

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

OPTICIS CO., LTD

Petitioner,

v.

INNEOS LLC,

Patent Owner.

Case No. IPR2023-01256
U.S. Patent No. 7,198,416

DECLARATION OF MICHAEL LEBBY, PH.D.

TABLE OF CONTENTS

	Page
I. SCOPE OF THE ENGAGEMENT	1
1. Opticis Korea’s translation of Japanese Patent No. 2848279 to Kurita et al. (“Kurita”) (EX1004).....	2
2. U.S. Patent No. 5,078,499 to LaMarche (“LaMarche”) (EX1005)	2
3. U.S. Patent No. 6,870,195 to Lemoff et al. (“Lemoff”) (EX1006)	2
4. U.S. Patent Publ. No. 2005/0069013 to Bhandarkar et al. (“Bhandarkar”) (EX1013).....	2
II. PROFESSIONAL BACKGROUND AND QUALIFICATIONS	3
III. PERSON HAVING ORDINARY SKILL IN THE ART	8
IV. LEGAL UNDERSTANDING	9
A. Claim Interpretation	9
B. Means Plus Function	10
C. Prior Art.....	11
D. Obviousness.....	12
E. Enablement.....	12
F. Indefiniteness.....	13
G. Written Description	13
V. OVERVIEW OF THE ’416 PATENT	13
A. The Challenged Claims of the ’416 Patent	14
VI. TECHNICAL BACKGROUND/STATE OF THE ART.....	14
VII. CLAIM CONSTRUCTION	16
A. Preambles Are Limiting	16

1.	“Optical combiner”	17
2.	“Usable in data communication systems for multiplexing the outputs of a plurality of n lasers wherein each of said n outputs has a different output wavelength”	21
3.	“For transmission into and through a stopped single optical fiber”	22
B.	“Focusing means for focusing said n collimated output beams onto a single stop at said stopped single optical fiber”/ “focusing means for focusing said collimated output beams onto a single spot at said stopped single optical fiber...”	22
C.	“Stopped single optical fiber”	27
VIII.	SUMMARY OF OPINIONS	31
IX.	RESPONSE TO INVALIDITY ARGUMENTS	33
A.	Ground 1: The ’416 Patent Is Not Obvious Over Kurita	33
1.	(“Kurita”) (EX1004)	33
2.	Independent Claim 1	37
a.	Claim 1: [1.0]	37
b.	Claim 1: [1.3]	43
c.	Claim 1: [1.5]	44
3.	Dependent Claim 2:	48
4.	Dependent Claim 6:	50
5.	Claim 7:	50
6.	Dependent Claim 9:	50
B.	Ground 2: Claims Are Not Obvious Over Kurita in view of LaMarche and/or Lemoff	50
1.	(“Kurita”) (EX1004)	52

2.	(“LaMarche”) (EX1005)	55
3.	A POSITA would not have been motivated to combine Kurita and LaMarche	61
4.	(“Lemoff”) (EX1006)	69
5.	A POSITA Would Not Combine Kurita and Lemoff.....	71
6.	Independent Claim 1	75
	a. Claim 1:	75
	b. Claim 1:	75
7.	Claim 2:.....	77
8.	Claim 6:.....	78
9.	Claim 7:.....	78
10.	Claim 9:.....	79
C.	Ground 3 & 4: Claims Are Not Obvious Over Lemoff in view of LaMarche.....	79
1.	(“Lemoff”) (EX1006)	79
2.	(“LaMarche”) (EX1005)	81
3.	A POSITA would not have been motivated to combine Lemoff and LaMarche	87
4.	Independent Claim 1	98
	a. Claim 1:	98
	b. Claim 1:	104
	c. Claim 1:	108
5.	Dependent Claim 2:	119
6.	Dependent Claim 6:	120

7.	Claim 7:.....	120
8.	Dependent Claim 9:	121
D.	Ground 5: Bhandarkar Is Not Prior Art.....	121
1.	The '416 Patent Is Entitled to a Priority Date of July 17, 2003	121
a.	Conception and Diligent Reduction to Practice	121
b.	The '416 Provisional Application Provides Adequate Written Description and Enables the Full Scope the Invention	127
i.	The Challenged Claims Are Supported by Written Description in the Provisional Application	127
ii.	The Challenged Claim Are Enabled by the Provisional Application.....	131
X.	REVISION OR SUPPLEMENTATION.....	134

I, Michael Lebby, Ph.D., hereby declare under penalty of perjury that the following statements are made based on my personal knowledge and are true and correct.

I. SCOPE OF THE ENGAGEMENT

1. I have been retained by Womble Bond Dickinson (US) LLP (“WBD”) on behalf of Inneos, LLC (hereinafter “Patent Owner” or “Inneos”) to provide analysis and opinion in connection with the petition for *inter partes* review (“IPR” or “Petition”) filed before the United States Patent and Trademark Office (“PTO”) Patent Trial and Appeal Board (“Board”). I understand that my testimony is being submitted in connection with Patent Owner Inneos’ Preliminary Response to be considered by the Board.

2. I understand that the Petition involves U.S. Patent No. 7,198,416 (“the ’416 Patent”) (EX1001) that is assigned to Inneos. I have been asked to provide my opinions as to the validity of claims 1, 2, 6, 7, and 9 of the ’416 Patent (collectively, the “Challenged Claims”) of the ’416 Patent in view of the grounds set forth in the Petition.

3. It is my understanding that for the ’416 Patent, the earliest possible priority date is July 17, 2003, based on the findings by the Examiner during prosecution of the ’416 Patent and position taken by Patent Owner in Patent Owner Inneos’ Preliminary Response, which I agree with. Accordingly, unless stated otherwise, all of the opinions I express in this Declaration have been made from the standpoint of a person of ordinary skill in the art, as described below, on or around July 17, 2003.

4. My opinions directed to the validity or invalidity of the Challenged Claims are based, at least in part, on the following prior art publications:

1. Opticis Korea's translation of Japanese Patent No. 2848279 to Kurita et al. ("Kurita") (EX1004);
2. U.S. Patent No. 5,078,499 to LaMarche ("LaMarche") (EX1005);
3. U.S. Patent No. 6,870,195 to Lemoff et al. ("Lemoff") (EX1006); and
4. U.S. Patent Publ. No. 2005/0069013 to Bhandarkar et al. ("Bhandarkar") (EX1013).

5. This Declaration sets forth the opinions that I have formed related to the Challenged Claims of the '416 Patent based on my personal knowledge, education, research, personal and professional experience, and the information I have reviewed as of the date of this Declaration. In connection with my analysis, I have reviewed each Exhibit filed along with the Petition, including the prior art publications that form the basis of Petitioner's invalidity challenges, as well as the other exhibits cited in the Petition. I have given the Exhibits different levels of attention based on their roles in the Petition.

6. I am being compensated at my normal hourly rate of \$695 for my work in this proceeding, including studying this matter, preparing this declaration and providing deposition and trial testimony. My compensation is not contingent upon the outcome of this proceeding or the particular testimony or opinions that I express. I have personal knowledge of the facts stated in the declaration, and I am willing to competently testify to them if and when called to do so.

7. Between now and such time that I may be asked to testify, I expect to continue my review, evaluation, and analysis of evidence presented during this proceeding. I expressly reserve the right to amend or supplement this report, as appropriate. In the event that additional relevant information becomes available to

me, I also reserve the right to review and consider that information in further developing or refining my opinions.

II. PROFESSIONAL BACKGROUND AND QUALIFICATIONS

8. I am currently the CEO of Lightwave Logic. I am also the CEO and CTO of Oculi LLC, where I perform expert witness consulting concerning photonics, optoelectronics, semiconductors, and fiber optic telecommunications technology. I am also currently a technical expert for the Photonics Unit of the European Commission, where I participate in organizing workshops and lectures, evaluating photonics proposals and advising the European Commission on projects. I was voted the Photonic Integrated Circuits Conference Entrepreneur and Business Leader of the Year in March 2018. I was elected as a Fellow to the National Academy of Inventors in 2020.

