,408,547	Optical read/write head
184	5,400,423	Molded star coupler and method of making same
185	5,400,352	Semiconductor laser and method therefor
186	5,390,275	Molded waveguide and method for making same
187	5,389,312	Method of fabricating molded optical waveguides
188	5,388,120	VCSEL with unstable resonator
189	5,369,529	Reflective optoelectronic interface device and method of making
190	5,369,415	Direct retinal scan display with planar imager
191	5,367,593	Optical/electrical connector and method of fabrication

192	5,361,317	Assembly with fixture aligning and affixing an optical fiber to an optical device
193	5,359,686	Interface for coupling optical fibers to electronic circuitry
194	5,359,669	Remote retinal scan identifier
195	5,359,618	High efficiency VCSEL and method of fabrication
196	5,358,880	Method of manufacturing closed cavity LED
197	5,351,331	Method and apparatus for splicing optical fibers with signal I/O
198	5,351,257	VCSEL with vertical offset operating region providing a lateral waveguide and current limiting and method of fabrication
199	5,349,210	Optical reading head with angled array
200	5,348,616	Method for patterning a mold
201	5,345,530	Molded waveguide and method for making same
202	5,345,527	Intelligent opto-bus with display
203	5,345,524	Optoelectronic transceiver sub-module and method for making
204	5,337,397	Optical coupling device and method for making
205	5,337,391	Optoelectronic sub-module and method of making same
206	5,335,300	Method of manufacturing I/O node in an optical channel waveguide and apparatus for utilizing
207	5,325,451	Modular optical waveguide and method for making
208	5,324,964	Superluminescent surface light emitting device
209	5,323,477	Contact array imager with integral waveguide and electronics
210	5,313,545	Molded waveguide with a unitary cladding region and method of making
211	5,309,537	Optoelectronic coupling device and method of making
212	5,286,982	High contrast ratio optical modulator
213	5,282,071	Contact areas on an optical waveguide and method of making
214	5,276,762	Magnetic holding methods for optical fiber I/O assembly
215	5,276,754	Optoelectronic mount and method for making
216	5,271,083	Molded optical waveguide with contacts utilizing leadframes and method of making same
217	5,265,184	Molded waveguide and method for making same
218	5,249,245	Optoelectroinc mount including flexible substrate and method for making same
219	5,230,030	Interface coupling electronic circuitry
220	5,228,101	Electrical to optical links using metalization
221	5,225,816	Electrical connector with display
222	5,218,465	Intelligent interconnects for broadband optical networking
223	5,172,384	Low threshold current laser
224	5,170,448	Optical waveguide apparatus and method for partially collecting light
225	5,125,054	Laminated polymer optical waveguide interface and method of making same
226	5,116,461	Method for fabricating an angled diffraction grating
227	5,068,007	Etching of materials in a noncorrosive environment
228	5,067,829	Dynamic optical beam steering

229	5,045,908	Vertically and laterally illuminated p-i-n photodiode
230	5,034,092	Plasma etching of semiconductor substrates

PUBLICATIONS (Papers)

1. C. Eschenbaum, A. Mertens, C. Fullner, A. Kuzmin, A. Schwarzenberger, A. Kotz, G. Ramann, M. Chen, J. Drisko, B. Johnson, J. Zyskind, J. Marcelli, M. Lebby, W. Freude, S. Randel, C. Koos, "Thermally Stable Silicon-Organic Hybrid (SOH) Mach-Zehnder Modulator for 140 GBd PAM4 transmission with Sub-1V Drive Signals" ECOC Post Deadline session 1; 13:42 to 13:54pm, 22nd September 2022; "Thermally Stable Silicon-Organic Hybrid (SOH) Mach-Zehnder Modulator for 140 GBd PAM4 Transmission With Sub-1 v Drive Signals (Th3B.2) given by Carsten Eschenbaum, *Karlsruhe Inst Tech (KIT)* and SilOriX Gmbh.
2. Amir Abbas Kashi; Jos J. G. M. Van der Tol; Kevin A. Williams; Weiming Yao; Michael S. Lebby; Cory Pecinovsky; and Yuqing Jiao' "**Electro-Optic Slot Waveguide Phase Modulator on the InP Membrane on Silicon Platform**" IEEE Journal of Quantum Electronics, Year: 2021 | Volume: 57, Issue: 1, pages 1-10.
3. Ristic, S.; Tolstikhin, V.; Pimenov, K.; Watson, C.;Florjanczyk, M.; and **Lebby, M**.; "100Gb/s Multi-Guide Vertical Integration Transmitter PIC in InP for Fiber-Optics Interconnects," Poster paper P2.20, ECOC 22-27th Sept, 2013, London, UK http://www.ecoc2013.org/sc2.html.
4. Dargis, R.; Williams, D.; Smith, R.; Arkun, E.; Semans, S; Vosters, G.; **Lebby, M**.; and Clark, A., "Study of the Structural and Thermal Properties of Single Crystalline Epitaxial Rare-Earth-Metal Oxide Layers Grown on Si," (2011); ECS Transactions **doi: 10.1149/1.3633032,** ECS Trans. **2011** volume 41, issue 3, **161-167** http://www.ecsdl.org/getabs/servlet/GetabsServlet?prog=normal&id=ECSTF8000041000003000161000001&idtype=cvips&gifs=yes&ref=no.
5. Dargis, Rytis; Arkun, E. ; Clark, Andrew ; Roucka, R. ; Smith, Robin ; Williams, David ; **Lebby, Michael** ; Demkov, Alexander A. "Rare-earth-metal oxide buffer for epitaxial growth of single crystal GeSi and Ge on Si(111)," Journal of Vacuum Science & Technology Volume:30 Issue:2
6. Dargis. R, Clark. A, Arkun. F.E, Smith. R, **Lebby. M**, "Engineering of the Interface between Silicon and Rare-Earth Oxide Buffer for GaN Growth," ECS Meeting, 27 October, 2013, San Francisco, USA. Doi: 10.1063/1.4753828.
7. Roucka. R, Clark. A, Semans. S, Tolle. J, **Lebby. M,** "Scalable virtual Ge templates for III-V integration on Si wafers," 8th International conference on concentrating photovoltaic systems: CPV8, 16-18th April 2012, Toledo, Spain.
8. R. Dargisa, A. Clarka, E. Arkuna, R. Rouckaa, R. Smitha, A.A. Demkovb, **M. Lebby**a, "Growth and application of epitaxial heterostructures with polymorphous rare-earth oxides," Journal of Crystal Growth, Volume 378, 1 September 2013, Pages 177–179.
9. Rytis Dargis*, Erdem F. Arkun, Radek Roucka, Robin Smith, David Williams, Andrew Clark, **Michael Lebby**, "Epitaxial Si, SiGe and Ge on binary and ternary rare earth oxide

buffers;" physica status solidi (c). Special Issue: E-MRS 2012 Spring Meeting – Symposium A, see further papers in Phys. Status Solidi A 209, No. 10 (2012). Volume 9, Issue 10-11, pages 2031–2035, October 2012.
10. F. Erdem Arkuna, **Michael Lebby**b, Rytis Dargisb, Radek Rouckab, Robin S. Smithb and Andrew Clarkb "Scalable GaN-on-Silicon Using Rare Earth Oxide Buffer Layers," doi: 10.1149/05009.1065ecst *ECS Trans.* 2013 volume 50, issue 9, 1065-1071 [Electrochemical Society].
11. R. Dargisz, A. Clark, E. Arkun, R. Roucka, D. Williams, R. Smith and **M. Lebby** "Epitaxial Si and Gd_2O_3 Heterostructures: Distributed Bragg Reflectors with Stress Management Function for GaN on Si Light Emitting Devices,"; doi: 10.1149/2.004206jss *ECS J. Solid State Sci. Technol.* 2012 volume 1, issue 5, P246-P249.
12. R. Dargisz, D. Williams, R. Smith, E. Arkun, R. Roucka, A. Clark and **M. Lebby** "Structural and Thermal Properties of Single Crystalline Epitaxial Gd_2O_3 and Er_2O_3 Grown on Si(111),"; 10.1149/2.005202jss *ECS J. Solid State Sci. Technol.* 2012 volume 1, issue 2, N24-N28
13. F. Erdem Arkun*, Rytis Dargis, Robin Smith, David Williams, Andrew Clark, **Michael Lebby** "Integrated high reflectivity silicon substrates for GaN LEDs," physica status solidi (c) Volume 9, Issue 3-4, pages 814–817, March 2012.
14. Rytis Dargisa, Andrew Clarka, Erdem Arkuna, Radek Rouckaa, David Williamsa, Robin S. Smitha and **Michael Lebby**a ,"Epitaxial Si and Gd_2O_3 Heterostructures - Distributed Bragg Reflectors with Stress Management Function for GaN on Si Light Emitting Devices,"; doi: 10.1149/05004.0047ecst *ECS Trans.* 2013 volume 50, issue 4, 47-52.
15. Rytis Dargisa, David Williamsa, Robin Smitha, Erdem Arkuna, Scott Semansa, Gary Vostersa**,** **Michael Lebby**a and Andrew Clarka, "Study of the Structural and Thermal Properties of Single Crystalline Epitaxial Rare-Earth-Metal Oxide Layers Grown on Si(111),"; doi: 10.1149/1.3633032 *ECS Trans.* 2011 volume 41, issue 3, 161-167.
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63. **Lebby, Michael Stephen**, "Fabrication And Characterisation Of The Heterojunction Field Effect Transistor (Hfet) And The Bipolar Inversion Channel Field Effect Transistor (Bicfet): Characterisation Of Hfets And Bicfets, Fabricated From Gallium-Arsenide/Aluminum-Gallium - Arsenide With Magnetron Ion Etching, Sputtered Tungsten Gates, Ion Implanted Source/Drain Contacts And Rapid Thermal Anneals," University Of Bradford, UK, 1987.
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PUBLIC MEDIA (Books, Chapters, Reports, Abstracts, Videos, Lectures, Speeches, Reviews, Courses, Talks, Invited Talks, Keynote Talks, Plenary Talks, Webinars, Interviews, Articles, etc.)

1986

1) Paper: A new heterostructure FET
    a. Dec 1986
    b. "Electron Devices Meeting, 1986 International Volume: 32 Digital Object Identifier: 10.1109/IEDM.1986.191323 Publication Year: 1986, Page(s): 817-821"

1987

2) Thesis: Fabrication and characterization of the heterojunction field effect transistor and the bipolar inversion channel field effect transistor
    a. 1987

   b. Characterization of HFETs and BICFETs fabricated from GaAs/AlGaAs with magnetron ion etching, sputtered tungsten gates, ion implanted source/drain contacts and rapid thermal anneals.
   c. University of Bradford, UK 1987
3) Paper: Very high-transconductance heterojunction field-effect transistor (HFET)
   a. Jan 1987
   b. "A new form of FET has been demonstrated in the GaAs/AlGaAs material system. Designated the HFET, it has shown a transconductance of 500mS/mm at 300 K for a nominal Lg = 2/un and a drain current of 430mA/mm. The conduction occurs in an inversion channel at the heterointerface"
   c. "Electronics Letters Volume: 23, Issue: 2 Digital Object Identifier: 10.1049/el:19870056 Publication Year: 1987 , Page(s): 77 - 79"
4) Talk and abstract: Magnetron Ion Etching of self aligned HFETs
   a. May 1987
   b. Electrochemical Society (ECS) Conference proceedings SOTAPOCS VI, Compound Semiconductors, Philadelphia

1988

5) Paper: Demonstration of a p-channel GaAs/AlGaAs BICFET
   a. Feb 1988
   b. "Electron Device Letters, IEEE Volume: 9, Issue: 2 Digital Object Identifier: 10.1109/55.2048 Publication Year: 1988 , Page(s): 84 - 86"
6) Paper: GaAs/AlGaAs inversion channel devices for an integrated opto-electronic technology
   a. Jun 1988
   b. "Electron Devices, IEEE Transactions on Volume: 35, Issue: 12 Digital Object Identifier: 10.1109/16.8871 Publication Year: 1988"
7) Paper: A p-channel BICFET in the InGaAs/InAlAs material system
   a. Jun 1988
   b. "Electron Device Letters, IEEE Volume: 9, Issue: 6 Digital Object Identifier: 10.1109/55.716 Publication Year: 1988 , Page(s): 278 - 280"
8) Paper: An inversion channel technology for opto-electronic integration
   a. Sep 1988
   b. "Optical Communication, 1988. (ECOC 88). Fourteenth European Conference on (Conf. Publ. No.292), Publication Year: 1988, Page(s): 211 - 214 vol.1"
9) Paper: Performance and advantages of BICFETs versus HBTs
   a. Sep 1988
   b. "Bipolar Circuits and Technology Meeting, 1988., Proceedings of the 1988 Digital Object Identifier: 10.1109/BIPOL.1988.51041 Publication Year: 1988 , Page(s): 41- 45"
10) Talk and abstract: RIE and MIE comparison for optoelectronic integrated circuit processing
   a. Nov 1988

b. IEEE LEOS Conference, Santa Clara, California

11) Paper: Reactive ion etching (RIE) and magnetron ion etching (MIE) combinations for opto-electronic integrated circuit (OEIC) processing
    a. Nov 1988
    b. Proc. SPIE Vol. 1037, p. 88, Monitoring and Control of Plasma-Enhanced Processing of Semiconductors, James E. Griffiths; Ed.

1989

1) Paper: An n-channel BICFET in the InGaAs/InAlGaAs/InAlAs material system
    a. 1989
    b. "Electron Device Letters, IEEE Volume: 10 , Issue: 7 Digital Object Identifier: 10.1109/55.29660 Publication Year: 1989 , Page(s): 304 - 306"
2) Paper: An n-channel BICFET in the GaAs/AlGaAs material system
    a. Feb 1989
    b. "Electron Device Letters, IEEE Volume: 10, Issue: 2 Digital Object Identifier: 10.1109/55.32438 Publication Year: 1989 , Page(s): 88 - 90"
3) Paper: An Inversion Channel Technology For Opto-Electronic Integration
    a. 8th Feb 1989
    b. A new approach to optoelectronic integration is reported which combines electronic and optical devices fabricated with a common sequence and a single MBE wafer growth. The devices have in common, an inversion layer structure produced by charge sheet doping.
    c. Proceedings Vol. 0994 Optoelectronic Materials, Devices, Packaging, and Interconnects II, Glen M. McWright; Henry J. Wojtunik, Editors, pp.251-510 Date: 9 February 1989 ISBN: 9780819400291

1991

4) Invited talk and abstract: Use of VCSELs for the MONSOON parallel digital computer
    a. Jan 1991
    b. International workshop on architectures for free-space digital computing, Colorado.
5) Invited Paper and Presentation: Approaching the problem of high-density interconnects in the 'Monsoon' data-flow parallel processor with optics"
    a. 28th Jan1991
    b. AFOSR, ONR, DARPA: A compendium of position papers from the workshop on architectures for free space digital optical computing

1993

6) Invited talk and abstract: Optoelectronic Devices and Applications
    a. 1993
    b. IEEE workshop on optical interconnects

7) Invited talk and abstract: VCSEL Technology and Progress
    a. 1993
    b. IEEE Waves and Devices, Phoenix Section, Tempe, Arizona, Arizona State University

1994

8) Invited talk and abstract: Ridge waveguide VCSELs: improvement over planar VCSELs
    a. May 1994
    b. USA Laser workshop, CLEO, Baltimore, MD
9) Invited talk and abstract: Packaging VCSELs with GUIDECAST(tm) an overmolded waveguide packaging platform
    a. Aug 1994
    b. IEEE Tropical workshop on optoelectronic packaging, Breckenridge, Colorado.