9. Over the course of my 40-year career in optoelectronics, I have worked in nearly every aspect of optoelectronics, including laser diodes, photodetectors, LEDs and fiber optics. Accordingly, I have experience and expertise relating to epitaxial wafer growth, laser/photodetector device fabrication, implementation of these devices into packages, and packaging materials such as plastics, metallic based, semiconductor based, and ceramic based. I have also designed optoelectronic device packages (e.g., through-pin, surface mount, flip-chip and various combinations thereof) for printed circuit board mounting. Many of the designed packages were implemented into modules and sub-system applications, i.e., fixtures in which optoelectronics packages are incorporated. The modules have been fiber-optic, display, lighting, and sensing based. In particular, I have designed optoelectronic devices such as LEDs, laser diodes (VCSELs—vertical cavity surface emitting lasers), photodiodes and solar cells with a focus on efficient optical device

design that maximizes device performance. For example, I have worked on improving light extraction efficiency in laser diodes as well as LEDs.

10. I am a chartered engineer in the United Kingdom, which is a status equivalent to a professional engineer in the United States. I started my career in 1977 at the Ministry of Defense (United Kingdom) in the Royal Electrical and Mechanical Engineer division as a telecommunications apprentice. At the Ministry of Defense, I also studied material and characterization issues of Gallium Arsenide (GaAs) and Indium Phosphide (InP) optoelectronic devices as well as semiconductor device design, fabrication, and characterization, and particularly with materials using III-V semiconductors. I have also worked with silicon for integrated circuits, as well as silicon photonics. I also worked on ceramic-based radio-frequency (RF) electronic packaging that included low-temperature co-fired ceramic.

11. I attended the University of Bradford, where I obtained a Bachelor of Engineering (Electrical Engineering), with honors, in 1984, an MBA in 1985, and a Ph.D. (Electrical Engineering) in 1987. My Ph.D. thesis is based on the characterization and fabrication of both optoelectronic and electronic semiconductor devices. In 2004, I was awarded a Doctor of Engineering (a Doctorate degree higher than a Ph.D.) from the University of Bradford for my “Technical Contributions to Optoelectronics.” This was only the second time in the University of Bradford’s history that a Doctor of Engineering was granted based on industry experience.

12. At the same time, I attended the University of Bradford and afterward from 1985 to 1989, I worked as a researcher in the Photonics Research Department of AT&T Bell Labs (“Bell Labs”). At Bell Labs, I focused my research on novel device designs using III-V semiconductor material systems that included FETs, bipolar transistors, LEDs, laser diodes, and photodetectors. My research at Bell Labs became the subject of my Ph.D. thesis.

13. After I completed my Ph.D. at the University of Bradford and my work at Bell Labs, I became a Research and Development Manager (“R&D Manager”) in the photonics division of Motorola’s Corporate R&D Labs (“Motorola”) from 1989 to 1998. My responsibilities at Motorola included research and development of optical interconnects, displays, laser devices, LEDs, optical lenses, and optical waveguides as well as the packaging and reliability of mobile product prototypes. While at Motorola, I was the inventor or co-inventor of over 150 utility patents. In 1998, I received a special award from the Chairman of Motorola for exemplary patent accomplishments. At that time, I had the highest number of issued utility patents in the history of Motorola.

14. As an R&D Manager at Motorola, I worked on a number of other projects, with a particular interest in miniature displays using technologies such as LEDs, organic LEDs, lasers, and LCDs, as well as technological problems related to package lenses and molding unique and innovative shapes in optics. One of the devices I worked on at Motorola was the Vertical-Cavity Surface-Emitting Laser (“VCSEL”). This device design required special attention to optical efficiency and distributed Bragg reflectors (“DBR”), as well as transparent packaging similar to the approach in LED packaging. I also initiated Motorola’s work in optical interconnect (Optobus™) technology, and I was involved in research and development of the IC chip designs that this parallel interconnect module utilized. In this project, transparent plastics were developed and process over-molded onto standard metallic lead frames for both light-emitting devices (e.g., LEDs, VCSELs) as well as photodetectors, which collect light and convert it into an electronic signal. These transparent lead frame packages were developed in volume production at Motorola. I also worked on various techniques to multiplex both electrical and optical signals for fiber optics, such as wavelength division multiplexing (WDM).

15. I also worked on GaAs-based LED opto-couplers, which are optoelectronic packages that optically isolate the LED from a photodetector in a plastic package. These optoelectronic packages are usually designed with either a glass transparent plate or transparent organic polymer positioned between the LED and the photodetector. My work at Motorola also addressed full color display and display electronics composed of red, green and blue LEDs, and specifically how to package these technologies to allow for high electrical, optical, and thermal performance. I also worked with displays that included large arrays of visible LEDs (i.e., 10,000 LEDs on a chip) and phosphor technology. I also worked on photonics prototypes, which were subject to optimized optical device design and optical/transparent packaging, and consumer products that utilized LEDs in opto-coupler, display and imager platforms that were all driven using standard electronic ICs and electronic signaling, as well as packages that included transparent plastic packaging varieties where the transparent plastic material was molded to a variety of conventional stamped metallic lead frames and flexible tape automated bonding (TAB) using materials such as Kapton®.

16. In 1998, I left Motorola to join TE Connectivity (previously Tyco Electronics) as Director of Technology and Business Development, where I helped develop technology strategy for optical communications products for the Global Optoelectronics Division. My work included designing and characterizing LED- and laser-based packages and modules for customer qualification specifications.

17. In 1999, I joined Intel Capital (“Intel”) as Director of Business Development, and also as a corporate investor. My work at Intel included sourcing, negotiating, and closing private placement equity deals in the optical networking, component, optical lens, and semiconductor industries. My work at Intel also included investigating the investment in photonic devices, optical interconnect, wavelength division multiplexing, packaging, transceiver modules, as well as LEDs,

lasers, and displays. I also was one of the founders of Intel's silicon photonics division, which worked to establish a fabrication facility in South San Jose to investigate the integration of silicon FET electronics with optoelectronics into the same silicon semiconductor wafer.

18. From 2005 to 2010, I became the Executive Director, President, and CEO of the Optoelectronic Industry Development Association (OIDA), a trade association that represented photonics manufacturers in the fields of fiber optics, display, sensing, defense, aerospace, LED lighting and motor vehicles. I was responsible for organizing technical conferences, workshops and forecasts using industry roadmaps that featured optical interconnects, fiber optics, wavelength division multiplexing, LEDs, fiber optics, optics, fiber, optical sensors, displays and their associated packaging.

19. In 2010, I became the General Manager and CTO of Translucent, Inc., a start-up company that developed and manufactured silicon and rare earth oxide-based epitaxial semiconductor wafers.

20. I joined Glyndŵr University from 2013 to 2015 as a Professor of Optoelectronics, where I focused on the design, simulation and testing of high speed, low power photonic integrated circuits, optoelectronic integrated circuits, laser diodes, optics and solar cells.

21. From 2013 to 2015, I was also the President and CEO of OneChip Photonics Corporation, where I served as an elected independent board member focusing on the technical and business operational strategy for communications based on InP photonic integrated circuits and optoelectronic integrated circuits for fiber optic transceivers that incorporated various electrical and optical multiplexing schemes and solutions.

22. Over the course of my career, I have also given a number of peer-reviewed presentations, speeches, and talks at workshops and conferences, including on optoelectronic devices, optoelectronic components, and packaging technology.

23. I am a named inventor of over 230 issued patents or published patent applications, as set forth more fully in my CV, which is attached to the end of my declaration.

24. I have authored or co-authored numerous publications, which are set forth fully in my CV.

25. I have participated in many conferences and workshops as a contributor, speaker, moderator, chairman, session leader, etc. These are set forth fully in my CV.

III. PERSON HAVING ORDINARY SKILL IN THE ART

26. I understand that validity of a patent must be analyzed from the perspective of a hypothetical person having ordinary skill in the art in the same field as the patent.

27. I have been informed that such hypothetical person of ordinary skill is presumed to be aware of all of the relevant art at the time of the invention, i.e., the effective filing date of the application for the asserted patent. I have been informed that a person of ordinary skill would think along the lines of conventional wisdom in that art. The person of ordinary skill is not an automaton, and may be able to fit together the teachings of multiple patents and publications employing ordinary creativity and the common sense that familiar items may have obvious uses in another context or beyond their primary purposes.

28. In determining the level of ordinary skill in the relevant art, I have been informed that the Board must consider several factors: (i) the type of problems encountered in the art, (ii) the prior art solutions to those problems, (iii) the rapidity

with which innovations are made, (iv) the sophistication of the technology, and (v) the educational level of active workers in the field.

29. I understand that the Petitioner has argued that “A POSITA would have had at least a bachelor’s degree in electrical engineering, physics, or a related field, and at least two years of practical experience in optical technologies. EX1003, Section VII(D)(i).” For the purposes of this analysis, I have adopted this as the definition of a POSITA. Accordingly, my opinions contained herein are based on this level of ordinary skill in the art at the time of the invention.

30. I am qualified as a POSITA, both now and at the time of the invention.

IV. LEGAL UNDERSTANDING

31. I use the legal principles below, of which I have been informed by counsel, as a guide in formulating my opinions.

A. Claim Interpretation

32. My opinions concern what I believe the person of ordinary skill in the art would have understood the meaning of certain claim terms to be based on the patent documents.

33. I have been informed that assessing the validity of a patent claim requires a two-step analysis. The first step involves the proper interpretation or construction of the claim language in order to determine its scope and meaning. The second step requires comparing the claim, as properly construed, to the alleged prior art to determine whether the limitations of the claim are met by the prior art.

34. I have been informed that this standard is the same as that used in United States district courts, in which claim terms are given their ordinary and customary meaning as would be understood by a person of ordinary skill in the art at the time of the invention having taken into consideration the language of the claims, the specification, and the prosecution history of record.

B. Means Plus Function

35. Sometimes, a patentee may express a claim term as “means” for performing a certain “function,” or use similar language. I understand that a claim term in this format is called a “means-plus-function” claim term.¹ When expressed in this format, my understanding is that the claim term does not identify the actual structure of the claim limitation. Instead, the claim term only describes the function performed by the limitation. One must then look to the specification to identify the corresponding structure identified by the patentee for performing the stated function.

36. My understanding is that parties may sometimes dispute whether a claim term is a means-plus-function term. My understanding is that the use of the word “means” provides a rebuttable presumption that the term is a means-plus-function term. However, if the word “means” is not used, my understanding is that there is a rebuttable presumption that a term is not a means-plus-function term.

37. If a term is a means-plus-function term, my understanding is there are two steps for determining the meaning and scope of the term. First, one must identify the claimed function set forth in the claim for the term. Second, one must identify the structure disclosed in the written description that corresponds to the claimed function. When there are multiple claimed functions, one must identify the corresponding structure that performs each of the claimed functions. Structure disclosed in the written description is ‘corresponding’ structure only if the written description or prosecution history clearly links or associates that structure to the function recited in the claim.

¹ Because the ’416 Patent was filed prior to the America Invents Act (AIA), and its renumbering of 35 U.S.C. § 112, I used the old statutory notation, “§112(6) or “§112 ¶ 6,” instead of the post-AIA notation, “§112(f).”

38. I understand the corresponding structure must include all structure that actually performs the recited function. However, §112 does not permit incorporation of structure from the written description beyond that necessary to perform the claimed function.

39. I understand that where a specification provides no corresponding structure, the knowledge of a POSITA is irrelevant and a means plus function claim is invalid. However, when structure is disclosed in the specification, the knowledge of a POSITA is relevant in determining whether the structure is disclosed in sufficient detail.

C. Prior Art

40. It has been explained to me by counsel for Petitioner that information which satisfies one of the categories of prior art set forth in 35 U.S.C. § 102 (“AIA”) may be used in an invalidity analysis under §103. If information is not properly classified as prior art under one of the subsections of §102 of the Patent Code, then it may not form the basis of an obviousness determination.

41. I understand that IPR petitions can rely on patents and printed publications or other public disclosures, prior art public uses, and on-sale activities. I understand that Petitioner has not asserted an invalidity ground on prior art public uses or on-sale activities. I also understand that extrinsic evidence such as a declaration may only be considered to explain the meaning of a reference and cannot expand the meaning of a reference. I understand that the Board cannot accept general conclusions about what is “basic knowledge” or “common sense” as a replacement for documentary evidence for core factual findings in a determination of patentability.

D. Obviousness

42. I understand that a proper 35 U.S.C. §103 obviousness analysis requires a searching comparison of the claimed invention—including all its limitations—with the teachings of the prior art. I understand that obviousness of a claim under 35 U.S.C. §103 requires a four-prong analysis: (1) a determination of the scope and content of the prior art; (2) the differences between the prior art and the claim at issue; (3) the level of ordinary skill in the pertinent art; and (4) secondary considerations, if any, such as long felt need, commercial success, failed efforts by others, praise for the invention, unexpected results, disbelief of experts, general skepticism of those in the art, commercial acquiescence, and simultaneous development. I understand that a claimed invention is not proved obvious merely by demonstrating that each of its elements was known independently from the prior art. In addition, I understand that a patent challenger must identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements. In determining whether a claimed invention is obvious, each claim must be considered separately, and hindsight may not be used, but only what was known at the time of the invention. I understand that when considering the issue of obviousness, expressly recited claim features are not mere peripheral issues where conclusions of a party or the Board may substitute for core factual findings based on evidence that the feature is met by the prior art. I also understand that if an independent claim is not obvious then its dependent claims also cannot be obvious because they all depend from a nonobvious claim.

E. Enablement

43. I understand that 35 U.S.C. §112(a) requires that a patent's claims be supported by a specification to enable any person skilled in the art to make and use the claimed invention. I understand the test of enablement is whether one reasonably

skilled in the art could make or use the invention from the disclosures in the patent coupled with information known in the art without undue experimentation.

F. Indefiniteness

44. I understand that a patent is invalid for indefiniteness if its claims, read in light of the specification and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention.

G. Written Description

45. I understand that a provisional application satisfies the written description requirement when the description clearly allows persons of ordinary skill in the art to recognize that the inventor invented what is claimed. I understand that possession of the invention is conveyed by such descriptive means as words, structures, figures, diagrams, formulas, etc., that fully set forth the claimed invention, although the exact terms need not be used *in haec verba*.

V. OVERVIEW OF THE '416 PATENT

46. The '416 Patent pertains to multiplexing used in optical communications. Multiplexing is a technology used in optical communications that allows multiple signals to be transmitted over a single optical fiber. There are several types of multiplexing techniques used in optical communications. Relevant here is wavelength division multiplexing (WDM) where multiple signals are sent simultaneously over a single optical fiber by using different wavelengths of light for each signal. The signals are separated at the receiving end by a device, which separates the different wavelengths into individual signals. Multiplexing is a critical technology in optical communications as it allows for high-speed, efficient, and cost-effective transmission of large amounts of data over using a single fiber optic cable.

47. The '416 Patent represents advances in multiplexing technology used in fiber optics data communications systems. Specifically, the inventions cover an optical combiner that is capable of combining laser beams of different wavelengths onto a single spot on an optical fiber using optical components that are integrated into the optical combiner itself.