1995

10) Paper: Parallel optical interconnects using VCSELs
    a. 1995
    b. "High Speed Semiconductor Devices and Circuits, 1995. Proceedings., IEEE/Cornell Conference on Advanced Concepts in Digital Object Identifier: 10.1109/CORNEL.1995.482526 Publication Year: 1995 , Page(s): 348 - 356"
11) Book: Research in VCSEL devices - Annual technical review1995
    a. 1995
    b. Annual collection of optoelectronic device and reliability department papers at the photonics technology center, Motorola, Tempe, USA.
    c. Key focus was the commercialization of VCSEL technology, especially at 850nm for the Optobus™ parallel array product and other associated VCSEL prototypes.
    d. Motorola
12) Invited talk and abstract: Ridge waveguide VCSEL device performance
    a. May 1995
    b. USA Laser workshop, CLEO, Anaheim, California
13) Invited talk and abstract: VCSEL Arrays and GUIDECAST(tm) packaging technology as used in OPTOBUS(tm)
    a. Sep 1995
    b. European Laser Workshop, Eindhoven, Netherlands

1996

14) Book: Research in optoelectronic devices volume II
    a. 1996
    b. Annual collection of optoelectronic device and reliability department papers at the photonics technology center, Motorola, Tempe, USA. Key focus was the commercialization of VCSEL technology, especially at 850nm for the optobus

parallel array product and other associated VCSEL prototypes. Demonstration of 660nm VCSELs discussed.

c. Motorola

15) Paper: Low-cost high-performance optical interconnect
    a. 1996
    b. Proceedings, Conference on Lasers and Electro-Optics, (CLEO), vol 9, 1996
16) Paper: Key challenges and results of VCSELs in data links
    a. 1996
    b. "Lasers and Electro-Optics Society Annual Meeting, 1996. LEOS 96., IEEE Volume: 2 Digital Object Identifier: 10.1109/LEOS.1996.571604 Publication Year: 1996 , Page(s): 167 - 168 vol.2"
17) Paper: A low-cost high-performance optical interconnect
    a. 1996
    b. "Components, Packaging, and Manufacturing Technology, Part B: Advanced Packaging, IEEE Transactions on Volume: 19 , Issue: 3 Digital Object Identifier: 10.1109/96.533892 Publication Year: 1996 , Page(s): 532- 539"
18) Paper: Characteristics of VCSEL arrays for parallel optical interconnects
    a. 1996
    b. "Electronic Components and Technology Conference, 1996. Proceedings., 46th Digital Object Identifier: 10.1109/ECTC.1996.517404 Publication Year: 1996 , Page(s): 279 - 291"
19) Paper: Use of VCSEL arrays for parallel optical interconnects
    a. 10th Apr 1996
    b. Proc. SPIE 2683, Fabrication, Testing, and Reliability of Semiconductor Lasers, 81 (April 10, 1996); doi:10.1117/12.237679
20) Paper: A low-cost high-performance optical interconnect
    a. Aug 1996
    b. The Optobus™ link is a ten channel parallel bidirectional data link based on multimode fiber ribbons. The guiding principal of the Optobus™ design was to produce an optical interconnect capable of competing with copper on price, not just performance. Recognizing that packaging dominates the cost of optical interconnects, the design focused on minimizing the complexity of the optical subassembly. A key component of this strategy is the use of AlGaAs/GaAs vertical cavity surface emitting lasers (VCSELs). Another is designing the silicon receiver and transmitter arrays around the module level packaging parasitics. The resulting parallel transceiver modules achieve a minimum throughput of 1.5 Gb/s in each direction with a power dissipation of 1.6 W
    c. Components, Packaging, and Manufacturing Technology, Part B: Advanced Packaging, IEEE Transactions on Volume: 19 , Issue: 3 Page(s): 532- 539
21) Invited talk and abstract: Ridge Waveguide and Planar VCSEL Device Reliability
    a. Sep 1996
    b. European Laser Workshop, Olso, Norway
22) Invited talk and abstract: Vertical cavity surface emitting lasers for communication applications

a. Oct 1996
b. Optical Society of America (OSA) Annual meetings, proceedings, paper WR1, Rochester, NY

23) Paper: Characteristics of VCSELs and VCSEL arrays for Optical Data Links
a. 10th Dec 1996
b. Motorola: Technical Enrichment Matrix Conference, Motorola SPS- SABA, Hilton Pavilion, Mesa, Az

1997

24) Paper: Effect of proton implantation on the degradation of GaAs/AlGaAs vertical cavity surface emitting lasers
a. 1997
b. Electronics Letters, ISSN 0013-5194, 1997, Volume 33, Issue 2, p. 137

25) Paper (invited): Laser safety issues with VCSEL arrays in OPTOBUS(tm)
a. 1997
b. Optical Society of America (OSA); Annual Meeting, Micro-optics session

26) Paper: Relative intensity noise of 780nm vertical cavity surface emitting lasers Jan 1997
a. Proceedings of the 1997 Pacific Rim Conference on Lasers and Electro-Optics, CLEO/Pacific Rim, No 46984, Jan 1997

27) Paper: Characteristics of VCSELs and VCSEL arrays for optical data links
a. Feb 1997
b. Proc. SPIE 3004, Fabrication, Testing, and Reliability of Semiconductor Lasers II, 122 (May 1, 1997); doi:10.1117/12.273825

28) Paper: Parallel interconnect for a novel system approach to short distance high information transfer data links
a. April 1997
b. Proceedings of SPIE, ISSN 0277-786X, 04/1997, Volume 3038, Issue 1

29) Paper: Vertical cavity surface emitting laser packaging with auto power control
a. May 1997
b. Proceedings, 47th Electronic Components and Technology Conference, pp. 368-370, May 1007

30) Course (peer reviewed): "Optoelectronic devices and packaging"
a. May 1997
b. IEEE ECTC

31) Paper: Vertical cavity surface emitting laser packaging with auto power control
a. 18th May 1997
b. Electronic Components and Technology Conference, 1997. Proceedings., 47th

32) Invited Talk and Abstract: VCSEL/detector technology for parallel optical interconnects
a. 17th Jun 1997
b. International Workshop for new technologies, interconnects, and communications in distributed and parallel systems by IRIT, ONERA, CERT, CNRS, and LAAS (France)

33) Invited talk and abstract: Vertical cavity surface emitting lasers and applications
    a. Sep 1997
    b. European Laser Workshop, Glasgow, Scotland

1998

34) Course and Tutorial: Optoelectronic Devices and Packaging: VCSEL Technology
    a. Jan 1998
    b. "Optoelectronic devices and packaging have found increasing use in many new products over the last 20 Yrs. This tutorial primarily will focus on semiconductor laser based technology with particular emphasis on emerging new technologies such as the Vertical Cavity Surface Emitting Laser (VCSEL) and how to take advantage of itâ€™s uniqueness in packaging. The tutorial will look at the driving factors required for low cost high volume VCSEL based packages and what impact they will have in tomorrows products. As there are many packaging solutions for VCSEL based technology proposed, the course will show the relative merits of popular new technologies with respect to high volume and low cost manufacturing.
    c. 4th IEEE Workshop on AST Phoenix Research Center
35) Paper: ORMOCERs - new photo-patternable dielectric and optical materials for MCM-packaging
    a. Jan 1998
    b. Hybrid inorganic-organic polymers (ORMOCERs*) have been developed and tested in an ongoing EU-program (BE 7250 DONDOMCM) for evaluation in MCM applications. The photopattemable materials with negative resist behavior are composed o f inorganic oxidic structures cross-linked or substituted by organic groups. They are prepared from organosilane precursors by sol-gel-processing in combination with organic crosslinking of polymerizable organic functions. As a result of these functionalities the properties of the ORMOCERs can be adjusted to particular applications. Systematic variation of composition combined with adaptation to micro system technology allows great flexibility in processing. Some features of these materials are: Postbaking at moderate temperatures (120 "C - 180 "C) enables processing on substrates such as FR-4 and BT. Combined use as dielectric and passivation layers in electrical systems and devices as well as core and cladding for optical applications enables e/o applications with high integration levels. Easily adaptable to thin film technology: spin-on with planarization >90% and via diameters down to 20 pm have been achieved
    c. Proceedings of the 1998 48th Electronic Components and Technology Conference
36) Paper and Invited talk: VCSEL Devices and Packaging for Fiber Optic Transceivers
    a. 30th Mar 1998
    b. OSA Technical Digest: Integrated Photonics Research (IPR) 1998 paper: IWD1
37) Paper: Automatic power control of a VCSEL using an angled lid TO56 package
    a. May1998

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Ex. 2001 - Page 125

b. 1998 Proceedings. 48th Electronic Components and Technology Conference

38) Paper: O/e-MCM packaging with new, patternable dielectric and optical materials
    a. May 1998
    b. Electronic Components & Technology Conference, 1998. 48th IEEE
39) Paper: ORMOCERs(TM)-new photo-patternable dielectric and optical materials for MCM-packaging
    a. May 1998
    b. Hybrid inorganic-organic polymers (ORMOCERs*) have been developed and tested in an ongoing EU-program (BE 7250 DONDOMCM) for evaluation in MCM applications. The photo-pattemable materials with negative resist behavior are composed of inorganic oxidic structures cross-linked or substituted by organic groups. They are prepared from organosilane precursors by sol-gel-processing in combination with organic crosslinking of polymerizable organic functions. As a result of these functionalities the properties of the ORMOCERs can be adjusted to particular applications. Systematic variation of composition combined with adaptation to micro system technology allows great flexibility in processing. Some features of these materials are: Post baking at moderate temperatures (120 "C - 180 "C) enables processing on substrates such as FR-4 and BT. Combined use as dielectric and passivation layers in electrical systems and devices as well as core and cladding for optical applications enables e/o applications with high integration levels. Easily adaptable to thin film technology: spin-on with planarization >90% and via diameters down to 20 pm have been achieved
    c. 1998 Proceeedings. 48th Electronic Components and Technology Conference
40) Course (peer reviewed): "Optoelectronic devices and packaging: VCSEL technology"
    a. May 1998
    b. IEEE ECTC
41) Co-Chairman Optoelectronics session, 48th ECTC Conference
    a. 25th May 1998
    b. Co-chairman Optoelectronics session, 48th ECTC Conference Seattle, Washington
    c. ECTC, IEEE-CPMT, EIA/ECA
42) Invited Presentation and Abstract: VCSEL Technology - VCSEL technology is discussed with the work between AMP and MODE (division of EMCORE) fiber optics.
    a. Sep 1998
    b. ECOC European Laser Workshop (in association with ECOC 1998, Madrid, Spain
    c. https://openlibrary.org/books/OL22322573M/ECOC_'98_24th_European_Conference_on_Optical_Communication
    d.
43) Paper: Optical bistability in vertical cavity surface emitting lasers with a simple intra-cavity epitaxial absorber layer
    a. 4th Oct 1998

b. Conference Digest: Semiconductor Laser Conference, 1998. ISLC 1998 NARA. 1998 IEEE 16th International

44) Talk: Optical bistability in vertical cavity surface emitting lasers with a simple intra-cavity epitaxial absorber layer
   a. 4th Oct 1998
   b. Conference Digest: Semiconductor Laser Conference, 1998. ISLC 1998 NARA. 1998 IEEE 16th International
   c.
45) Paper: Vertical cavity surface emitting laser-based parallel optical data link
   a. Dec 1998
   b. Optical Engineering, vol 37, no. 12, pp.3113-18, Dec. 1998.
46) Paper: VCSEL devices and packaging
   a. Dec 1998
   b. Proceedings of SPIE, ISSN 0277-786X, 05/2003, Volume 3289, Issue 1

1999

47) Paper and Interviewed Article: Commercial VCSEL Manufacturing
   a. Apr 1999
   b. Compound Semiconductor
48) Course (peer reviewed): "Optoelectronic devices and packaging: VCSEL and edge emitter technology"
   a. May 1999
   b. IEEE Electronics and components technology conference; San Diego, California

2000

49) Invited Panel Session: Opto Electronic Integrated Circuits - More IC than OE?
   a. 5th Mar 2000
   b. "The panel session focused on optical integration for communications. Other panel members included Brendan Hyland CEO of Kymata amongst others.
   c. OSA Executive Forum: Photonics and Telecommunications: the tidal wave of the new millennium
50) Course: Optoelectronics Components and Modules for Datacom and Telecom
   a. May 2000
   b. Optoelectronics components and modules for the Telecommunication industry and Datacom Networks are rapidly advancing in terms of speed, lower cost and design. The main objectives of this course are to review the current and future trends for active devices and packaging technology for discrete components and data network modules. The course will cover in detail the fundamental active III-V devices and components used today and review current trends in both III-V device technology and packaging for telecom and datacom applications.
   c. Proceedings 50th Electronics Components and Technology Conference May 2000
51) Invited Presentation and Abstract: An investor's perspective on optical interconnects

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a. 24th May 2000
b. The talk discusses the investor's perspective on optical interconnects from Intel Capital.
c. IEEE: Workshop on interconnections within high=speed digital systesm

52) Invited Presentation: Optoelectronic Integration for Metro DWDM: Intel's perspective...
a. 3rd Sep 2000
b. As part of the ECOC conference in Munich Germany, this workshop invited 9 speakers to discuss the future of optical networking in metropolitan environments.
c. Electronicast Europe

53) Keynote Presentation: Optoelectronics Integration for Metro DWDM, Intel's Perspective
a. 9th Oct 2000
b. Electronicast Corporations: Optical communications start-up and emerging companies conference

54) Panel Session: Semiconductors to Optics
a. 6th Nov 2000
b. Representing Intel at the conference, the panel explored the reasons why Intel was investing into photonics, optics, and fiber optic communications. Panel moderator was Drew Lanza, VC Morgenthaler.
c. JP Morgan communications components conference: the convergence of optical components and communications ICs

2001

55) Paper: Optical components and their role in optical networks
a. 2001
b. Electronic Components and Technology Conference, 2001. Proceedings., 51st

56) Invited Presentation: "Starting a company and hitting the ground running"
a. 7th Feb 2001
b. Storm Ventures limited partner meeting

57) Keynote Talk: Industry 'Optomism'
a. 30th Apr 2001
b. Electronicast; Fiber Optics for the next decade conference; 13th Annual Monterey conference http://www.electronicastconsultants.com

58) Keynote Talk: Next decade in fiber optic communications
a. 1st May 2001
b. Electronicast: 13th Annual Fiber Optics for the Next Decade Conference

59) Panel session: Next decade in fiber optic communications
a. 2nd May 2001
b. Electroicast: 13th Annual Fiber Optics for the Next Decade Conference
c. http://www.photonics.com/Article.aspx?AID=8916

60) Paper: OEICs: commercialization at last
a. Jul 2001
b. Compound Semiconductor, vol. 7. no. 6, pp. 81-2, 85, July 2001

2002

61) Book chapter: "Optical sources: Light-emitting diodes and laser technology"
    a. Published 2002
    b. "The Handbook includes chapters on all the major industry standards, quick reference tables, helpful appendices, plus a new glossary and list of acronyms. This practical handbook can stand alone or as a companion volume to DeCusatis: Fiber Optic Data Communication: Technological Advances and Trends (February 2002, ISBN: 0-12-207892-6), which was developed in tandem with this book.
    c. Academic Press (1998, 2002); ISBN: 0-12-207892-6; Handbook of Fiber Optic Data Communication By Casimer DeCusatis
62) Book chapter: "Semiconductor laser and light emitting diode fabrication"
    a. Published 2002
    b. "The Handbook includes chapters on all the major industry standards, quick reference tables, helpful appendices, plus a new glossary and list of acronyms. This practical handbook can stand alone or as a companion volume to DeCusatis: Fiber Optic Data Communication: Technological Advances and Trends (February 2002, ISBN: 0-12-207892-6), which was developed in tandem with this book.
    c. Academic Press: Editor DeCusatis: Fiber Optic Data Communication: Technological Advances and Trends (February 2002, ISBN: 0-12-207892-6)
63) Keynote speech: "Business and Technical Perspectives for Optical Networking
    a. 14th Jul 2002
    b. PhoPack 2002 Stanford University
64) Interview Optcon (Japan), "Ignis Optics: Small is beautiful"
    a. 15th Aug 2002
    b. Overview of Ignis Optics strategy for fiber optic transceivers with innovative optoelectronic devices and packaging (in Japanese).
    c. Optcon volume 8, no 161, pp50-51
65) Panel Session: An adventure into venture capital - lessons from silicon valley
    a. 12th Sep 2002
    b. Evening forum discussion chaired by Professor Richard Harrison, Chair, with panel members Pitch Johnson (VC), Brendan Hyland (Nutrior Ventures), Jane Karwoski (All-hotels Ltd), and Colin Rutherford (Intelli Partners). Sponsored by Scottish Development International, University of Edinburgh, British Council
66) Invited Paper: Elegant cost-effective optical subsystems for next generation optical networks
    a. 13th Nov 2002
    b. Electronicast: 4th Annual OADM and advanced photonics communication networks conference - market and technology trends, San Mateo, California

2004

67) Invited Paper (extended abstract) and Presentation: Automated commercial fabrication of wideband tunable lasers using ultra-high resolution e-beam lithography

a. 27th Oct 2004
b. IoP/CS-MAX extended abstract at the Compound Semiconductor Manufacturing Expo, Monterey, California, pp92-94 in the technical digest.