48. The claimed optical combiner is an efficient, compact, and cost-effective multiplexing device that does not require dielectric filters requiring alignment or expensive waveguides needed in prior art systems. As the patent recites, the invention allows “for the first time, an inexpensive, injection molded, one piece optical combiner capable of combining, separately collimating and focusing the output of multiple lasers into a single optical fiber with a uniform, high coupling efficiency.” EX1001 at 2:11-15.

A. The Challenged Claims of the '416 Patent

49. Petitioner has challenged the Challenged Claims as being invalid under each Ground asserted in the Petition.

50. My declaration responds to all of Petitioner's arguments.

VI. TECHNICAL BACKGROUND/STATE OF THE ART

51. For over four decades, optical fiber has been an efficient way to modulate and transmit optical signals over distances. A point-to-point fiber optical transmission link typically consists of an optical transmitter and receiver connected over an optical fiber and may use optical amplification during transmission. The optical transmitter converts electrically modulated data to a modulated optical-carrier signal that is coupled to an optical transmission fiber via a physical link interface. After transmission over the optical fiber, an optical receiver is used to convert the optical data to an electronic analog baseband electrical signal. A basic receiver consists of a photodetector connected to the fiber that converts the optical

signal to a representative modulated electrical current. In other words, the optical transmitter takes data that has been changed by electricity and turns it into light signals that travel through a cable. At the other end of the cable, the optical receiver changes the light signals back into the original electronic signals. The receiver works by using a special device called a photodetector that converts the light back into electricity.

52. The use of fiber optics revolutionized the computer and telecommunications industry. With the acceleration of the Internet in the 1990s, and especially the late 1990s, companies entered the marketplace with different innovations in not only fiber optics interconnect generally, but also specifically, fiber optic equipment. The lengths and styles of optical interconnects allowed fiber optics to be utilized as an optical connection in not only data centers, but also in high performance computing, computational processing, as well as consumer-based applications such as video today. Using fiber optical communications as a platform, shorter data links could be applied to new industries such as consumer communications between displays, computers, and peripheral devices. Link lengths are significantly reduced in these environments, and new standards for these shorter interconnect cables emerged (such as DVI, HDMI, USB, etc.).

53. The prior art optical multiplexing devices combined or separated multiple light signals with varying optical wavelengths, but in a different way than described in the '416 Patent. The prior art optical multiplexing devices that combined multiple light signals with varying optical wavelengths for fiber optic data communications and telecommunications were “typically designed using dielectric filters or expensive waveguides,” as described in the specification. EX1001 at 1:45-46.

54. Kurita and Lemoff relied upon in the Petition present different solutions for multiplexing multiple wavelengths onto a single fiber without using typical

optical multiplexers. Kurita uses an optical arrangement with individual optical components that must be manually aligned. EX1004. Kurita teaches using its optical arrangement in connection with an optical wavelength switch. EX1004. Lemoff emulates WDM through mis-aligned spots onto an unusually large optical fiber. EX1006. LaMarche does not relate to multiplexing light onto a single fiber and presents an entirely different solution to an entirely different problem of using simultaneous broadcasting method in multipoint to multipoint connections. EX1005.

55. In Dr. Willner's declaration, he has provided some background on wavelengths division multiplexing, lenses for coupling light, and coupling efficiency, much of which I find not pertinent to the design of the integrated, optical combiner disclosed in the '416 Patent. These references do not disclose or suggest combining optical components that are capable of multiplexing light onto a single fiber using an optical combiner with integrated optical components or an optical combiner with a pre-aligned connector that allows for the fiber to be passively aligned with the optical components inside of the optical combiner.

56. An overview of the prior art relied upon by Dr. Willner in Grounds 1-5 is provided in the section of my report that responds to Petitioner's invalidity arguments. *See* §IX.

VII. CLAIM CONSTRUCTION

A. Preambles Are Limiting

57. I understand that Petitioner contends that the preambles of claims 1 and 7 are not limiting. A POSITA reviewing the claims and the specification would understand that the preamble of claims 1 and 7 are limiting.

58. I understand that a preamble is limiting if it recites essential structure or steps, or if it is necessary to give life, meaning, and vitality to the claim. I also understand that there is no "litmus test" for determining whether a preamble is

limiting, and that Federal Circuit opinions are to provide guideposts. I agree with Patent Owner's proposed constructions below.

1. "Optical combiner"

59. Patent Owner proposes "optical combiner" to be construed as "an integrated subassembly of optical components for multiplexing light of different wavelengths, which includes an integrated, pre-aligned connector with a stop to hold the single fiber optic cable." I agree with Patent Owner's proposed construction. A POSITA reviewing the claims and the specification would understand that the term "optical combiner" is limiting in more ways than the body of the claims as Patent Owner proposes.

60. First, the patent specification makes clear that the patented invention covers an integrated device with integrated optical components. The specification describes that the integrated device can be comprised of a single piece or single part module constructed in various ways. EX1001 at [Abstract], 2:11-15, 4:61-63. The specification also states that the "molded device" can be constructed of two or more parts that are combined to accomplish the same function. *Id.* at 1:51-55, 2:17-18. The specification also discusses "forming" various optical components that are part of the combiner. *See, e.g., id.* at 3:39-44, 3:67-4:9, 4:10-13, 4:55-57.

61. The '416 Patent also describes "the present invention" as "provid[ing] for the first time, an inexpensive, injection molded, one piece optical combiner capable of combining, separately collimating and focusing the output of multiple lasers into a single optical fiber with a uniform, high coupling efficiency." EX1001 at 2:11-15. Then, the specification provides that the invention can be a two-piece combiner.

62. The specification also describes the benefits of the patented invention of the '416 Patent which are benefits that stem from an integrated optical combiner,

and not discrete optical components that must be manually aligned as in the prior art cited by Dr. Willner.

- a. “Another object of the present invention is to integrate a fiber optic connector within the optical module, to passively align an optical fiber to the coupling optic.” *Id.* at 2:38-40.
- b. “Passive Alignment[:] All of the optical components within the multiplexer could utilize passive alignment mechanisms.” *Id.* at 4:58-59.
- c. Manufacturing throughput Replication[:] procedures are extremely fast, thus reducing the overall cost of the manufactured device. *Id.* at 4:55-57.
- d. “Monolithic Coupling Optics[:] Each optical coupling and redirection component is integrated within a single monolithic plastic-molded device in most embodiments.” *Id.* at 4:61-63.

63. Based on these disclosures in the specification, a POSITA would understand that the claimed “optical combiner” is “an integrated subassembly of optical components.” The term “subassembly” is how a POSITA would refer to the combined components that have been sub-assembled into a single device or are formed as one single piece. The ’416 Patent also uses the term “module.” EX1001 at 3:32-34 (“The first embodiment of the invention is a combiner 10 comprised of a **single piece plastic molded coupling module 16**...”); *id.* at 3:39-40 (“The **plastic molded coupling module 16** is formed by integrating[optical components]”); *id.* at 4:10-11 (“As shown best in FIG. 8, the bottom surface 240 of **module 216** is recessed with four separate inclined surfaces...”); *id.* at 4:32-34 (“FIG. 9 shows a single slice of optic 216 to more clearly illustrate the interaction with the **module 216** with the circular array of lasers 211–214.”).

64. Another important structural feature of the optical combiner is the integrated pre-aligned connector of the optical combiner disclosed in the specification. The integrated pre-aligned connector allows the fiber to be inserted into the connector and be passively aligned with the combiner's integrated optical components. This is apparent to a POSITA reading the specification. *Id.* at 3:17-18 (“The integrated ferrule 80 enables one to place an output fiber optic cable into the pre-aligned connector.”); *id.* at [Abstract] (“a single plastic-injection molded part” includes a “fiber optic connector ferrule”); *id.* at 2:38-40 (“Another object of the present invention is to integrate a fiber optic connector within the optical module, to passively align an optical fiber to the coupling optic.”). Additionally, one key advantage of the invention of the '416 Patent is “Passive Alignment” where “All of the optical components within the multiplexer could utilize passive alignment mechanisms.” *Id.* at 4:58-59. Without the pre-aligned optical connector, the fiber would need to be manually aligned with the optical combiner's integrated optical components. It is clear from the specification that the '416 Patent teaches passive alignment.

65. Each of the Figures of the '416 Patent that show a complete optical combiner include the integrated pre-aligned connector at element 80 or 180. *See* FIGS. 1, 4, 6. A POSITA would understand that FIGS. 7-10 only show the internal optical components of the optical combiner and do not show a complete optical combiner. As stated in the specification, these figures only “generally” show the combiner. *Id.* at 4:36-37. The Figures are described as such in the specification. *Id.* at 2:61-62 (“FIG. 8 is a sectional view of a portion of the third embodiment”); *id.* at 4:32-47; *id.* at 2:63-65 (“FIG. 9 is a perspective view of the third embodiment shown in FIGS. 7 and 8, wherein a slice of the molded coupling optic is shown to illustrate the invention.”); *id.* at 4:42-45 (“The focusing lens 350 is supported in its position

shown in FIG. 10 by means known to those skilled in the art which are deleted in the interest of brevity.”).

66. Thus, a POSITA would understand the “optical combiner” claimed in the ’416 Patent includes an integrated pre-aligned connector.

67. Another structural feature of the optical combiner is a stop. The stop is another alignment feature of the ’416 Patent that is positioned inside the pre-aligned connector (ferrule) that allows the fiber to be passively aligned to the optical components inside the optical combiner. *Id.* at 2:38-40 (“Another object of the present invention is to integrate a fiber optic connector within the optical module, to passively align an optical fiber to the coupling optic.”); *id.* at 4:58-60 (“All of the optical components within the multiplexer could utilize passive alignment mechanisms.”) This pre-alignment is possible because the fiber is stopped in the pre-aligned connector at a determinate location.

68. Claims 1 and 7 recite that the optical combiner is used to transmit laser outputs though “a stopped single fiber.” The specification describes the stop as being inside the integrated ferrule. *See id.* at 3:11-15 (lights from the laser beams are “focused by the focusing lens 30 onto a spot at which a single optical fiber (not shown) is stopped by fiber stop or seat 60 formed in ferrule 80.”); *id.* at 3:23-24 (“the fiber (not shown) inserted into ferrule 80, seated at the fiber stop 60...”).

69. FIGS. 1 and 4 call out the stop at element 60. The stop 60 blocks the inserted optical fiber from being inserted further. The stop can also be seen in FIG. 6. *See* FIGS. 1–6; *id.* at 2:46-58. Again, a POSITA would understand that the FIGS. 7–10 only show the internal optical components of the optical combiner and do not show a complete optical combiner’s stop. *Id.* at 2:59-3:2, 3:61-63, 4:32-47. Nevertheless, the specification explains that FIGS. 7–8 includes a stop. “It is significant to note that, as shown in FIG. 8, the output beams of lasers 212 and 214 are refracted through output lens 250 through equal angles. This is significant

because the beam passing through quadrant 252 will not be reflected **by the stopped single fiber optic** back into laser 212. Rather, the laser output 212 passing through quadrant 252 will tend to be reflected from the **stopped fiber optic** back towards quadrant 254.” *Id.* at 4:20-27. Thus, a POSITA would understand that for these embodiments as well that the optical combiner includes a stop causing the fiber to be pre-aligned with the optical components.

70. Based on all of the above, a POSITA would understand that the term “optical combiner” used in the preamble has meaning beyond the claim elements in the body of the claims.

2. “Usable in data communication systems for multiplexing the outputs of a plurality of n lasers wherein each of said n outputs has a different output wavelength”

71. A POSITA would understand that this portion of the preamble is limiting in view of the claims and the specification.

72. The term “multiplexing” provides important context for the invention being claimed. The patent specification makes clear that the patented invention covers an integrated device with integrated optical components for multiplexing outputs of lasers onto a single fiber. The specification makes clear that the inventors were working on a particular problem within the field of WDM devices. “The prior art includes inherent problems overcome by the present invention. Prior art wavelength division multiplexed devices (WDM) are typically designed using dielectric filters requiring alignment or expensive waveguides.” *Id.* at 1:42-46. “The present invention provides, for the first time, an inexpensive, injection molded, one piece optical combiner capable of combining, separately collimating and focusing the output of multiple lasers into a single optical fiber with a uniform, high coupling efficiency.” *Id.* at 2:11-26; *see also id.* at 4:64-65; 1:51-55.

73. Additionally, the limitation “the outputs of a plurality of n lasers” is referred to again in the body of the claims as “the output of said n laser output beams.” *Id.* at 5:31. The concept of outputs with different output wavelengths is also repeated throughout the claims.

74. A POSITA would understand this term to be limiting.

3. “For transmission into and through a stopped single optical fiber”

75. The “stopped single optical fiber” or “said single fiber” is referred to three times through claim 1 and 7. The body of the claims refer back to the stopped single optical fiber in the preamble.

76. Additionally, Petitioner and Dr. Willner seek to construe a portion of this term in the body of the claim.

77. This limitation explains an important aspect of the invention – to transmit the laser output beams that are different wavelengths through a single fiber using an optical combiner subassembly. This is what WDM is and what a POSITA would understand what the optical combiner should accomplish.

78. I agree with the Patent Owner this limitation adds meaning and context to the claim.

B. “Focusing means for focusing said n collimated output beams onto a single stop at said stopped single optical fiber”/ “focusing means for focusing said collimated output beams onto a single spot at said stopped single optical fiber...”

79. I understand the parties have agreed that this term is a means plus function term. The parties agree that the function in claim 1 is “focusing said n collimated output beams onto a single stop at said stopped single optical fiber” and “focusing said collimated output beams onto a single spot at said stopped single optical fiber” for claim 7.

80. I understand that Petitioner and Dr. Willner have identified the corresponding structure in the specification to be a focusing lens and equivalents. I disagree that the corresponding structure necessary to perform the function is a focusing lens. I disagree with this because more structure than a “lens” is necessary to perform the function. In one sense, a focusing lens is one that focuses—but that is not all of what the claim function requires—it requires focusing collimated output beams onto a single stop at said stopped single optical fiber. A POSITA would understand that not every “focusing lens” is capable of doing this.

81. Typically, the term focusing lens connotes a lens that focuses light to a focal point on a fiber, but the claims and the specification are not limited to this but discuss focusing the light onto a spot.

82. The specification provides four embodiments that contain the structures that perform the function. In each of these embodiments, a lens integrated into the optical combiner that is in alignment with the collimating lenses and the core of the stopped optical fiber to perform the claimed function. This is because the claimed optical combiner allows for passive alignment with the fiber. A POSITA would understand that the focusing means must be integrated into the optical fiber.

83. Thus, I agree with Patent Owner’s construction that the corresponding structure is a **“lens integrated into the optical combiner that is in alignment with the collimating lenses and the core of the stopped optical fiber”** and equivalent structures. *E.g.*, EX1001 at 3:32-36, 3:45-49.

84. A POSITA would also understand the lensing properties that are necessary for the integrated focusing lens that will cause the light to focus the collimated beams onto a single spot on the fiber.

85. Moreover, the functional requirement that the collimated beams be focused onto a single spot at said stopped single optical fiber further highlights the structural relationship between the optics of the focusing means and the structure of

the optical combiner: the distance from the focusing means to the “stop” and the size of the spot on the stopped optical fiber both define the particular optical features of the focusing means.