2005

68) Book: Optoelectronic Markets 2005
   a. Jun 2005
   b. Comprehensive market report and forecast of current optoelectronics markets, needs, technologies, and applications. This report forecasts the current state and direction of the optoelectronics industry.
   c. OIDA
69) Cover story/Interview: Does a foundry model add up for InP optoelectronics
   a. Jul 2005
   b. Interview with Michael Hatcher from Compound Semiconductor magazine. Volume 11, Number 7, August 2005 pp 17-19
   c. Compound Semiconductor: Three-fives and silicon heterostructures
70) Short Article: President's Letter to OIDA Membership
   a. Nov 2005
   b. OIDA Newsletter, quarterly from 2005-2009
71) Invited talk: Worldwide Optoelectronic Trends and Economic Opportunities.
   a. 18th Nov 2005
   b. UNCC 4th Annual symposium: UNC Charlotte Center for Optoelectronics and Optical Communications

2006

72) Workshop: 100 Gb Ethernet: The Next Challenge for Communications Systems
   a. 1st Oct 2006
   b. Workshop chairman and editor of the report: Abstract: The communications market is continuously evolving to provide better and cheaper services. These changes have led to the movement away from the traditional voice-switched networks to more data-centric packet networks. This report seeks to examine the next generation of Ethernet devices as we strain the technology limits at 100 Gb/s? How will datacom and telecom networks differ in their approaches? OIDA
73) Workshop: The Challenge for Indium Phosphide Photonic Development and the Optical Foundry
   a. 2006
   b. "Workshop chairman and editor of the report.
   c. Abstract: Indium Phosphide, InP, is a semiconductor material with properties that make it particularly suitable for optoelectronic devices. Optical communications requirements drove its initial development. Recently, the applications for InP semiconductor devices have broadened to include high-speed electronics and optical sensors. This report examines the current state of the InP device market

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and its future direction. Addresses challenges for a pure foundry play and the role for InP devices. Seeks to find the best ways to address the needs for InP device development in the U.S."

d. OIDA

74) Workshop: Nitride LED and Laser Technology and Its Impact on the Display, Medical, and Storage Industries
    a. 2006
    b. Workshop chairman and editor of the report:
    c. Abstract: Since the development of p-type material in 1989, research in nitride emitter technology has developed rapidly over the last 15 years. This material system provided a new range of color applications that could be better utilized and with far better reliability than the II-VI material system. This report examines material systems and developments for short wavelength (green-ultraviolet) lasers and LEDs with techniques such as color-mixing and phosphor conversion.
    d. OIDA
75) Invited Article: A New Model for the Optoelectronic Indium-based Semiconductor Industry
    a. May 2006
    b. OSA: Optics and Photonics News
76) Book: Worldwide Optoelectronics Markets and Trends 2006
    a. Jun 2006
    b. Comprehensive market report and forecast of current optoelectronics markets, needs, technologies, and applications. This report forecasts the current state and direction of the optoelectronics industry.
    c. OIDA, 431 pages
77) Workshop: High Power Diode Laser Sources and Their Impact on Industrial, Medical, and Military Laser Industries
    a. 1st Jul 2006
    b. Workshop chairman and editor of the report:
    c. Abstract: High power semiconductor laser diodes are used in several different market segments today. The technology continues to advance and improvements in efficiency and power are reported each year. Semiconductor laser diodes are used either directly or indirectly to enable new applications or as a replacement for older technology approaches. This report examines practical implementations and limitations for lasers in the 100 W to 100 kW range and roadmaps and developments anticipated over the next five years.
    d. OIDA
78) Workshop: Biophotonic Sensors and Smart Fiber Optic Sensor Networks
    a. 1st Aug 2006
    b. Workshop chairman and editor of the report:
    c. Abstract: This roadmap report examines biophotonic sensor opportunities from many perspectives including; government, industrial, university and venture capital. The markets, technologies, commercialization, and roadmap trends are presented in addition to promising areas for R & D.

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d. OIDA

79) Workshop: Wide Area Surveillance
    a. 1st Oct 2006
    b. Workshop chairman and editor of the report:
    c. Abstract: This report examines wide area surveillance of pipelines and other strategic infrastructure as it is rapidly becoming an important issue on a worldwide basis. The increasing need for surveillance for both homeland security as well as defense applications should make this commercially attractive to both the defense as well as to commercial industry. (Report is 62 pages followed by hard copies of presentations from the forum.)
    d. OIDA
80) Invited Talk: OIDA optoelectronics markets, technology and opportunities for optofluidics
    a. 20th Oct 2006
    b. Organized by the DARPA center for optofluidics: translational research and commercialization workshop.
    c. DARPA Optofluidics industry forum, UCSD San Diego, CA
81) Invited talk: Global optoelectronics technology roadmaps and trends
    a. 27th Oct 2006
    b. UNCC 5th Annual Symposium: UNC Charlotte Center for Optoelectronics and Optical Communications
82) Workshop: Artificial vision systems
    a. 1st Dec 2006
    b. Workshop chairman and editor of the report:
    c. Abstract: The ability to identify objects of interest and emerging threats around a vehicle in real time or by a warfighter looking for threats in a large field of view is currently severely hampered by the limitations of current algorithms and processing platforms. There have been recent advances in several technology areas, which if combined intelligently could solve this hard problem in enhancing situational awareness cost effectively. This report looks at the issues surrounding automated surveillance systems specifically looking at enhanced binoculars and convoy vehicle automated protection systems.
    d. OIDA
83) Keynote address: Global perspectives in optoelectronics and photonics
    a. 6th Dec 2006
    b. Photonics 21: European Union's 7th Framework Program Key Photonics Platform

2007

84) Workshop: Micropackaging for the Next Generation of Optical and Electrical Components
    a. 2007
    b. Workshop chairman and editor of the report:

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c. Abstract: Optical components are ubiquitous. Applications that use them include DVD players, audio devices, cell phones, re-writable drives, projection displays, and communication devices. This report concentrates on the role of micropackaging for the for next generation fiber optic components with an eye towards lower cost and higher volume.
d. OIDA

85) Workshop: Silicon Photonics: Challenges and Future, 2007
a. 2007
b. Workshop chairman and editor of the report:
c. Abstract: Copper interconnects are currently used extensively within the data center environment. Fiber optic technology is used as a connectivity solution when higher performance is required and the cost differential compared to a copper solution is affordable. Fiber optic technology offers several key advantages over copper solutions for data transmission. This report looks at silicon photonics as a potential optical interconnect solution and addresses the issues and technology paths being pursued.
d. OIDA

86) Workshop: Photonic Sensors Roadmapping Report, 2007
a. 2007
b. Workshop chairman and editor of the report:
c. Abstract: This OIDA workshop report examines application specific sensor needs for both the government and the private sector with an emphasis on the oil and gas market, sensing function integration, cost reduction opportunities, and barriers and competing technologies.
d. OIDA

87) Paper: Fiber optic sensing technology: emerging markets and trends
a. 2007
b. Third European Workshop on Optical Fibre Sensors.
c. Edited by Cutolo, Antonello; Culshaw, Brian; Lopez-Higuera, Joshua Miguel.
d. Proceedings of the SPIE, Volume 6619, pp. 661902 (2007). (SPIE Homepage)

88) Article: "Optoelectronics Technology: New and Exciting Markets in Consumer and Entertainment"
a. 10th Jan 2007
b. "The total optoelectronics components and enabled products grew 20% in 2005 to $364 billion, from $304 billion in 2004. Components grew 17% in 2005 to $104 billion, from $89 billion in 2004. When flat panel displays are excluded as components, components grew 10% in 2005 to $30 billion, from $27 billion in the previous year. Enabled products grew 21% to $260 billion in 2005, from $215 billion in 2004.
c. IEEE CPMT Santa Clara

89) Abstract and conference invited talk: The case for a photonics foundry in USA
a. 27th April 2007
b. European Conference on Integrated Optics (2007): Towards foundries for photonic ICs

90) Paper: Optoelectronics Roadmap OIDA-iNEMI
    a. May 2007
    b. IEEE Packaging and Assembly
91) Workshop: 100 Gbit Interconnects and Above: The Need for Speed
    a. 1st May 2007
    b. Workshop chairman and editor of the report:
    c. Abstract: The electronic society we live in today is seeing increased demand for data transfer, internet downloads, online applications, video sharing and storage. The electronic world of banks, companies, universities and governments require large secure datacenters connected to secure networks. This continuously drives for the development of more powerful servers and computer systems. This report examines needs and motivations for optical interconnect implementation. Looks at the applications, history, market drivers, and future issues that affect this crossover.
    d. OIDA
92) Book: 2007 Global Optoelectronics Industry Market Report and Forecast
    a. Jun 2007
    b. Comprehensive market report and forecast of current optoelectronics markets, needs, technologies, and applications. This report forecasts the current state and direction of the optoelectronics industry.
    c. OIDA, 517 pages
93) Paper: Growing at light speed
    a. The article discusses the significance of optoelectronics in high technology manufacturing industries. Optoelectronics components are being used in the manufacturing cameras of mobile phones, plasma display panel TVs and LCD TVs, among others. Since its application allows product differentiation and innovation, it has spurred growth in segments such as the consumer/entertainment, computer and communications industries. The article also discusses the differences in the material and processing equipment such as silicon photonics.
    b. Sep 2007
    c. IEEE Circuits Assembly; Sep 2007, Vol. 18 Issue 9, p44
94) Keynote/special invited talk: "10 Grand Challenges in Photonics"
    a. 31st Oct 2007
    b. Sixth annual symposium UNCC Optoelectronics Center

2008

95) Workshop: Perspectives on the Optoelectronics Industry: Manufacturing in the 21st Century, 2008
    a. 2008
    b. Workshop chairman and editor of the report:
    c. Abstract: This report provides insight and perspectives by senior-level representatives from industry on global trade and manufacturing practices in the

field of optoelectronics. Three areas examined are: 1) Can automation or optical integration relieve the momentum to outsource and off-shore manufacturing from North America? 2) The supply chain and the economics of manufacturing in the U.S., Europe, and Asia, and 30 The implications of offshore manufacturing on both the U.S. defense and commercial market sectors within the different fields of optoelectronics.

d. OIDA

96) Workshop: Perspectives on the Optoelectronics Industry: Innovation, 2008
   a. 2008
   b. Workshop chairman and editor of the report: Abstract: This report documents some of the issues raised at the Optoelectronics Industry Development Association (OIDA) forum and provides a review on the critical issue of innovation in the U.S. and the impact it has on future American competitiveness and technology leadership. This report looks at innovation and R&D from many perspectives: global, business. university, government funding agencies.
   c. OIDA

97) Workshop: Perspectives on the Optoelectronics Industry, 2008
   a. 2008
   b. Workshop chairman and editor of the report:
   c. Abstract: The United States is falling behind in the manufacturing, packaging, and assembling of optoelectronics products. Innovating technology may also be imperiled. This report is the result of the first of three optoelectronic forums sponsored by the Defense Advanced Research Projects Agency (DARPA), This report details the trends, findings, and directions for optoelectronics in each of these market applications. Included in the first chapter of this report is the global optoelectronics summary that was compiled by OIDA in 2007.
   d. OIDA

98) Workshop: Future Optical Communication Systems, 2008
   a. 2008
   b. Workshop chairman and editor of the report:
   c. Abstract: This report examines future optical communication needs and technologies. Topics include: Networks, Core, Metro, and Access Technology, photonic integration, and markets.
   d. OIDA

99) Book chapter: Being an Intrapreneur and Entrepreneur in the Optoelectronics Industry
   a. 2008
   b. This book provides actual entrepreneurial stories giving insight into the pitfalls and successes one might find in starting or even continuing with a small high-tech business. Insights into innovative, speculative, and (largely) successful new ventures, as experienced by those who went through the process, are complemented by comments and observations from others in the field including researchers, economists, investors, regional development agencies, technology transfer organizations, and universities. The book is recommended to entrepreneurs in all high technology disciplines and in particular for students and

early career professionals. It can be also useful for undergraduate and postgraduate courses in entrepreneurship, which many institutions are currently introducing, and to those who are interested in how a high-tech business might develop.

c. SPIE: Engineering a High-Tech Business: Entrepreneurial Experiences and Insights By JosÃ© Miguel LÃ³pez-Higuera, B. Culshaw (Editors) ISBN 978-0-8194-7180-2

2009

100) Workshop: Green Photonics: The Role of Optoelectronics in a Sustainable Future, 2009

a. 2009
b. Workshop chairman and editor of the report:
c. Abstract: This report explores the optoelectronics expectations for green photonics technology, and forecasts the associated markets through 2020. The cultural impact for a green, clean, and energy efficient lifestyle is just beginning. Over the next decade, many innovative new products will emerge in a variety of industries that will better define and demonstrate green photonics technology. It is clear to many that a broad range of products and services that the economy will utilize over the next decade will contain optoelectronics (interchangeable with the term photonics), either as key components or as components that enable better and more efficient systems.
d. OIDA

101) Conference: Optomism: "Powering the green revolution through photonics"

a. 4th Jan 2009
b. "Co-chairman of Optomism conference with Pennwell.
c. OIDA and Pennwell (Laser Focus World)

102) Invited talk, short abstract, and session chairman: Energy Efficient Photonics

a. 19th Mar 2009
b. Summary: Green photonics initiatives: The role of optoelectronics in a sustainable future...
c. European Commission: High Level Event on ICT for Energy Efficiency

103) Trial & Cross: Testimony before the US-China economic and security review commission on the optoelectronics industry

a. 24th Mar 2009
b. "Expert witness and testimony on Capitol Hill
c. Final oral comments: In preparing this testimony, many people I contacted stressed the importance of decisive action by the U.S. government and industry now. Optoelectronics sits at the intersection of multiple technical disciplines. U.S. universities and industry are particularly adept at bringing diverse people together to work on complex problems. We have, by the nature of our inherent diversity, an advantage. What for many presents a challenge, for us comes naturally. Thank you for this opportunity to present our industry's perspective. "

d. United States China Commission

104) Report: Photonics industry-university collaborations (PICs)
a. 1st Jun 2009
b. OIDA Final Technical Report

105) Paper: Green photonics technology and markets
a. Sep 2009
b. Green photonics technology will open up opportunities over the next decade for new and creative products to be designed as the interest in a green, clean and energy efficient lifestyle continues to grow. This overview forecasts the optoelectronics expectations for green photonics technology and associated markets over the next decade and explores just a few of the exciting opportunities from green photonics technology.
c. Electronics Letters, Vol 45, issue 20

106) Paper: Photonic Intgeration: what is the Holy Grail?
a. 14th Oct 2009
b. Compound Semiconductor

107) Keynote talk: Global optoelectronics and green photonics trends
a. 28th Oct 2009
b. UNCC 8th Annual Symposium: Optoelectronics Center

108) Keynote talk and abstract: Is this the rise of green photonics?
a. Dec 2009
b. ICFO (Institut de Ciancies Fotoniques) Barcelona, Spain

109) Book: 2009 Global Optoelectronics Industry Market Report and Forecast
a. Dec 2009
b. Comprehensive market report and forecast of current optoelectronics markets, needs, technologies, and applications. This report forecasts the current state and direction of the optoelectronics industry.
c. OIDA, 545 pages

110) Video presentation: Living at the speed of light
a. 10th Dec 2009
b. Living at the speed of light, hosted by renown physicist Michael Lebby, takes us on a fast paced fly through of the many facets of photonics and how the use of light touches the many aspects of our lives
c. National Research Council: Canadian Photonics Fabrication Centre

111) Book chapter: Packaging of Optical Components and Systems
a. 27th Dec 2009
b. "In this article, several types of semiconductor optical components are introduced, and packaging of optical components and systems will be discussed. Specifically, three common types of optical sources will be addressed: light emitting diodes (LED), edge-emitting semiconductor lasers, and vertical cavity surface emitting lasers (VCSEL).
c. Wiley Encyclopedia of Electrical and Electronics Engineering; DOI: 10.1002/047134608X.W2106; originally published in 1999, Vol 15, pp 499-516; John G Webster (Editor)

2010

112) Workshop: Fabrication Challenges and Opportunities in Photonics, 2010
   a. 2010
   b. Workshop chairman and editor of the report: Abstract: This report examines different operational models employed by industry (fabless, fab-lite, pure play foundry and vertically integrated companies), and the role of governments in stimulating the growth of the photonics industry.
   c. OIDA

113) Video and presentation: Green Photonics: Will it Change our Lives over the Next Decade?
   a. April 2010
   b. Photonics is growing to enable new green technologies and products. Photonics already has a large presence in various modules and components with opportunities to expand to home displays, solar cells, lighting, and various consumer applications. The global optoelectronics industry has a strong outlook for growth in the near future, with even faster growth in green photonics. Green photonics can help reduce greenhouse gas emissions, generate or conserve energy, reduce pollution, and improve human health.
   c. University of California, Santa Barbara: Institute of Energy Efficiency

114) Conference and workshop: 3rd Annual Green Photonics Forum (OIDA Green 2010)
   a. 10th Jun 2010
   b. Conference chairman: OIDA's innovative green photonics forums have become a focal point for photonics and optics in the area of sustainable energy. The annual forum on green photonics, brings together key players involved in developing the technical and business roles of photonics in building a more sustainable and renewable future. Efficiency, monitoring, and energy generation are areas where photonics technology will play a key role and the photonics industry will deliver solutions.
   c. OIDA

115) Paper: Silicon light emitting device based on rare earth oxide superlattice
   a. Sep 2010
   b. 7th IEEE International conference on Group IV photonics, Beijing China

2011

116) Paper: Study of the Structural and Thermal Properties of Single Crystalline Epitaxial Rare-Earth-Metal Oxide Layers Grown on Si(111)
   a. 2011
   b. ECS Transactions 16, 161 (2011)

117) Webinar and presentation
   a. 29th Mar 2011

b. "The future of photonics webinar and presentation: The Future of Photonics: Three Perspectives brings together three expert viewpoints on the future of the photonics industry (Michael Lebby will be the expert on market trends and photonic integrated circuits (PICs)). You will learn: global optoelectronics market outlook through 2021 trends in photonic integrated circuits over the next two decades."
c. Photonics Media
d.

118) Keynote invited speech: Green Photonics and GaN-on-Si for LEDs and Ge-on-Si for high Efficiency Multi-junction for PVs
a. Dec 2011
b. Conference proceedings: High Capacity Optical Networks and Enabling Technologies (HONET), 2011

2012

119) Paper: Structural and Thermal Properties of Single Crystalline Epitaxial Gd2O3 and Er2O3 Grown on Si(111)
a. 2012
b. ECS Journal of Solid State Science and Technology 1, N24 (2012)

120) Paper: Epitaxial Si, SiGe and Ge on binary and ternary rare earth oxide buffers
a. 2012
b. Phys. Status Solidi C 9, 2031 (2012)

121) Paper: Integrated high reflectivity silicon substrates for GaN LEDs
a. 13th Jan 2012
b. Volume 9, Issue 3-4, pages 814-817, March 2012, physica status solidi (c)

122) Paper: Integrated high reflectivity silicon substrates for GaN LEDs
a. 13th Jan 2012
b. "Conference Publication: ICNS-9 “Contributed Article Integrated high reflectivity silicon substrates for GaN LEDs
c. F. Erdem Arkun*,Rytis Dargis, Robin Smith, David Williams, Andrew Clark, Michael Lebby
d. Article first published online: 13 JAN 2012" ICNS-9 “Contributed Article Integrated high reflectivity silicon substrates for GaN LEDs

123) Paper: Rare-earth-metal oxide buffer for epitaxial growth of single crystal GeSi and Ge on Si(111)
a. 1st Mar 2012
b. Conference and journal publication."Rare-earth-metal oxide buffer for epitaxial growth of single crystal GeSi and Ge on Si(111)"
c. With publication details: 28th North American Molecular Beam Epitaxy Conference, Published by AVS through the American Institute of Physics, 2012

ISBN 978-0-9836933-0-7 ISSN: 2166-27646 J.Vac.Sci.Technol B 30(2), Mar/Apr 2012 pp02B110-1 to pp-3B110-6

124) Paper: Scalable virtual Ge templates for III-V integration on Si wafers
   a. 18th April 2012
   b. AIP Conference Proceedings / Volume 1477 / CONCENTRATOR SOLAR CELLS, CELL ASSEMBLIES AND RELATED MATERIALS

125) Paper and talk: Engineering of the Interface Between Silicon and Rare-Earth Oxide Buffer for GaN growth
   a. Sept 2012
   b. ECS Meeting Oct 2013, San Francisco, USA

126) Paper: Scalable GaN-on-Silicon using rare earth oxide buffer layers
   a. 9th Oct 2012
   b. ECS Trans 2013 volume 50, issue 9, 1065-1071

2013

127) Paper: Expitaxial Si and Gd2O3 Heterostructures - Distributed Bragg Reflectors with Stress Management Function for GaN on Si Light Emitting Devices
   a. 2013
   b. ECS Trans 2013 volume 50, issue 4, 47-52

128) Article: OPTICAL MATERIALS: 'On-silicon' engineered substrates speed photonic device development
   a. 1st Apr 2013
   b. Laser Focus World

129) Paper & Poster: 100Gb/s Multi-guide vertical integration transmitter PIC in InP for fiber-optics interconnects
   a. 24th Sep 2013
   b. Sasa Ristic and Michael Lebby, Valery Tolstikhin, and Kirill Pimenov,
   c. ECOC 2013

130) Paper: Epitaxial Si and Gd2O3 Heterostructures - Distributed Bragg Reflectors with Stress Management Function for GaN on Si Light Emitting Devices
   a. 1st Oct 2012
   b. ECS J. Solid State Sci. Technol. 1, 246 (2012)

131) Growth of GaN by MOCVD on rare earth oxide on Si(111)
   a. 31st Oct 2013
   b. ECS Transactions, 58, 455 (2013)

132) Invited talk/plenary: Next generation ICs using photonics integration
   a. 10th Dec 2013
   b. Talk that reviews OneChip Photonics technology and in general PICs, OEICs, Silicon photonics, and how these technologies play into datacenters (data centers) for client side high speed 100G fiber (fibre) optic transceiver interconnects and cabling.

c. IQE Capital markets day, Sky Pavillion, Rothschild Building, London, UK

133) Poster paper: A versatile InP OEIC (PIC) platform enabling 100G+ coherent receiver and client-side transceiver engines
   a. 12th Nov 2013
   b. Poster paper describing OneChip's latest results in coherent receivers, LR4 optical engines, and PSM4 optical engines.
   c. Silicon Photonics Workshop, Southampton University, UK

134) Talk and panel session: Approaches for combining 3-5 and silicon, add functionality to Si photonics, heterogeneous versus hybrid integration, introduction of photonic platforms
   a. 5th Dec 2013
   b. Short presentation on PICs, OEICs, Si photonics, and combinations of these technologies from a revenue, investment, application and technology standpoint.
   c. EPIC workshop: Meet or eat? collaboration and/or competition in photonic integrated circuits (PICs)

135) Invited talk: Feedback USA/International related events
   a. 5th Dec 2013
   b. Feedback on the subject of InP PICs, OEICs, and silicon photonics from workshops and related international events from around the globe.
   c. EPIC workshop: Meet or eat? Collaboration and/or competition in Photonic Integrated Circuits (PICs)?

2014

136) Invited talk/plenary: High-Performance Datacenter Platform: Using InP for Silicon Photonics
   a. 8th Jan 2014
   b. IEEE-CPMT/Photonics Society local chapter meeting, Santa Clara, California

137) Invited talk/Panel session “Optical interconnect in datacenters”
   a. 18th Mar 2014
   b. "The 1st Optical Interconnect in Data Centers Symposium takes place on the 18th and 19th of March 2014 in Berlin/ Germany.
   c. It is focused on high-performance, low-energy and low-cost and small-size optical interconnects across the different hierarchy levels in data center and high-performance computing systems: on-board, board-to-board and rack-to-rack.
   d. EPIC: Symposium on optical interconnect in datacenters

138) Keynote talk: Photonic integration in InP: A regrowth-free platform for fabless manufacturing model
   a. 19th March 2014
   b. CS International Conference Frankfurt, March 17th-20th 2014

139) Invited talk/Panel session: InP based photonics integration platform for datacenter and coherent communications
   a. 2nd April 2014

b. Invited talk/panel session on the future of integrated photonics. Discussion was on both InP and silicon photonics technologies over the next decade.
c. Workshop on the future of Integrated Photonics organized by the Netherlands Office for Science & Technology is pleased to invite you to a workshop, occurring in conjunction with the upcoming Photonics West conference

140) Invited talk and abstract: Coherent Receiver Chip for 100G DP-QPSK
a. 30th April 2014
b. SIOE (Semiconductor and integrated optoelectronics) Conference, Cardiff, Wales, UK 29th April-1st May 2014, Institute of Physics

141) Invited talk/keynote lecture: Compound semiconductors driving photonics technologies to become the future for high-speed communications through integration, performance, and sustainability
a. 12th Jun 2014
b. Glyndwr University, Wales, UK

142) Invited Talk/Panel session: EPIC technology workshop on Photonic Integrated Circuits (PIC) packaging standardization
a. 18th Jun 2014
b. EPIC

143) Invited talk: Compound Semiconductors (CS) driving photonics
a. 11th June 2014
b. Invited presentation for Welsh Gvt and commercial industry in epitaxial growth. The talk covered photonics: global markets, green photonics, photonics technology sectors (lighting, solar, displays, sensors, communications), integrated photonics and silicon photonics. Commercial industry invite by International Quantum Epitaxy (IQE)
c. Growth and application of epitaxial heterostructures with polymorphous rare earth oxides
d. Journal of Crystal Growth

144) Invited presentation for Day of Photonics at Glyndwr University: Photonics - markets, applications, integrated, next generation IC
a. 21st Oct 2014
b. Invited presentation/lecture on photonics at the Glyndwr University.
c. Welsh Optoelectronic Forum (WOF)

145) Invited talk and moderator: Integrated photonics pilot lines
a. 14th Nov 2014
b. "Photonics Pilot Line Workshop 14 November 2014 - Brussels, Belgium
c. European Commission and Photonics21

2015

146) Invited talk: Integrated photonics roadmap synthesis
a. 7th May 2015
b. Integrated Photonics Institute for Manufacturing Innovation (IP-IMI) site visit technical review:

c. The University of Southern Californiaâ€™s (USC) Information Sciences Institute (ISI) is leading an effort with partner universities at the University of California-Los Angeles (UCLA), the University of California-Berkeley (UCB), the University of California-San Diego (UCSD), Arizona State University, the University of New Mexico, and the Ohio State University, as well as numerous industry partners, to develop the only California-based and led proposal to compete for the IP-IMI award. If successful, the proposal will receive a federal award of up to $110 million over five years. A successful proposal requires 100 percent or more in matching funds (cash or in-kind) from state and local governments and from industry partners.
d. IPI-CDMS (Integrated Photonics Institute and Center for Design and Manufacturing Services)

147) Invited talk and Chair panel session: EPIC workshop on photonic integrated circuits; "Global integrated photonics update and roadmaps"
a. 9th Jun 2015
b. "Invited talk: Global integrated photonics update and roadmaps
c. Panel Session: Integrated photonics foundry status
d. EPIC trade association, Europe

148) Keynote talk and invited abstract: "Integrated photonics as a vehicle for the next generation IC"
a. 9th Sep 2015
b. Internet Technology Applications (ITA) ITA-15 conference Wrexham, Wales, UK 8-11th Sept 2015

149) Press interview: "Building Big Business with the Next Generation Integrated Circuits!"
a. 15th Sep 2015
b. "Insights from Michael Lebby, CEO OneChip Photonics Corporation, the keynote speaker at the Photonics Integration Conference
c. Photonics Integration Conference, organized by Jakajima, Netherlands

150) Project advisor: European Commission ICT-28-2015 Cross-Cutting ICT KETs: Innovation Action (b) Pilot line for OLEDs on flexible substrates
a. 20th Sept 2015
b. European Commission

151) Project advisor: European Commission ICT-28-2015 Cross-Cutting ICT KETs: Innovation Action (b) Pilot line for analytical mid-infrared (MIR) micro-sensors
a. 22nd Sep 2015
b. European Commission

152) Keynote talk and abstract: "PIC the next generation IC..."
a. 23rd Sep 2015
b. Photonic Integration Conference, organized by Jakajima, Netherlands

153) Project advisor: European Commission ICT-28-2015 Cross-Cutting ICT KETs: Innovation Action (b) Pilot line for PIC fabrication on III-V and/or dielectric based platforms for PICs (Photonic Integrated Circuits)
a. 24th Sep 2015

b. European Commission

154) Session organizer/Committee member: Market Focus at ECOC exhibit 2015
   a. 28th Sep 2015
   b. Session organizer/Committee member: Market Focus at ECOC exhibit 2015 with sessions in broadband access, datacentres, service provider optical transmission, network agility/SDN, photonics integration and packet optical transport. Nexus Business Media Ltd

2016

155) Reviewer: European Commission ICT-29-2016: Photonics KET 2016 (section a(i) Biophotonics: advanced imaging for in-depth disease diagnosis)
   a. 10th May 2016
   b. European Commission
   c. http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5094-ict-29-2016.html

156) Reviewer: European Commission ICT-29-2016: Photonics KET 2016 (a(iii) Pervasive high-specificity and high-sensitivity sensing for a safer environment)
   a. 12th May 2016
   b. European Commission

157) Reviewer: European Commission ICT-29-2016 Photonics KET (b) Innovation Actions (i) Application driven core photonic devices integrated in systems.
   a. 14th May 2016
   b. European Commission

158) European Commission Reviewer: European Commission ICT-29-2016 Photonics KET (b) Innovation Actions (ii) Pilot line for assembly and packaging
   a. 15th May 2016
   b. European Commission

159) Invited Talk: Annual Shareholder Meeting 2016 - Market Perspective LWLG Polymer Photonics vs Legacy Devices
   a. 20th May 2016
   b. Presentation to investor group at Lightwave Logic's Annual Shareholder Meeting Lightwave Logic

160) Technical presentation for Lightwave Logic Inc., at the Annual Shareholder Meeting (ASM).
   a. 20th May 2016
   b. Lightwave logic Inc., Boulder, Colorado.
   c. Annual shareholder meeting for Lightwave Logic Inc., with live presentation with live Q&A from investors

161) Invited Presentation and abstract: "High-Performance Polymer Photonics for Next-Generation Photonic Integrated Circuits"
   a. 3rd Oct 2016
   b. ECOC Market Focus by ECOC Exhibition

162) Video Interview: ECOC Market Focus on Datacenters and emerging new PIC technologies that include silicon and polymer photonics
    a. 3rd Oct 2016
    b. Video taped interview by ECOC Exhibition Market Focus on Datacenters and emerging new PIC technologies that include polymer photonics.
    c. ECOC Exhibition
163) Panel session: European Commission ICT-29-2016: Photonics KET 2016 (section a(ii) Breakthrough in miniaturization of SSL light engines and systems); comment on industry and academic technology.
    a. 5th Nov 2016
164) Reviewer: European Commission ICT-29-2016: Photonics KET 2016 (section a(ii) Breakthrough in miniaturization of SSL light engines and systems)
    a. 5th Nov 2016
    b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2020, and rate proposals to EU guidelines.