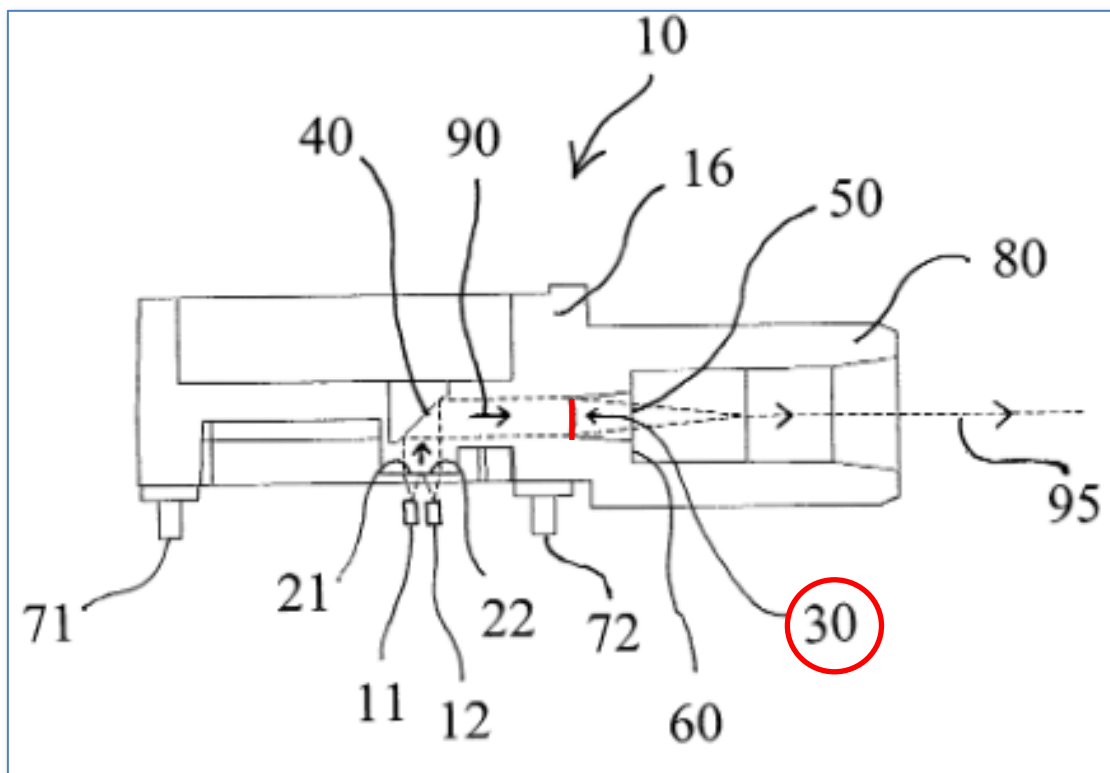
86. Each structural embodiment in the '416 Patent specification supports this construction:

- Embodiment 1: FIGS. 1–4 (focusing lens 30), Abstract (“focusing lens housed within a fiber optic connector ferrule”), 3:8-15, 3:17-18, 3:22-29, 3:32-36, 3:39-44, 3:45-49; cls. 1 & 7
- Embodiment 2: FIGS. 5–6 (focusing lens 130), 3:50-51, 3:54-55, 3:58-60; 3:45-49; 3:22-29 Abstract (“focusing lens housed within a fiber optic connector ferrule”); cls. 1 & 7; *see also* Embodiment 1
- Embodiment 3: FIGS. 7–9 (focusing lens 250), Abstract (“focusing lens housed within a fiber optic connector ferrule”), 3:67-4:2, 4:5-9, 4:10-14, 4:16-19, 4:20-23; cls. 1 & 7; *see also* Embodiment 1
- Embodiment 4: FIGS. 10–11 (focusing lens 350), Abstract (“focusing lens housed within a fiber optic connector ferrule”), 4:36-39, 4:42-46, 4:49-51, cls. 1 & 7; *see also* Embodiment 1

87. In each of the structures described in the '416 Patent, the focusing means is integrated into the optical combiner such that it is aligned with the collimating lenses and lasers in a way to carry out the claimed function—to focus the laser outputs onto a single spot at the fiber that is placed in a pre-aligned connector.

88. The first corresponding structure described in the specification for performing the focusing function is identified in FIGS. 1–4. *See* FIGS. 1–4; *id.* at 3:7-8 (“FIGS. 1–4 show an optical combiner 10 that illustrates a first embodiment of the present invention.”). As shown in FIG. 1, the structural integration and the positioning of the focusing means inside the optical combiner allows it to perform

the function of focusing the light from the collimated output beams onto a single spot at said stopped single optical fiber. The arrows shown in FIG. 1 below show the optical path 90 and collimated output beam 95 as the light is being directed onto a stopped single fiber.



89. Thus, in this embodiment, the focusing means is an integrated part of the optical combiner. The optical “**combiner 10 comprised of a single piece plastic molded coupling module 16 consisting of four collimating lenses 21–24 and one lens 30 for focusing several geometrically placed collimated beams onto the output fiber...**” *Id.* at 3:32-34. The ’416 Patent Abstract also describes the “focusing lens” as “**housed within a fiber optic connector ferrule.**” *Id.* at [Abstract]. In further describing integrated focusing lens of the first embodiment, the specification states “[t]he **plastic molded coupling module 16 is formed by**

integrating an aspherical on-axis, offset collimating lens array 21–24, a redirection prism 40, **a focusing lens 30....**” *Id.* at 3:39-41. In explaining how the lens focuses the light, the specification provides “[l]asers 11,12 are located at the focal points of the input lenses and the light is collimated, reflected off a prism 40 and **focused by the focusing lens 30 onto a spot at which a single optical fiber (not shown) is stopped by fiber stop or seat 60 formed in ferrule 80.**” *Id.* at 3:11-15. The specification explains, “by arranging four (in this embodiment) collimating lenses 21, 22, 23, 24 **of a size small enough to fit inside the diameter of the focusing lens 30**, and matching their NA to the light sources, the maximum amount of light will couple into the collimated output beam 95.” *Id.* at 3:26-31.

90. The second corresponding structure described in the specification for performing the focusing function is identified in FIGS. 5–6 and further described in the text. *Id.* at 3:50-30; *see also id.* at 2:55-58 (“FIG. 5 is an isometric view of a second embodiment of the invention; FIG. 6 is an isometric cross-sectional view of the second embodiment of FIG. 5”). As shown in FIG. 6, the focusing means is integrated into the optical combiner and properly aligned with the collimating lenses. “**Similar to the embodiment described in FIGS. 1–4**, the embodiment shown here utilizes a two-dimensional array of four lenses 121, 122, 123, 124 for collimating the input light signals from a two-dimensional, two by two, array of lasers (not shown), **a single focusing lens 130**, and a fiber connector 180 that allows one to place a fiber optic cable into the pre-aligned connector.” *Id.* at 3:54-60. Like FIGS. 1–4, the focusing means is integrated as part of the optical combiner and is housed within the pre-aligned connector. *See* FIGS. 5, 6. The collimating lenses are small enough to fit inside the diameter of the focusing lens 130. *See id.*

91. The third corresponding structure described in the specification for performing the focusing function is identified in FIGS. 7–9. *See* FIGS. 7–9 (focusing lens 250). In describing these figures, the specification states that, “**The focusing**

lens 250 is formed on the top surface of the module 216.” *Id.* at 4:5-6. The specification describes the **“surface of focusing lens 250 is smooth”** and that it **“includes four pie-shaped radial quadrants 251–254.”** *Id.* at 4:6-8. In describing FIG. 8, the specification describes the focusing lens as having **“separate pie-shaped quadrants 252 and 254…”** *Id.* at 4:16-19.