2017

165) Invited Talk and Panelist: Emerging Technologies Summit; Integrated Photonics session, Stanford University, as part of the Kingdom of the Netherlands trade mission to Silicon Valley
    a. 10th Jan 2017
    b. "Discussion with HRH Prince Constantijn and DG Bertolt Leeftink about photonics ecosystem and startups. Photonics highlights (Michael Lebby)
    c. Consulate General San Francisco, The Kingdom of Netherlands
166) Video: The importance of photonics roadmapping
    a. 30th Jan 2017
    b. Video on the importance of roadmapping photonics technologies at Photonics West San Francisco, 30th Jan 2017. Interview by Photon Delta.
167) Technical Advisor/Expert: 2nd review of MIRPHAB pilot line consortium funded by H2020 at European Commission
    a. 20th Feb 2017
    b. 2nd review for MIRPHAB consortium at the European Commission, Brussels
    c. European Commission, Brussels
168) Technical Advisor/Expert: 2nd review of PI-SCALE project pilot line funded by H2020, European Commission
    a. 21st Feb 2017
    b. 2nd review of PI-SCALE consortium pilot line at European Commission, Brussels
    c. European Commission, Brussels, Belgium
169) Technical Advisor/Expert: 1st review of PIXAPP pilot line consortium funded by H2020 at European Commission
    a. 21st Feb 2017
    b. 1st Review of Pixapp project at EU Commission as part of the pilot line project.

c. European Commission, Brussels

170) Invited Talk: Belgium LWLG Investor Group at the Royal Antwerp Golf Club
   a. 6th Mar 2017
   b. Invited talk entitled "High performance polymer photonics for next generation PICs"
   c. Belgium LWLG Investor Group

171) Chairman: PIC (Photonic Integrated Circuits) International Conference, Brussels, Belgium
   a. 7th Mar 2017
   b. "Photonic Integrated Circuits International
   c. CS International

172) Invited Talk: Photonics Integration Circuits - Global Market Analysis 2017
   a. 13th Mar 2017
   b. Invite by The Netherlands Department of Economics to review PIC technology and markets for potential investment.
   c. The Dutch Government - Dept of Economics, The Hague together with Photon Delta, The Netherlands

173) Technical Advisor/Expert: 2nd review of PIX4LIFE pilot line consortium funded by H2020 at European Commission
   a. 14th Mar 2017
   b. 2nd review of PIX4LIFE pilot line consortium at the European Commission, Brussels.
   c. European Commission, Brussels, Belgium

174) Keynote talk: Entitled "The rise of PIC based technologies over the next decade and how datacenters and telecom may enable other exciting applications"
   a. 1st May 2017
   b. Xilinx as part of their; "Xilinx silicon technology series seminars"

175) Invited Talk: Lightwave Logic Inc Annual Shareholder Meeting "High Performance Polymer Photonics for Next Generation PICs"
   a. 18th May 2017
   b. Presentation of corporate technology and strategy for Lightwave Logic Inc and polymer PIC platforms.
   c. Lightwave Logic Inc (OTCQB:LWLG)

176) Management/CEO presentation for Lightwave Logic Inc., at the Annual Shareholder Meeting (ASM).
   a. 18th May 2017
   b. Lightwave logic Inc., Boulder, Colorado.
   c. Annual shareholder meeting for Lightwave Logic Inc., with live presentation with live Q&A from investors.

177) Plenary Talk: Global Market Research at the World Technology Mapping Forum, s'Hertogenbosch, Netherlands
   a. 14th Jun 2017
   b. "PhotonDelta and the AIM Photonics Academy are organising the first meeting of the World Technology Mapping Forum. The goal of the forum is to produce the

first International Photonic Systems Roadmap, looking ahead to global technology needs in 2030 and beyond.

c. PhotonDelta, Netherlands as part of the International Photonics System Roadmap (IPSR) conference

178) Video interview: World Photonic Mapping Forum; s'Hertogenbosch, Netherlands
   a. 15th Jun 2017
   b. Interview on photonics roadmaps.
   c. PhotonDelta (via Videographer Jonathan Marks)

179) Invited video 'Lightwave Logic roadmaps for polymer photonics at the 3rd International Roadmap conference, Eindhoven, Netherlands
   a. 16th June 2017
   b. PhotonDelta video PR team

180) Invited talk and abstract: Polymer based PICs
   a. 14th Sep 2017
   b. ECOC, Datacenter technologies. Sweden

181) Video: Polymer based PICs
   a. 15th Sep 2017 ECOC, Sweden as part of Market Focus at the ECOC Exhibit. (youtube: Michael Lebby ECOC 2017)

182) Keynote invited talk and abstract: PIC based technologies
   a. 22nd Sep 2017
   b. PIC Conference, The Netherlands

183) Invited talk and abstract: Polymer PIC technology as part of the Photonics Integrated Circuits (PIC) conference in Eindhoven, Netherlands.
   a. 5th Oct 2017
   b. PIC technologies and polymer photonics

184) Invited talk: PIC Training conference/workshop in Sunnyvale, Silicon Valley
   a. PIC training session/workshop

185) Invited talk: Photonics Pilot Lines
   a. 8th Dec 2017
   b. European Commission, Photonics Proposers Meeting, Brussels

2018

186) International Roadmap meeting at Berenshot, Utrecht, Netherlands
   a. 20th Jan 2018
   b. Invited talk: International Roadmap meeting: Datacom/Telecom ICT markets, AOC, and Polymer PIC technology platforms

187) Co-Chairman: PIC (Photonic Integrated Circuits), International Conference, Brussels, Belgium
   a. 10th Apr 2018
   b. Photonic Integrated Circuits International
   c. CS International

188) Session chair and moderator: High volume, high performance PICs (Photonic Integrated Circuits) at the International Conference, Brussels, Belgium

a. 10th Apr 2018
b. Photonic Integrated Circuits International
c. CS International

189) Session chair and moderator: Silicon Photonics (SiP) PICs (Photonic Integrated Circuits) at the International Conference, Brussels, Belgium
a. 11th Apr 2018
b. Photonic Integrated Circuits International
c. CS International

190) Invited Talk: Scalable PIC platforms: "The impact of using polymer PICs for 100 and 400Gbps datacom applications," PICs (Photonic Integrated Circuits) at the International Conference, Brussels, Belgium
a. 10th Apr 2018
b. Photonic Integrated Circuits International
c. CS International

191) Management/CEO presentation for Lightwave Logic Inc., at the Annual Shareholder Meeting (ASM).
a. 17th May 2018
b. Lightwave logic Inc., Denver, Colorado.
c. Annual shareholder meeting for Lightwave Logic Inc., with live presentation with live Q&A from investors.

192) Invited video 'Welcome to WTMF 18' at the 2nd International Roadmap conference, Eindhoven, Netherlands
a. 12th June 2018
b. PhotonDelta video PR team

193) Reviewer: European Commission ICT-03-2018: Photonics Pilot lines (InP and silicon photonics PICs)
a. 11th Jun 2018
b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2020, and rate proposals to EU guidelines.

194) Reviewer: European Commission ICT-04-2018: Tbps optical fiber optic transceivers
a. 11th Jun 2018
b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2020, and rate proposals to EU guidelines.

195) Reviewer: European Commission ICT-04-2018: Connected lighting
a. 11th Jun 2018
b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2020, and rate proposals to EU guidelines.

196) Workgroup chair and moderator: Telecom long haul roadmap committee at the International world mapping conference, Enschede, Netherlands
a. 20th Jun 2018
b. Photondelta Conference: chairing technical workgroup meetings to address photonics roadmap trends and challenges.
c. Photondelta in coordination with iNEMI, and AIM photonics.

197) Invited talk: Telecom, Datacom, and ICT roadmap committee at the International world mapping conference, Enschede, Netherlands
   a. 20th Jun 2018
   b. Photondelta Conference: chairing technical workgroup meetings to address photonics roadmap trends and challenges.
   c. Photondelta in coordination with iNEMI, and AIM photonics.

198) Invited talk and abstract: Pushing the performance of 50Gbps NRZ polymer modulators towards 100Gbps NRZ in a PIC platform to access 400 and 800Gbps data-rates
   a. 25th Sep 2018
   b. ECOC, Datacenter technologies. Sweden

199) Reviewer (European Commission) for pilot line PISCALE
   a. 18th Sept 2018
   b. European Commission, Brussels
   c. PISCALE is a pilot line that is focused on bringing to commercial market flexible organic display technologies in both panel and reel to reel formats.

200) Reviewer (European Commission) for pilot line MIPHAB
   a. 19th Sept 2018
   b. European Commission, Brussels
   c. MIPHAB is a pilot line that is focused on bringing to commercial market near infra-red devices and packaging for industrial, defense, military and high volume applications.

201) Video: Pushing the performance of 50Gbps NRZ polymer modulators towards 100Gbps NRZ in a PIC platform to access 400 and 800 Gbps datarates.
   a. 25th Sept 2018
   b. ECOC, Market Focus at the ECOC Exhibit, (Youtube: Michael Lebby ECOC 2018)

202) Invited talk and abstract: ECOC International Symposium on Hybrid PICs entitled “Polymer PICs: technology and prospects"
   a. 26th Sept 2018
   b. International Symposium on Hybrid PICs co-located at the ECOC conference, Rome, Italy.

203) Reviewer (European Commission) for pilot line PIXAPP
   a. 2nd Oct 2018
   b. European Commission, Brussels
   c. PIXAPP is a pilot line that is focused on bringing to commercial market PIC (photonic integrated circuit) packaging solutions for InP and silicon photonics based technologies.

204) Reviewer (European Commission) for pilot line PIX4LIFE
   a. 3rd Oct 2018
   b. European Commission, Brussels
   c. PIX4LIFE is a pilot line that is focused on bringing to commercial market PIC dielectric solutions for applications in the visible wavelength range in the medical applications market.

2019

205) Invited talk: Polymer modulators and polymer PIC technologies: PIC Training conference/workshop in Sunnyvale, Silicon Valley
   a. 28th Jan 2019
   b. PIC training session/workshop at Keysight facility
206) Reviewer (European Commission) for pilot line MIPHAB
   a. 16th Feb 2019
   b. European Commission, Brussels
   c. MIPHAB is a pilot line that is focused on bringing to commercial market near infra-red devices and packaging for industrial, defense, military and high volume applications.
207) Reviewer (European Commission) for pilot line PIX4LIFE
   a. 25th Mar 2019
   b. European Commission, Brussels
   c. PIX4LIFE is a pilot line that is focused on bringing to commercial market PIC dielectric solutions for applications in the visible wavelength range in the medical applications market.
208) Co-Chairman: PIC (Photonic Integrated Circuits), International Conference, Brussels, Belgium
   a. 26-27th Mar 2019
   b. Photonic Integrated Circuits International
   c. CS International
209) Session chair and moderator: High volume, high performance PICs (Photonic Integrated Circuits) for Foundries at the International Conference, Brussels, Belgium
   a. 26th Mar 2019
   b. Photonic Integrated Circuits International
   c. CS International
210) Session chair and moderator: High volume PICs (Photonic Integrated Circuits) at the International Conference, Brussels, Belgium
   a. 27th Mar 2019
   b. Photonic Integrated Circuits International
   c. CS International
211) Invited Talk: Polymer PICs for 400Gbps+ datacom applications," PICs (Photonic Integrated Circuits) at the International Conference, Brussels, Belgium
   a. 27th Mar 2019
   b. Photonic Integrated Circuits International
   c. CS International
212) Reviewer (European Commission) for project CARDIS
   a. 18th Apr 2019
   b. European Commission, Brussels
   c. CARDIS is an EU project for PIC based technology to monitor blood flow and artery stiffness in the human body using long wavelength lasers and silicon photonics.

213) Management/CEO presentation for Lightwave Logic Inc., at the Annual Shareholder Meeting (ASM).
   a. 16th May 2019
   b. Lightwave logic Inc., Denver, Colorado.
   c. Annual shareholder meeting for Lightwave Logic Inc., with live presentation with live Q&A from investors with presentation:

214) Reviewer: European Commission ICT-03-2019: Fiber optic communications and bio-photonics for medical applications
   a. 6th June 2019
   b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2020, and rate proposals to EU guidelines.

215) Workgroup chair and moderator: Datacom roadmap committee at the International world mapping conference, Berlin, Germany
   a. 12th June 2019
   b. Photondelta Conference: chairing technical workgroup meetings to address photonics roadmap trends and challenges.
   c. Photondelta in coordination with iNEMI, and AIM photonics.

216) Keynote speaker: 'Global markets for PIC technologies' at the 3rd International world mapping conference, at the Fraunhofer HHI, Berlin, Germany
   a. 15th June 2019
   b. Photondelta Conference: chairing technical workgroup meetings to address photonics roadmap trends and challenges.
   c. Photondelta in coordination with iNEMI, and AIM photonics.

217) Reviewer: European Commission ICT-05-2019: Pilot lines (free form optics and integrated photonics for bio-medical applications
   a. 16th June 2019
   b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2020, and rate proposals to EU guidelines.

218) Invited speaker: 'Lightwave Logic polymer modulator platform' at the Spring Investor Conference, NYC, NY
   a. 2nd April 2019
   b. Spring Investor Summit (Microcap Conference)

219) Invited video 'Lightwave Logic polymer modulator platform' at the Spring Investor Conference, NYC, NY
   a. 2nd April 2019
   b. Spring Investor Summit (Microcap Conference)

220) Invited video 'Lightwave Logic advancing its silicon photonic prototypes" by Proactive, NY
   a. 2nd April 2019
   b. Proactive video (Wall St) series
   c. Lightwave Logic, Inc. (OTCQX: LWLG) CEO Michael Lebby tells Proactive the Englewood, Colorado-based technology platform company is in discussions with large and small players within the telecommunications and data-communications space, including companies who are involved in the manufacturing routers.

221) Reviewer: (European Commission) for project InSiDe
   a. 29th Apr 2019
   b. European Commission, Brussels
   c. InSiDe is an EU project for PIC based technology in the medical field to monitor blood flow and artery stiffness in the human body using long wavelength lasers and silicon photonics. Hospital clinical trials will be conducted. It is a follow-on with more clinical trials from the initial CARDIS EU project.

222) Invited video Interview by EPIC CTO Jose Pozo in EPIC's Photonics Industry Luminary video series.
   a. 28th Jan 2019 (at Photonics West conference in San Francisco)
   b. EPIC Trade Association, Europe

223) Invited video 'Global Markets and Trends' at the 3rd International Roadmap conference, Faunhofer HHI, Berlin Germany
   a. 16th June 2019
   b. PhotonDelta video PR team

224) Reviewer (European Commission) for pilot line PISCALE
   a. 11th Sept 2019
   b. European Commission, Brussels
   c. PISCALE is a pilot line that is focused on bringing to commercial market flexible organic display technologies in both panel and reel to reel formats.