92. The fourth corresponding structure described in the specification for performing the focusing function is identified in FIGS. 10-11. *See* FIGS. 10–11 (focusing lens 350). This optical combiner includes a **“two-piece” molded module that contains “a separately molded output lens 350”** and **“separately molded collimating lenses 321–324.”** *Id.* at 4:35-43. In describing these figures, the specification states that **“[t]he focusing lens 350 is supported in its position shown in FIG. 10 by means known to those skilled in the art…”** *Id.* at 4:43-45. Thus, like each of the other embodiments, the focusing means is integrated into the optical combiner to focus the laser outputs onto a single stop of the stopped optical fiber. (Above, under §VII.A.1. I discussed that the term optical combiner provides the additional structural limitation that the optical components are integrated into the optical combiner, and the specification’s description related to FIGS. 7–11 are consistent with that reading).

93. Based on these disclosures, a POSITA would understand that the focusing means must be a lens integrated into the optical combiner that is in alignment with the collimating lenses and the core of the stopped optical fiber to perform the claimed function.

C. “Stopped single optical fiber”

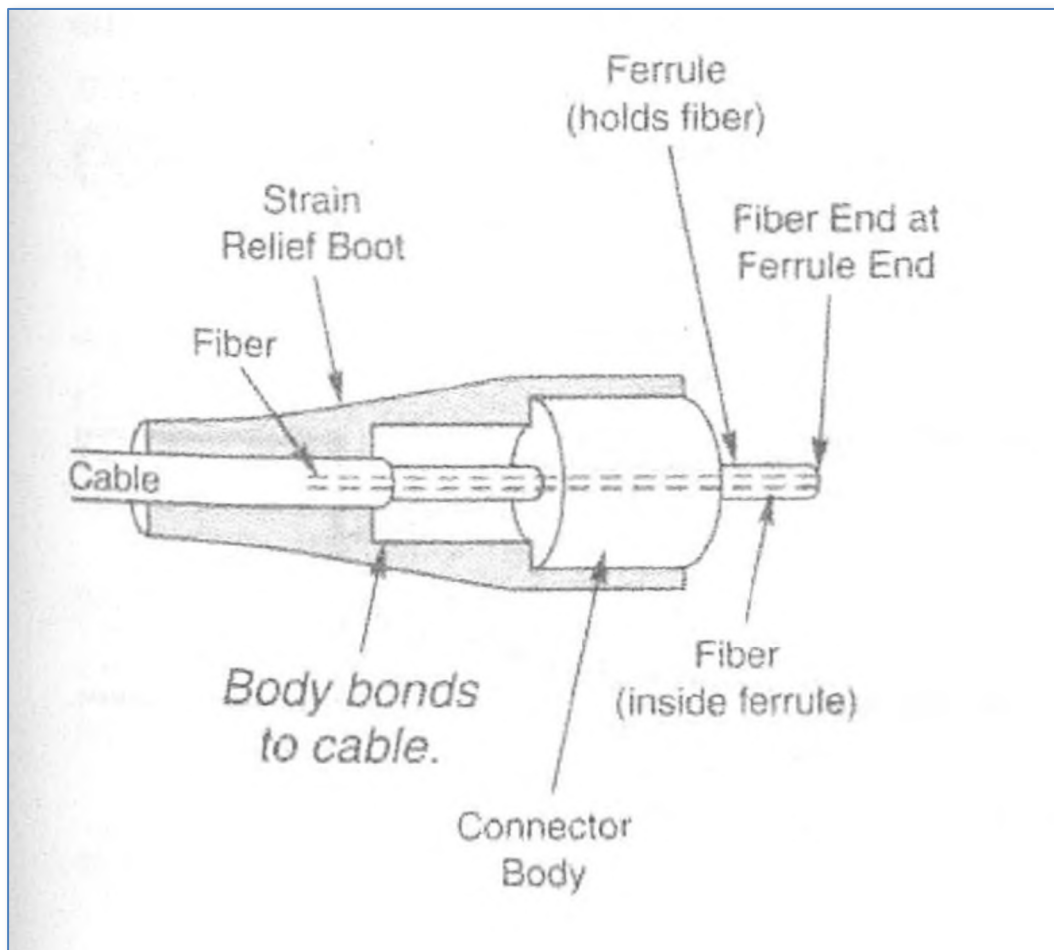
94. Petitioner proposes to construe only the word “stopped” in this phrase and proposes “stopped” should be construed as “‘fixed,’ such that movement would be substantially limited.”

95. Patent Owner has proposed that “stopped single optical fiber” should be construed as **“a single optical fiber that has been inserted into the optical combiner until it abuts a physical structure that prevents the fiber from being inserted further into the optical combiner.”** The term “stopped single optical fiber” appears in the preamble and the body of independent claims 1 and 7. EX1001 at 5:26-27, 5:33, 5:39, 6:23, 6:33, 6:39.

96. I agree with Patent Owner’s construction that a stopped single optical fiber is more than a fixed single fiber.

97. The portion of the claimed optical combiner of the ’416 Patent that “fixes” the fiber in place is the ferrule or the pre-aligned connector. The “stop” that is described in the ’416 Patent is referred to a seat, and indicates what the fiber abuts against when it is entered into the pre-aligned connector.

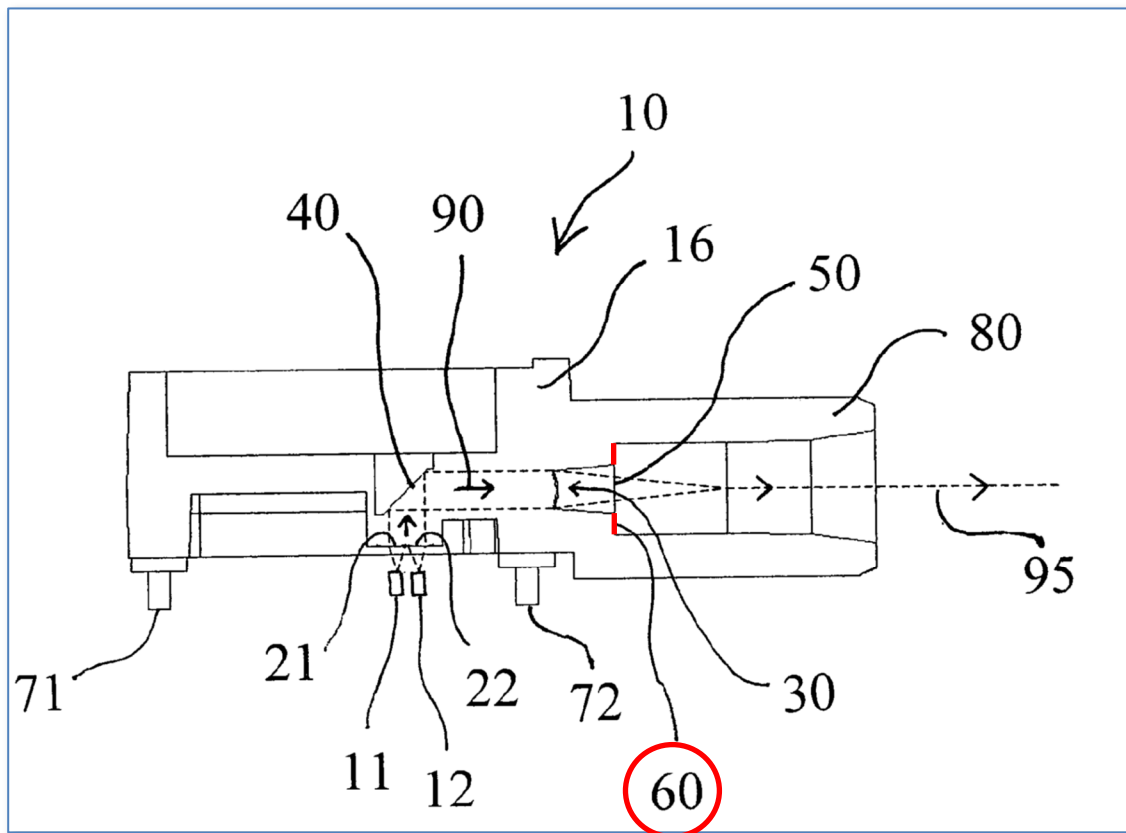
98. A “ferrule” is a “component of a fiber optic connection that holds a fiber in place and aids in its alignment.” EX2016, at p. 336. Not all ferrules are structurally the same. Below is an image of a ferrule that does not have a stop, and the reference describes the fiber passing all the way through the ferrule. EX2017, at p. 317. (“The fiber end may be pushed slightly past the end of the ferrule and then polished to a smooth face.”).