225) Invited talk and abstract: ECOC International Symposium on Hybrid PICs entitled "Polymer modulators enable the next generation of speeds and low power in optical networks"
   a. 22nd Sept 2019
   b. International Symposium and workshop (WO5) on Hybrid PICs,
   c. ECOC conference 2019, Dublin, Ireland
   d. https://www.ecoc2019.org/workshop.html

226) Invited talk and abstract: "Polymer modulators with >50GHz performance for power consumption reduction at 400, 800, and 1600 Gbaud aggregated data-rates"
   a. 24th Sept 2019
   b. Market Focus Session, Photonics Integration and Digital Silicon Photonics,
   c. ECOC 2019, Dublin, Ireland
   d. https://www.ecocexhibition.com/visit/market-focus/market-focus-2019-timetable/

227) Video: Polymer modulators with >50GHz performance for power consumption reduction at 400, 800, and 1600 Gbaud aggregated datarates"
   a. 24th Sept 2019
   b. ECOC, Market Focus at the ECOC Exhibit, (Youtube: Michael Lebby ECOC 2019)
   c. ECOC 2019, Dublin, Ireland

228) Chairman and moderator, Market Focus ECOC 2019 session: Service and Content Provider Optical Transmission
   a. 24th Sept 2019
   b. Market Focus Session #5, ECOC 2019, Dublin, Ireland
   c. https://www.ecocexhibition.com/visit/market-focus/market-focus-2019-timetable/

229) Chairman and moderator, Market Focus ECOC 2019 session: Optical Network Agility/Software Defined Networks
   a. 24th Sept 2019
   b. Market Focus Session #7, ECOC 2019, Dublin, Ireland
   c. https://www.ecocexhibition.com/visit/market-focus/market-focus-2019-timetable/
230) Reviewer (European Commission) for pilot line MIPHAB
   a. 10th Dec 2019
   b. European Commission, Brussels
   c. MIPHAB is a pilot line that is focused on bringing to commercial market near infra-red devices and packaging for industrial, defense, military and high-volume applications.

2020

231) Webinar: Wall Street resource
   a. 9th Jan 2020
   b. Lightwave Logic HQ facilities in Denver, Colorado
   c. A 30min recorded webinar answering questions on Lightwave Logic and its business plans, technology and plans for the future.
232) Invited video Interview by EPIC in EPIC's Photonics Industry video series on European funded pilot lines.
   a. 5th Feb 2020 (at Photonics West conference in San Francisco)
   b. EPIC Trade Association, Europe
233) Reviewer (European Commission) for pilot line InPULSE
   a. 19th Mar 2020
   b. European Commission, Brussels
   c. InPULSE is a pilot line that is focused on bringing to commercial market InP based photonic integrated circuits (PICs) for fiber communications, both datacom as well as telecom high-volume applications.
234) Keynote and Plenary speaker SPIE Photonics Europe International Conference
   a. Originally 31st March (then moved to 7th April 2020)
   b. Strasbourg, France (the plenary talk was completed using audio embedded powerpoint video remotely).
   c. The conference was held virtually in 2020 and the talk was attended by over 1000 attendees/visits.
235) Chairman (elected) of ECOC Market Focus technical committee as part of the ECOC Exhibition.
   a. 10th May 2020
   b. Committee hosted and organized by ECOC Exhibition
   c. Market Focus Committee
236) Invited speaker and presentation at Lightwave Logic Annual Shareholder meetings 2020 with Business Management Update, and presentation entitled, "Lightwave logic business review"
   a. 14th May 2020

b. Presentation can be found at:
c. Hosted by Lightwave Logic Inc. and MZ Group (Investor Relations)

237) Co-Chair (and summit host) of online summit for PIC International virtual session with live Q&A.
a. 19th May 2020
b. Hosted by Angel Tech
c. Virtual conference with combination of pre-recorded presentations, live presentations, and live Q&A. Over 150 attendees.

238) Invited video clip on PIC technologies for online summit of PIC International conference.
a. 19th May 2020
b. Video clip (2:04) can be found
c. Summit host's introduction to the online summit PIC conference.

239) Invited speaker, EPIC 24hr Photonics World Tour virtual conference with talked entitled; "EO Polymers enable high speed and low power modulators at 1550nm and 1310nm."
a. 24th Jun 2020
b. EPIC 24hr Photonics World Tour final talk #72 and concluding remarks.

240) Invited paper/article entitled, "Electro-Optic Polymers Improve Speed and Power Efficiency" with co-authors Karen Liu and Cory Pecinovsky, Lightwave Logic Inc.
a. 5th Aug 2020
b. Published by Photonics Spectra magazine,
c. Hosted by photonics.com

241) Invited video interview, "2020 Market Focus and technology trends for ECOC 2020, Brussels, Belgium" as Chairman of ECOC 2020 Market Focus Technical Committee
a. 5th Aug 2020
b. Market Focus Exhibition for ECOC 2020,
c. Hosted by ECOC exhibition

242) Chair and invited speaker, PIC International virtual conference on PICs: PIC Virtual II with presentation entitled; "Optical devices and industry roadmaps."
a. 2nd Nov 2020

243) PIC International Conference and Invited speaker, EPIC Virtual Conference on Datacenters (in collaboration with EA and COBO) with presentation entitled; "Using polymer modulators to upgrade your PIC + Industry Roadmaps."
a. 4th Nov 2020
b. EPIC Trade Association and subsequent YouTube video and also at EPIC
c. Hosted by EPIC
d. Hosted by CS International and PIC International (Angel Business, London)

244) Reviewer (European Commission) for pilot line PIX4LIFE
a. 2nd Dec 2020
b. European Commission, Brussels (virtual review)

c. PIX4LIFE is a pilot line that is focused on bringing to commercial market PIC dielectric solutions for applications in the visible wavelength range in the medical applications market.

2021

245) Invited speaker, EPIC Photonics Plus conference (virtual) with a talk entitled "Polymer Plus™: Upgrading your PIC with Ultrafast and Low Power Modulators."
   a. 16th Feb 2021
   b. EPIC Trade Association and also at EPIC: https://photonicsplus.com/exhibitors/
   c. Hosted by EPIC

246) Invited speaker (updated virtual presentation), EPIC Photonics Plus conference (virtual) with a talk entitled "Commercializing Polymer Modulators."
   a. 10th Mar 2021
   b. EPIC Trade Association
   c. Hosted by EPIC

247) Invited Webinar and panelist: Roth Capital Partners
   a. 17th Mar 2021
   b. 33rd Annual Roth Conference
   c. Financial investment conference for public company review. Panelist for answering questions by bankers, investment specialists, and fund managers on Lightwave Logic and its business plans, technology and plans for the future.

248) Invited white paper/article entitled, "Polymers for Fiber Optic Communications: What does the Integrated Photonics Roadmap Say" co-authors Michael Lebby and Karen Liu, Lightwave Logic Inc.
   a. 24th Mar 2021
   b. Published by Lightwave Logic Inc.
   c. Executive summary: The IPSR (Integrated Photonic Systems Roadmap), a recent broad collaboration that unified the efforts of multiple established photonics roadmap efforts, describes the key technology bottlenecks for a broad array of applications and most promising solutions to overcome them. This whitepaper highlights the portion of the roadmap specific to fiber optic communications and within that the implications for the role of electro-optic polymers. Key findings identify critical advances that will be needed over the next decade to support the growth of very high data rate applications. By the end of the decade, integration of electronics with photonics will be part of broad integrated platforms. Innovative materials technologies such as polymers can be useful to enhance integrated photonics platforms with the use of high- speed modulators and passive optical interconnects.

249) Reviewer (European Commission) for pilot line Phabulous
   a. 31st Mar 2021
   b. Via European Commission (virtual review)

c. Phabulous is a pilot line that is focused on bringing to commercial market micro-optics and free-form optics technology. Focus is on SMEs, prototyping and small volume manufacturing.

250) Chair and invited speaker, PIC International virtual conference on PICs: PIC Virtual III with presentation entitled; "Integrated photonic roadmaps."
   a. 12th Apr 2021
   b. PIC International Conference
   c. Hosted by CS International and PIC International (Angel Business, London)

251) Reviewer (European Commission) for pilot line InPULSE (also known as Jeppix)
   a. 23rd Apr 2021
   b. Via European Commission (virtual review)
   c. InPULSE is a pilot line that is focused on bringing to commercial market InP based photonic integrated circuits (PICs) for fiber communications, both datacom as well as telecom high-volume applications.

252) Invited speaker, EPIC Virtual Conference on PIC Packaging with presentation entitled; "Integrated photonics roadmaps: enabling high performance packaging."
   a. 26th Apr 2021
   b. EPIC Trade Association and subsequent YouTube video and also at EPIC: https://www.epic-assoc.com/epic-online-technology-meeting-on-pic-packaging/
   c. Hosted by EPIC

253) Invited conference and panelist: Oppenheimer 6th Annual Virtual Emerging Growth Conference
   a. 11th May 2021
   b. Oppenheimer 6th Annual Virtual Emerging Growth Conference.
   c. Financial investment conference for public company review. Panelist for answering questions with a variety of bankers, investment specialists, and fund managers on Lightwave Logic and its business plans, technology and plans for the future.

254) Invited speaker and presentation at Lightwave Logic Annual Shareholder meetings 2021 with Business Management Update, and presentation entitled, "Lightwave logic business review"
   a. 27th May 2021
   b. Presentation
   c. Hosted by Lightwave Logic Inc. and MZ Group (Investor Relations)

255) Keynote speaker for PITC opening ceremony with presentation entitled, "Photonic Integrated Circuits (PICs): Enabling our future…"
   a. 2nd June 2021
   b. Agenda
   c. Hosted by PITC (Photonics Integrated Technology Center); Photon Delta, TNO, Eindhoven University, Twente University.

256) Invited speaker: LD Micro Invitational XI conference (virtual) with presentation entitled, "Lightwave Logic Investor Presentation"
   a. 10th June 2021
   b. Presentation

c. Hosted by LD Micro NASDAQ: SRAX

257) Invited video interview: "2021 Market Focus and technology trends for ECOC 2021, Bordeaux, France" as Chairman of ECOC 2021 Market Focus Technical Committee
   a. 15th June 2021
   b. Market Focus Exhibition for ECOC 2021,
   c. Hosted by ECOC exhibition

258) Invited speaker at HC Wainwright non-deal roadshow (virtual)
   a. 3rd and 4th August 2021
   b. Presentation of "Lightwave Logic investor presentation"
   c. Hosted by HC Wainwright Investment Bank

259) Invited speaker at Q3 Investor Summit (virtual)
   a. 17th and 18th August 2021
   b. Presentation of "Lightwave Logic investor presentation"
   c. Hosted by Investor Summit

260) Invited speaker and video recording at HC Wainwright conference (virtual)
   a. 13-15th September 2021
   b. Presentation of "Lightwave Logic investor presentation"
   c. Hosted by HC Wainwright Investment Bank

261) Invited speaker and video interview at NASDAQ for 10th September 2021 marketing closing. Live interview at NASDAQ HQ in Times Square, NYC.
   a. 10th September 2021
   b. Live interview for TV networks of Lightwave Logic's aspirations.
   c. Hosted by NASDAQ at their TV studios

262) Invited interview to close the week of trading at NASDAQ on 10th September, 2021 with live speech, and televised session. The closing was carried by CNBC, FOX, Bloomberg, BNN networks during the close session.
   a. 10th September, 2021
   b. Live interview for Lightwave Logic, and live market closing for NASDAQ
   c. Hosted by NASDAQ at their TV studios: https://youtu.be/8dmHC8MeF6E

263) TV and video interview by TD Ameritrade in conjunction with the ringing of the closing bell at NASDAQ on 10th September, 2021
   a. 10th September 2021
   b. Live TV interview on TD Ameritrade at NASDAQ studios, Time Square, NYC
   c. Hosted by TD Ameritrade financial network

264) Session chairman: ECOC Market Focus technical committee as part of the ECOC Exhibition: sessions included PIC and Silicon Photonics, Optics in Cloud computing, optical transmission (SDN, network agility), Fiber Access, 5G, Cable, PON, FTTX, FTTC, Fiber to the room, New technologies and optical systems, New markets, and new packaging platforms.
   a. 13th September 2021
   b. Committee hosted and organized by ECOC Exhibition
   c. Market Focus Committee

265) Invited video interview: “2021 Market Focus impact for ECOC 2021, Bordeaux, France” as Chairman of ECOC 2021 Market Focus Technical Committee at the conference by ECOC TV
   a. 13th September 2021
   b. Market Focus Exhibition for ECOC 2021,
   c. Hosted by ECOC exhibition
266) Invited talk and abstract: “Advancing integrated photonics with elector-optic polymer modulators”.
   a. 13th September 2021
   b. Market Focus Session, PIC and SiPH/Datacenters/Optics in cloud computing
   c. ECOC 2021, Bordeaux, France
267) Winner: Acceptance of glass trophy for ECOC Industry awards on behalf of Lightwave Logic in the optical integration category:
   a. 14th September 2021
   b. Product Focus session, ECOC Exhibition Industry Award Winner Announcement
   c. ECOC 2021, Bordeaux, France
268) Interview: ECOC Industry awards on behalf of Lightwave Logic in the optical integration category by ECOC TV
   a. 14th September 2021
   b. Product Focus session, ECOC Exhibition Industry Award Winner Announcement
   c. ECOC 2021, Bordeaux, France
269) Video interview: PIC International Conference November 9-11, Brussels, Belgium
   a. 24th September 2021
   b. Overview of conference, technical sessions, and integrated photonics
   c. PIC International, Brussels, Belgium as part of the online web portal presence.
270) Reviewer (European Commission) for pilot line InPULSE (also known as Jeppix)
   a. 21st Sep 2021
   b. Via European Commission (virtual review)
   c. MedPhab is a pilot line that is focused on bringing to commercial market silicon photonics based technologies for medical applications. Demonstrator use-cases as prototype products have been selected for the validation of the pilot line technologies covering both *in-vivo* and *in-vitro* domains. The cases include: manufacturing a disposable plasmonic-fluidic sensors and a wearable PCI temperature sensor.
271) Reviewer: (European Commission) for pilot line MIRPHAB
   a. 28th Sep 2021
   b. Via European Commission (virtual review)
   c. MIRPHAB is a pilot line that is focused on bringing to commercial market infra-red wavelength modules and technologies based on quantum cascade lasers, MIR detectors, Antimonide based compound semiconductors and their associated packaging.
272) Reviewer: (European Commission) for pilot line InPULSE (also known as Jeppix)
   a. 1st Oct 2021

b. Via European Commission (virtual review)
c. InPULSE is a pilot line that is focused on bringing to commercial market InP based photonic integrated circuits (PICs) for fiber communications, both datacom as well as telecom high-volume applications.

273) Invited Video presentation: LD Micro Main Investor conference entitled "Investor Presentation for LD Micro"
a. 12th October 2021
b. For virtual attendees at the LD Micro conference in Los Angeles (Luxe Hotel), California
c. Invited video presentation for virtual audience at LD Micro main event in LA California

274) Invited audio interview: LD Micro for BIZPOD (the Drill Down by Cory Johnson).
a. 12th October 2021
b. Located at LD Micro main in LA, California
c. BIZPOD audio interview as part of their start-up entrepreneur series:

275) Invited oral presentation: Includes Q&A for LD Micro Main Investor conference entitled "Investor Presentation for LD Micro"
a. 12th October 2021
b. For live in-person attendees at the LD Micro conference in Los Angeles (Luxe Hotel), California
c. Invited live presentation on Lightwave Logic technology and business plans for virtual audience at LD Micro main event in LA California

276) Invited Video presentation: Ladenburg Thalmann Virtual Technology Expo conference entitled "Investor Presentation for Ladenburg Thalmann virtual Technology Expo Investor Presentation"
a. Video-taped on 27th October 2021 for release on 18th November 2021
b. For virtual attendees at the Thalmann Virtual Technology Expo conference.
c. Invited video presentation for virtual audience at 2021 Ladenburg Thalmann Virtual Technology Expo
d. Presentation

277) Invited video: Chairmans introduction to the 5th PIC International Conference
a. 7th-10th November 2021
b. Conference hosted by Angel events.
c. Sheraton Airport Hotel, Brussels, Belgium.

278) Session Chairman: 2nd PIC Pilot Line Conference
a. 7th November 2021
b. Conference hosted by Angel events.
c. Sheraton Airport Hotel, Brussels, Belgium.

279) Keynote speaker: Includes presentation entitled, "PIC Pilot Lines: Competitive Positioning" as part of the of 2nd PIC Pilot Line Conference,
a. 7th November 2021
b. As of the conference hosted by Angel events.
c. Sheraton Airport Hotel, Brussels, Belgium.

280) Session chairman: 5th PIC International conference
   a. 8-10th November 2021
   b. Conference hosted by Angel events together with CS International, SSI International, and PIC Pilot Line Conference.
   c. Sheraton Airport Hotel, Brussels, Belgium.

281) Invited Panelist: For the panel entitled, "PICs for LIDAR" of 6th PIC International conference
   a. 8-10th November 2021
   b. Conference hosted by Angel events together with CS International, SSI International, and PIC Pilot Line Conference.
   c. Sheraton Airport Hotel, Brussels, Belgium.

282) Invited speaker: With presentation entitled, "Increasing power efficiency with electro-optic (EO) polymers" at the 5th PIC International conference, in the day 2 session, "PICs vision- evolution and revolution"
   a. 8-10th November 2021
   b. Conference hosted by Angel events together with CS International, SSI International, and PIC Pilot Line Conference.
   c. Sheraton Airport Hotel, Brussels, Belgium.

283) Keynote speaker: For Macrotrends and talk entitled "Investor Presentation'
   a. 12th November 2021
   b. Conference hosted by Marcotrends with 200 in person attendees, and 3-500 online attendees.
   c. Ghent, Belgium

284) Invited Live TV interview: Benzinga (Spencer Israel show).
   a. TV interview on 7th Dec 2021
   b. Presentation

2022

285) Invited Live TV interview: Benzinga (Spencer Israel show).
   a. TV interview on 11th Feb 2022 with youtube recording
   b. Presentation and the Spencer Israel show/background

286) Invited Webinar and panelist: Roth Capital Partners at the 34th Annual Roth Dana Point Conference with Lightwave Logic investor presentation and meetings.
   a. 13-15th March 2022
   b. 34th Annual Roth Deer Valley Conference (invite only)
   c. Financial investment conference for public company review. Panelist for answering questions by bankers, investment specialists, and fund managers on Lightwave Logic and its business plans, technology and plans for the future.

287) Invited Article and Interview entitled: "Q&A: Electro-optic polymers herald a new age of ultra-fast communication." With Digital Journal and interviewer; Dr. Tim Sandle.

a. Digital Journal interview and publication on 1st April 2022 in the Digital Journal.
b. Article and interview

288) Invited Article entitled: "Electro-optic polymers allow faster, more efficient data transmission." With Broadband Communities)
a. Published in Broadband Communities 13th April 2022.
b. Article

289) Invited video: Chairmans introduction to the 6th PIC International Conference, recorded on 10th May 2022.
a. 8th May 2022 to be published in May 2022 for the conference being held on 27-29th June 2022
b. Conference hosted by Angel events.
c. Sheraton Airport Hotel, Brussels, Belgium.

290) Invited speaker at Oppenheimer 7th Annual Emerging Growth Conference (virtual)
a. 10th May 2022
b. Presentation of "Lightwave Logic investor presentation"
c. Hosted by Oppenheimer Investment Bank:

291) Invited interview: Authority Magazine: "The future of communication technology"
a. 11th May 2022, and published 18th May 2022.
b. Interview on the future of communications, hosted by
c. Interview with David Liu, Authority Magazine

292) Reviewer (European Commission) for pilot line InPULSE (also known as Jeppix)
a. 17th May 2022
b. Via European Commission (virtual review)
c. InPULSE is a pilot line that is focused on bringing to commercial market InP based photonic integrated circuits (PICs) for fiber communications, both datacom as well as telecom high-volume applications.

293) Invited speaker and presentation at Lightwave Logic Annual Shareholder meetings 2022 with Business Management Update, and presentation entitled, "Lightwave logic CEO management review"
a. 26th May 2022
b. Presentation
c. Hosted by Lightwave Logic Inc. and MZ Group (Investor Relations)

294) Invited oral presentation: LD Micro 12th Annual LD Micro Invitational conference with presentation entitled, "Lightwave Logic"
a. 7th June 2022
b. Presentation Webcast
c. Hosted by LD Micro NASDAQ: SRAX and located at Four Seasons in Westlake Village, California on 7-8th June 2022.

295) Invited video presentation: LD Micro XII Annual Invitational conference, recorded on 25th May 2022
a. Presentation

b. Hosted by LD Micro NASDAQ: SRAX at the Four Seasons in Westlake Village, California on 7-8th June 2022.

296) Invited speaker and presentation at MIT IPSRI roadmap event with presentation entitled "Transceiver roadmap 2022".
   a. 10th June 2022
   b. Presentation
   c. Hosted by IPRSI, MIT, and PhotonDelta world photonics roadmap

297) Board member Optica's Corporate Engagement Council, with activities focusing on industrial membership, marketing, conferences, workshops, meetings etc., for the photonics community globally.
   a. 10th June 2022, election to the CEC
   b. CEC listing
   c. Optica (Optical Society of America – previous name)

298) Reviewer: European Commission HORIZON-CL4-2022-DIGITAL-EMERGING-01-38 (CSA): International cooperation in semiconductors
   a. 8th June 2022
   b. European Commission: Reviewing submitted technical and coordinated support actions for electronics and photonics proposals for Horizon 2022 evaluation calls and rate proposals to EU guidelines.
   c. CSA

299) Reviewer: European Commission HORIZON-CL4-2022-DIGITAL-EMERGING-01-03: Advanced multi-sensing systems.
   a. 10th June 2022
   b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2022 evaluation calls and rate proposals to EU guidelines.
   c. RIA

300) Invited live interview with Dan Loney, Wharton Business Daily Radio Station
   a. 15th June 2022
   b. Wharton Business Daily live radio interview. Subject: Lightwave Logic business and technology plans for growth
   c. Location: virtual recording at Lightwave Logic, Englewood, CO.

301) Invited speaker at Diamond Equity Research Emerging Growth Invitational Conference (virtual)
   a. 17th June 2022
   b. Presentation of "Lightwave Logic investor presentation"
   c. Hosted by Diamond Equity Research Ban Lightwave Logic, Englewood, Colorado.

302) Invited video interview: "2022 Market Focus impact for ECOC 2022, Basel, Switzerland" as Chairman of ECOC 2022 Market Focus Technical Committee at the conference by ECOC TV (link to be published)
   a. 17th June 2022
   b. Market Focus Exhibition, technical sessions and awards for ECOC 2022,
   c. Hosted by ECOC exhibition and recorded virtually in San Francisco, CA.

303) Invited interview: MicrocapDaily: "Microcapdaily Interviews Dr. Michael Lebby CEO of Lightwave Logic, Inc. (NASDAQ: LWLG) On Radical Innovation Needed to Keep the Internet Growing"
   a. 23rd June 2022
   b. Interview on the radical innovation needed for the internet and optical networking
   c. Interview with Boe Rimes, Microcap Daily
304) Session chairman: 7th PIC International conference
   a. 28-29th June 2022
   b. Conference hosted by Angel events together with CS International and SSI International.
   c. Sheraton Airport Hotel, Brussels, Belgium.
305) Invited Panelist: For the panel entitled, "Optica Industry Panel: Hybrid Integration" of 6th PIC International conference
   a. Conference hosted by Angel events together with CS International, and SSI International.
   b. Sheraton Airport Hotel, Brussels, Belgium.
306) Invited speaker: With presentation entitled, "Enabling low power consumption optical networking using high speed, low power polymer modulators" at the 6th PIC International conference in the day 2 session, "Optimizing the PIC architecture"
   a. 28-29th June 2022
   b. Conference hosted by Angel events together with CS International, and SSI International.
   c. Sheraton Airport Hotel, Brussels, Belgium.
307) Invited speaker: "Status of Lightwave Logic and electro-optic polymers" at the Cleydael Golf Club, Antwerp, Belgium
   a. 30th June 2022
   b. Meeting organized by Belgium and Dutch retail investors of Lightwave Logic Inc. (NASDAQ:LWLG)
   c. Location: Belgium
308) Invited Article for 7th PIC conference entitled, "PIC International proved to be a fantastic success"
   a. 7th July 2022
   b. Conference hosted by Angel events together with CS International, and SSI International.
   c. Sheraton Airport Hotel, Brussels, Belgium.
309) Invited Live TV interview: Benzinga All Access Fireside Chat (Zunaid Suleman show).
   a. TV interview on 22nd July 2022 with youtube recording:
   b. Video interview and the Zunaid Suleman show/background at
   c. Location: Virtually recorded in Washington DC
310) Invited Live TV interview with SNN network show Planet MicroCap Podcast and host Robert Kraft
   a. 22nd July 2022
   b. Hosted by SNN and Robert Kraft, and video interview can be found

c. Location: Virtually recorded in Washington DC

311) Invited Live Radio interview with Bloomberg markets radio show and hosts Paul Sweeney and Matt Miller. Topic, "Lightwave Logic background, radical innovation, business plans, impact on the internet, and where will the industry go in 5years?" Link to radio interview"
   a. 9th August 2022
   b. Hosted by Paul Sweeney and Matt Miller at Bloomberg Market Radio show
   c. Location: recorded at Lightwave Logic, Englewood, Colorado.

312) Invited video interview with Smart Photonics' "50 Leaders of change" to address where the internet is going from a technology, photonics, and optical networking system perspective. Filmed by London based TBD Media
   a. 10th August 2022
   b. Hosted and videoed by TBD Media hub on
   c. Location: Filmed at Lightwave Logic HQ in Englewood, Colorado and released on 9th November 2022.

313) Invited talk: Jefferies Semiconductors, IT Hardware & Communications Infrastructure Summit
   a. 29-31st August 2022
   b. Hosted by Jefferies Investment Banking
   c. Sofitel Hotel, Chicago, Illinois

314) Invited lecture – TU/e (University of Eindhoven, Netherlands); Electrical Engineering (Photonics); "Polymer Modulators"
   a. 2nd September 2022
   b. Hosted by Photonics Integrated Circuits team, Electrical Engineering, TU/e
   c. TU/e (Eindhoven University), Eindhoven, Netherlands

315) Invited review PhD thesis and defense that included review of thesis, public questions for the candidate and ceremonial procession. Amir Abbas Kashi's thesis is entitled, "Electro-optic slot waveguide phase modulators on the InP membrane on silicon platform"
   a. 2nd September 2022
   b. Hosted by TU/e Electrical Engineering, integrated photonics department with co-reviewers including: Prof. J. Leuthold, Prof. K. Williams, and Prof Van der tol.
   c. TU/e (Eindhoven University), Eindhoven, Netherlands

316) Invited keynote talk as part of the 'New Materials in PICs' at "EPIC meeting on CMOS compatible integrated photonics at IMEC."
   a. 7-8th September 2022 with the talk on the 8th September 2022
   b. Hosted by IMEC and EPIC photonics association. With EPIC photonics at:
   c. Location at Leuven, Belgium at IMEC 1 foundry.

317) Invited speaker: "Status of Lightwave Logic and electro-optic polymers for foundry applications" at the Cleydael Golf Club, Antwerp, Belgium
   a. 8th September 2022
   b. Meeting organized by Belgium and Dutch retail investors of Lightwave Logic Inc. (NASDAQ:LWLG)
   c. Location: Belgium

318) Invited talk at HW Wainwright conference called: 'H.C. Wainwright 24th Annual Global Investment Conference', with a talk entitled, "Lightwave Logic Investor Presentation"
   a. 12 and 13th September 2022 (talk on 13th September 2022)
   b. Meeting organized by HC Wainwright Investment Banking
   c. Location: Lotte Palace Hotel, New York City, NY
319) Invited interview: Interviewed by Greg Bryan at Telegeography
   a. 16th September 2022
   b. Published by Telegeography Podcast and Greg Bryan on 27th September 2022
   c. Virtual interview
320) Invited review article: Subject was for EPIC on their CMOS-foundry workshop :
   a. 13th September 2022
   b. Published by EPIC photonics association and associated media outlets
   c. Review written in NYC, 13th September 2022
321) Invited article: Ping! Zine technology insights and can be found at:
   a. 29th September 2022
   b. Published by Ping! Zine technology insights on 29th September 2022
   c. Ping! Zine publishes in-depth content through authoritative contribution and thorough interviews with technology subject matter experts across multiple disciplines including cloud, data center, AI, big data, cybersecurity and more.
322) Session chairman: ECOC Market Focus technical committee as part of the ECOC Exhibition: sessions included PIC and Silicon Photonics, Optics in Cloud computing, optical transmission (SDN, network agility), Fiber Access, 5G, Cable, PON, FTTX, FTTC, Fiber to the room, new technologies and optical systems, new markets, and new packaging platforms.
   a. 19-21st September 2022
   b. Committee hosted and organized by ECOC Exhibition
   c. Market Focus Committee
323) Invited video interview: "2022 Market Focus impact for ECOC 2022, Basel, Switzerland," as Chairman of ECOC 2022 Market Focus Technical Committee at the conference by ECOC TV
   a. 20th September 2022
   b. Market Focus Exhibition for ECOC 2022,
   c. Hosted by ECOC exhibition:
324) Invited talk and abstract: "Utilizing foundries to scale hybrid electro-optic polymer modulators" with Dr. John Zyskind, VP Engineering, Lightwave Logic Inc
   a. 19th September 2022
   b. Market Focus Session, PIC components
   c. ECOC 2022, Basel, Switzerland
325) Interview, industry award chairman, and award presentation to Market Focus Industry Award winners: ECOC exhibition industry awards (in conjunction with optical connections magazine)
   a. 20th September 2022

b. Product Focus session, ECOC Exhibition Industry Award Winner Announcement
c. ECOC 2022, Basel, Switzerland

326) Market Focus Interview: ECOC TV on behalf of Lightwave Logic in the optical integration category by ECOC TV
a. 21st September 2022
b. Market Focus Session, PIC components
c. ECOC 2022, Basel, Switzerland

327) Invited talk and panelist for ECOC Rump session, with talk entitled, "Hybrid Integration Roadmap: From pilot production to production in a semiconductor fab" at ECOC technical conference, chaired by Dr Jose Pozo, CTO Optica.
a. 21st September 2022
b. ECOC Rump session
c. ECOC 2022, Basel, Switzerland

328) Paper (co-author): Post-deadline submission to ECOC 2022 entitled, "Thermally Stable Silicon-Organic Hybrid (SOH) Mach-Zehnder Modulator for 140 GBd PAM4 Transmission With Sub-1 v Drive Signals (Th3B.2) given by Carsten Eschenbaum, *Karlsruhe Inst Tech (KIT)* and SilOriX Gmbh.
a. 22nd September 2022
b. ECOC Post Deadline session 1; 13:42 to 13:54pm
c. ECOC 2022, Basel, Switzerland

329) Cited Acknowledgement for Post Deadline Paper: Post-deadline submission to ECOC 2022 entitled, ">500 GHz Bandwidth Graphene Photodetector Enabling Highest-Capacity Plasmonic-to-Plasmonic Links (Th3B.5) given by Stefan Koepfli, *Eidgenossische Technische Hochschule (ETH) Zurich*.
a. 22nd September 2022
b. ECOC Post Deadline session 1; 14:18 to 14:30pm
c. ECOC 2022, Basel, Switzerland

330) Invited presentation: Diamond Equity Research's annual Spotlight Emerging Growth Invitational Virtual Investor Conference, with a presentation entitled, "Lightwave Logic Investor Presentation"
a. 4th October 2022 (10:20-10:50am East coast time)
b. Diamond Equity Research's Spotlight Emerging Growth Invitational Virtual Investor Conference
c. Recorded 30th September 2022 virtually at LWLG.

331) Invited interview: Interviewed by Cory Johnson at The Drill Down podcast Podcast which
a. 7th October 2022
b. Published by The Drill Down Podcast and Cory Johnson on 17th October 2022
c. Virtual interview

332) Invited oral presentation: LD Micro Main Event XV conference with presentation entitled, "Lightwave Logic Update"
a. 25th October 2022
b. Oral presentation details can be found at: as well as
c. Hosted by LD Micro NASDAQ: SRAX

333) Invited video presentation: LD Micro Main Event XV conference, recorded on 25th October 2022
   a. 25th October 2022
   b. Presentation at: https://www.meetmax.com/sched/event_86249/conference_presentations.html?bank_access=0&event_id=86249
   c. Hosted by LD Micro NASDAQ: SRAX at the Luxe Sunset Boulevard Hotel LA 24-26th October 2022

334) Invited closing comments: Optica Co-packaged and pluggable optics industry summit. Comments were on pluggables vs co-packaged integrated photonics solutions, roadmapping, and transceiver trends on data rate and low power consumption.
   a. 25th and 26th October 2022
   b. Details on the event can be found at: https://www.optica.org/en-us/events/industry_events/2022_optica_industry_summit/
   c. Hosted by Optica (formally OSA) https://www.optica.org/en-us/home/ at Du Pont's innovation laboratories Sunnyvale, CA.

335) Invited speaker: Photonics Spectra Annual Conference with presentation entitled, "How electro-optic polymers boost PIC speed and power efficiency".
   a. Recorded on 28th October 2022, for 9-11th January 2023
   b. Details on the event can be found at:
   c. Hosted by Photonics Spectra

336) Invited talk at the Board meeting of Optica's Corporate Engagement Council. Presentation on focusing to increase industrial membership, improve marketing, optimize conferences and workshops for the industrial photonics community globally.
   a. 1st November 2022,
   b. CEC listing:
   c. Optica (Optical Society of America – previous name)

337) Invited interview with Laser Focus editor Peter Peter Fretty, Editor in Chief on the subject of Lightwave Logic, and the radical innovation needed by the optical network and internet.
   a. 3rd November 2022,
   b. Laser Focus world can be found and the magazine
   c. Laser Focus World

338) Invited panel moderator at PIC Summit Conference, Eindhoven, Netherlands in conjunction with IPSR-I workshops. Panel entitled, "Heterogeneous Intergration: Electronics and Photonics united" with companies that included: IMEC, LionX, VTT, Ligentec, Corning, Smart Photonics, Fraunhofer HHI
   a. 7th November 2022
   b. PIC Summit Europe conference.
   c. Located at the High Tech Center, Eindhoven, Netherlands

339) Invited speaker at PIC Summit Conference, Eindhoven, Netherlands in conjunction with IPSR conference to summarize panel findings and discussion with audience.
   a. 7th November 2022

b. PIC Summit Europe conference.
c. Located at the High Tech Center, Eindhoven, Netherlands

340) Invited Speaker and chair of datacom group at the PIC Summit Europe Conference and IPSR-I workshops with sessions entitled, 'Paving the way to killer applications in 2035.'located at TU/e Eindhoven University, Netherlands. Workshop 1c: Datacom roadmap for 2023.
a. 8th November 2022
b. PIC Summit Europe conference and IPSR-I roadmap workshops.
c. Located at the TU/e Eindhoven University, Netherlands.

341) Invited talk: IEEE IPC (Integrated Photonics Conference) as part of the conference in the session Industry Day-Hot topics in industry. Talk entitled: "Enabling More Efficient Optical Networking using Ultra-high Speed, Ultra-low Power, Ultra-small Foundry based Polymer Modulators"
a. 14th November 2022
b. IEEE IPC IEEE IPC (Integrated Photonics Conference)
c. Located at the Hyatt Regency, Vancouver, BC, Canada.

342) Invited talk and panelist: IEEE IPC (Integrated Photonics Conference) as part of the conference in the session Roundtable on Topics in Entrepreneurship. Talk entitled: "Entrepreneur or Intrapreneur" with company CEOs that included: OEwaves, Polariton, Freedom Photonics/Luminar, Aeponyx, Octane Wireless.
a. 14th November 2022
b. IEEE IPC IEEE IPC (Integrated Photonics Conference)
c. Located at the Hyatt Regency, Vancouver, BC, Canada.

343) Invited Video presentation: Ladenburg Thalmann Virtual Technology Expo conference 2022 entitled "Investor Presentation for Ladenburg Thalmann virtual Technology Expo Investor Presentation"
a. Video-taped on 29th November 2022 for release on 7th December 2022
b. For virtual attendees at the Thalmann Virtual Technology Expo conference 2022.
c. Invited video presentation for virtual audience at 2022 Ladenburg Thalmann Virtual Technology Expo:
d. Presentation can be found at:

344) Invited panelist: Photonics Spectra panel (virtual and recorded) titled, "Scaling PIC-based applications to volume production." Panelists included representatives from Sicoya, Polariton, and Ligentec, and hosted by Dr. Jose Pozo, CTO Optica.
a. Recorded on 6th December 2022, for release 9-11th January 2023 (
b. Details on the event can be found at:
c. Hosted by Photonics Spectra

345) Invited speaker at PhotonDelta's Delta Dialogues virtual interview entitled, "Heterogeneous Integration for PICs" on the summary and findings of PIC Summit Europe conference on Heterogeneous Integration that took place in November 2022. The session was chaired by Jorn Smeets, PhotonDelta.
a. 7th December 6, 2022
b. Details of the event
c. Hosted by PhotonDelta

346) Invited Panelist: Ladenburg Thalmann Virtual Technology Expo conference and presentation can be found at:
   a. 7th December 2022
   b. For virtual attendees at the Thalmann Virtual Technology Expo conference 2022.
   c. Invited investor presentation at 2022 Ladenburg Thalmann Virtual Technology Expo:

347) Invited Webinar and panelist: Roth Capital Partners at the 11th Annual Roth Deer Valley Conference with Lightwave Logic investor presentation and meetings.
   a. 14-16th December 2022
   b. 11th Annual Roth Deer Valley Conference
   c. Financial investment conference for public company review. Panelist for answering questions by bankers, investment specialists, and fund managers on Lightwave Logic and its business plans, technology and plans for the future.

348) Invited reviewer for European Commission program as part of the IPCEI (Important Project of Common European Interest) program on electronics and photonics.
   a. Duration of review process Jun 2022 to Dec 2022
   b. IPCEI (Important Project of Common European Interest) based on public funding.
   c. IPCEIs are projects by the EU commission that have the potential to make important contributions to sustainable economic growth, jobs, competitiveness and resilience for industry and the economy in the Union as well as strengthen its open strategic autonomy, by enabling breakthrough innovation and infrastructure projects through cross-border cooperation and with positive spill-over effects on the internal market and the society as a whole. In particular, semiconductor power FETs, laser diodes, amplifiers, FET technologies using both compound semiconductors (GaAs, GaN, InP) as well as silicon semiconductors (Silicon, SiGe) were reviewed.

2023

349) Reviewer: (European Commission) for project InSiDe
   a. 24th Jan 2023
   b. Located at IMEC Ghent University facility, Ghent, Belgium
   c. InSiDe is an EU project for PIC based technology in the medical field to monitor blood flow and artery stiffness in the human body using long wavelength lasers and silicon photonics. Hospital clinical trials will be conducted. It is a follow-on with more clinical trials from an initial CARDIS EU project.

350) Invited speaker and panelist for Laser Focus World Executive Forum in San Francisco with talk entitled. “Hybrid integration with electro-optic polymers” and panel session entitled, “Enabling silicon photonics success”
   a. 30th January 2023
   b. Details of the event and agenda
   c. Panelists included: Jose Pozo, CTO Optica, David Piehler, Dell Technologies, Peter Winzer, Nubis Communications, Robert Blum, Intel

351) Interview with Benjamin Glick of Mergermarket magazine entitled, "Lightwave could acquire more assets ahead of commercialization—CEO"
   a. 3rd February 2023
   b. Details of the interview can be found at
   c. Video interview remotely from Lightwave Logic HQ in Englewood, Colorado.

352) Interview and podcast with Don Witt of Telecom Reseller's Channel Daily News for a podcast on Lightwave Logic: Background, radical innovation, technology, acquisitions, world record results, goals, and the future of optical networking in a decade. Podcast can be found
   a. 8th February 2023 (interview) and published 14th February 2023
   b. Details can be found at
   c. Podcast is with Telecom Reseller which provides information on voice mail, audio/video conferencing and peripherals, association and industry news, services, applications, and related topics of daily importance to telecommunications professionals.

353) Invited Article entitled: "The Internet Is the Brick Wall Nostradamus Didn't See Coming" with sub-heading, "The road maps Lightwave Logic is creating for the future of photonics will guide people toward the focus areas and the technology challenges they can expect as performance demands increase." For the industry trends section of BBC magazine (Broadband Communities) at
   a. Published in Broadband Communities 14th February 2023.
   b. Article can be found at:

354) Interview with AlphaStreet entitled, "Lightwave Logic will license technology to make its polymers ubiquitous: CEO Dr. Michael Lebby" Interview can be found at
   a. 6th March 2023 (interview) and published 10th March 2023
   b. Details can be found at: https://news.alphastreet.com/lightwave-logic-will-license-technology-to-make-its-polymers-ubiquitous-ceo-dr-michael-lebby/
   c. Interview is with AlphaStreet which provides financial information on companies and utilize NLP and AI techniques in the research industry.

355) Invited speaker: Roth Capital Partners 35th Annual Roth Conference
   a. 13th Mar 2023
   b. 35th Annual Roth Conferenc
   c. Financial investment conference for public company review. Panelist for answering questions by bankers, investment specialists, and fund managers on Lightwave Logic and its business plans, technology and plans for the future.

356) Interview with Laser Focus by Jose Pozo as part of his Industry Executive interviews for the photonics industry. Key topics included intrapreneur and entrepreneur experience, Lightwave Logic, photonics experience, OIDA, roadmapping, and key drivers for a career in photonics integration.
   a. 16th March 2023 (interview) and published XXX 2023
   b. Details can be found
   c. Interview is with Laser Focus World which was originally published in 1965, as *Laser Focus World*—a monthly magazine for engineers, researchers, scientists, and technical professionals—provides comprehensive global coverage of

optoelectronic technologies, applications, and markets. Nearly 70,000 qualified optoelectronics professionals from around the world currently subscribe.

357) Interview with IDC by Brandon Hoff on Lightwave Logic, background, radical innovation, proprietary electro-optic polymer technology, goals and why the company is planning on making polymers ubiquitous for the hyper-scaler, datacenter markets.
   a. 16th March 2023 (interview)
   b. Details can be found at:
   c. Interview is with IDC which provides market and financial information on the information technology and optical networking industry.

358) Invited article for ISE entitled " Proactive Powering Problem-Solving with Polymers"
   a. 16th March 2023
   b. Details can be found at
   c. ISE has articles on IT solutions and education.

359) Invited article and interview (from panel discussion) at Laser Focus World Executive Forum in San Francisco with article entitled, "Silicon photonics: Is it witchcraft?
   a. 17th March 2023
   b. Details of the event written by Sally Cole Johnson for Laser Focus.
   c. Panelists included: Jose Pozo, CTO Optica, David Piehler, Dell Technologies, Peter Winzer, Nubis Communications, Robert Blum, Intel

360) Invited article for IMS expert insights entitled, "An Expert Witness Perspective on Inter Partes Review of Patents" by Dr. Michael Lebby, IMS Elite Expert,
   a. 12th April 2023
   b. Details can be found
   c. Patent litigation cases can be won or lost through the actions and competency of an expert witness—making their role not only important but crucial. The article takes a closer look at the part an expert witness plays during the *inter partes* review and considers how the IPR process could be improved.

361) Invited interview with Semiconductor Engineering by Karen Heyman, in an article called entitled, "Transitioning to Photonics"
   a. Interview taken on 4th April 2023 and published online 14th April 2023
   b. Details can be found
   c. The article is based on the premise that high speed and low heat make photonics technology essential, especially compared to electronics, but it's extremely complex, and talent is hard to find and train.

362) Session Co-chairman: 8th PIC International conference
   a. 17-18th April 2023 for 2 days of PIC sessions.
   b. Conference hosted by Angel events together with CS International and Power Electronics International conferences.
   c. Sheraton Airport Hotel, Brussels, Belgium.

363) Chair Panel session: For the panel entitled, "Foundry models for PICs" of 8th PIC International conference and moderated by Jose Pozo, CTO Optica. Panel members included Global Foundries, Tower, VTT

a. 17th April 2022
b. Conference hosted by Angel events together with CS International, and Power Electronics International conferences.
c. Sheraton Airport Hotel, Brussels, Belgium.

364) Invited speaker and oral presentation: With presentation entitled, "Positioning electro-optic polymer modulators as an optical engine to extend data rate and low power performance for optical networking" at the 8th PIC International conference, in the day 2 session, "Scaling PICs in volume using foundries"
a. 18th April 2023
b. Conference hosted by Angel events together with CS International, and Power Electronics International conferences.
c. Sheraton Airport Hotel, Brussels, Belgium.

365) Invited speaker: "Status of Lightwave Logic and electro-optic polymers" at the Cleydael Golf Club, Antwerp, Belgium
a. 18th April 2023
b. Meeting organized by Belgium and Dutch retail investors of Lightwave Logic Inc. (NASDAQ:LWLG)
c. Location: Belgium

366) Invited interview with Semiconductor Engineering by Karen Heyman, in an article called entitled, "New standard push co-packaged optics"
a. Interview taken on 4th April 2023 and published online 26th April 2023
b. Details can be found
c. The article is based on the premise that co-packaged optics (CPOs) promises five times the bandwidth of pluggable connections, however, the new architecture requires multiple changes to accommodate different applications, and if the design is efficient the optical engines will be able to impact both on-board optics as well as pluggable transceivers.

367) Invited speaker and oral presentation for the Sequire Investor Summit, San Juan, Puerto Rico. The presentation was entitled, "LWLG April 2023 investor presentation" with agenda
a. Conference on 25th and 26th April 2023 with presentation on 25th April 2023
b. Link to website for Sequire event:
c. Investor conference at the La Concha hotel San Juan, Puerto Rico.

368) Invited speaker and oral presentation: Ladenburg Thalmann Technology Expo and conference 2023. The presentation was entitled, "LWLG April 2023 investor presentation" and can be
a. 27th April 2023
b. The conference and expo 2023, was held at Convene Hotel, Park and 41st, New York, New York
c. The 2023 Expo featured presentations from the managements of approximately 50-60 public and private technology companies covering Media and Content-Tech, Software and Service-Tech, and Hardware and Defend-Tech.

369) Invited article: 8th PIC International conference overview entitled, "An overview of Angeltech 2023 (PIC international conference)", which can be found

a. 2nd May 2023
b. Overview is based on the results of the PIC International Conference hosted by Angel events (17-18th April 2023) together with CS International and Power Electronics International conferences.
c. Sheraton Airport Hotel, Brussels, Belgium.

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