EX2017.

99. The ferrule above does not contain a seat or stop, but the reference explains that the end of the fiber goes past the end of the ferrule to allow the two ends to be smoothed so the end of the fiber is flush with the end of the ferrule.

100. Unlike the example shown above (which does not include a stop or seat), the ferrule disclosed in the '416 Patent includes a stop or seat to mark the endpoint of the fiber optic cable's insertion into the ferrule. EX1001 at FIG. 1 (showing stop 60 inside ferrule 80); *see also id.* at 3:23-24 (fiber is "seated at the fiber stop 60"):



EX1001, FIG. 1; *see also* FIG. 4, at stop 60.

101. I agree with Patent Owner's construction because it is consistent with what a POSITA would understand when reading the specification. The specification explains that the "stop" of the optical combiner's pre-aligned connector prevents the fiber from going further into the optical combiner, allowing the fiber to be pre-aligned with the optical components of the optical combiner. *See id.* at 3:11-15 (lights from the laser beams are "focused by the focusing lens 30 onto a spot at which a single optical fiber (not shown) is **stopped by fiber stop or seat 60 formed in ferrule 80.**"); *id.* at 3:23-24 ("the fiber (not shown) inserted into ferrule 80, **seated at the fiber stop 60...**"). "The integrated ferrule 80 enables one to place an output fiber optic cable into the pre-aligned connector." *Id.* at 3:17-18; 3:39-44; 3:54-60.

“Another object of the present invention is to integrate a fiber optic connector within the optical module, to passively align an optical fiber to the coupling optic.” *Id.* at 2:38-40. “Passive Alignment [:] All of the optical components within the multiplexer could utilize passive alignment mechanisms.” *Id.* at 4:58-60.

102. Petitioner’s construction simply means that the fiber is fixed somewhere in space. Based on the claims and the specification, a POSITA would understand that the stopped single optical fiber is more than a fiber fixed in space. The specification makes clear that the fiber must be seated into the optical combiner’s integrated connector for it to be considered a “stopped single optical fiber.”

VIII. SUMMARY OF OPINIONS

103. In my opinion, the Challenged Claims of the ’416 Patent are not obvious over Kurita because:

- a. Kurita as a standalone §103 reference does not disclose every claim limitation of each independent claim;
- b. Kurita as a standalone §103 reference does not disclose additional, specific limitations found in the dependent claims.

104. In my opinion, the Challenged Claims of the ’416 Patent are not obvious over Kurita in view of LaMarche and/or Lemoff because:

- a. LaMarche is not analogous art to the ’416 Patent;
- b. Kurita in view of LaMarche does not disclose every claim limitation of each independent claim;
- c. Kurita in view of Lemoff does not disclose every claim limitation of each independent claim;
- d. Kurita in view of LaMarche and Lemoff does not disclose every claim limitation of each independent claim;

- e. Kurita in view of LaMarche and Lemoff along with any modifications or obvious variations does not disclose every claim limitation of each independent claim;
- f. Kurita in view of LaMarche and/or Lemoff does not disclose additional, specific limitations found in the dependent claims.

105. In my opinion, the Challenged Claims of the '416 Patent are not obvious over Lemoff in view of LaMarche because:

- a. LaMarche is not analogous art to the '416 Patent;
- b. Lemoff in view of LaMarche does not disclose every claim limitation of each independent claim;
- c. Lemoff in view of LaMarche does not disclose additional, specific limitations found in the dependent claims.
- d. Lemoff in view of LaMarche along with any modifications or obvious variations does not disclose additional, specific limitations found in the dependent claims.

106. In my opinion, the Challenged Claims of the '416 Patent are not obvious over Bhandarkar because:

- a. Bhandarkar is not prior art.

107. In my opinion, the provisional application provides written description support to the Challenged Claims.

108. In my opinion, the Challenged Claims are enabled.

109. In my opinion, the Challenged Claims are entitled to a priority date of July 17, 2003.

IX. RESPONSE TO INVALIDITY ARGUMENTS

A. Ground 1: The '416 Patent Is Not Obvious Over Kurita

110. I understand that Petitioner argues in Ground 1 that the Challenged Claims are invalid as obvious over Kurita as a standalone §103 reference.

111. In my opinion, Kurita as a standalone §103 reference does not disclose or teach every claim limitation of each independent claims, and as a result does not disclose or teach each and every claim limitation of the dependent claims, and therefore the Challenged Claims of the '416 Patent are not obvious under Ground 1

112. Further, Kurita as a standalone §103 reference does not disclose or teach additional, specific limitations of the dependent claims, and for that separate reason, those dependent claims of the '416 Patent are not obvious under Ground 1.

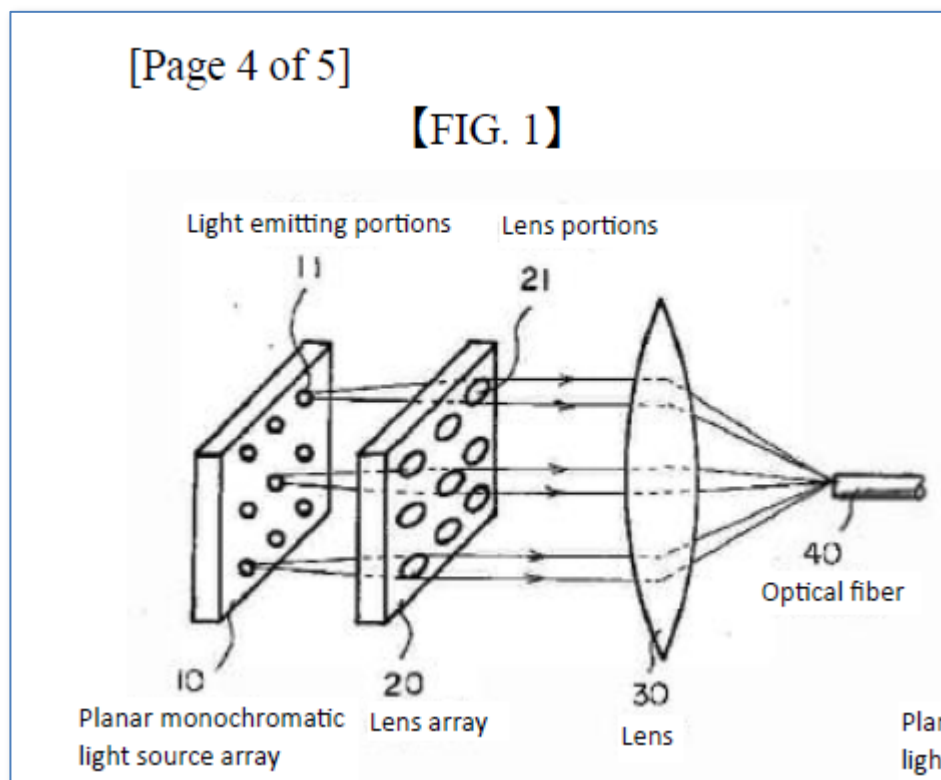
1. (“Kurita”) (EX1004)

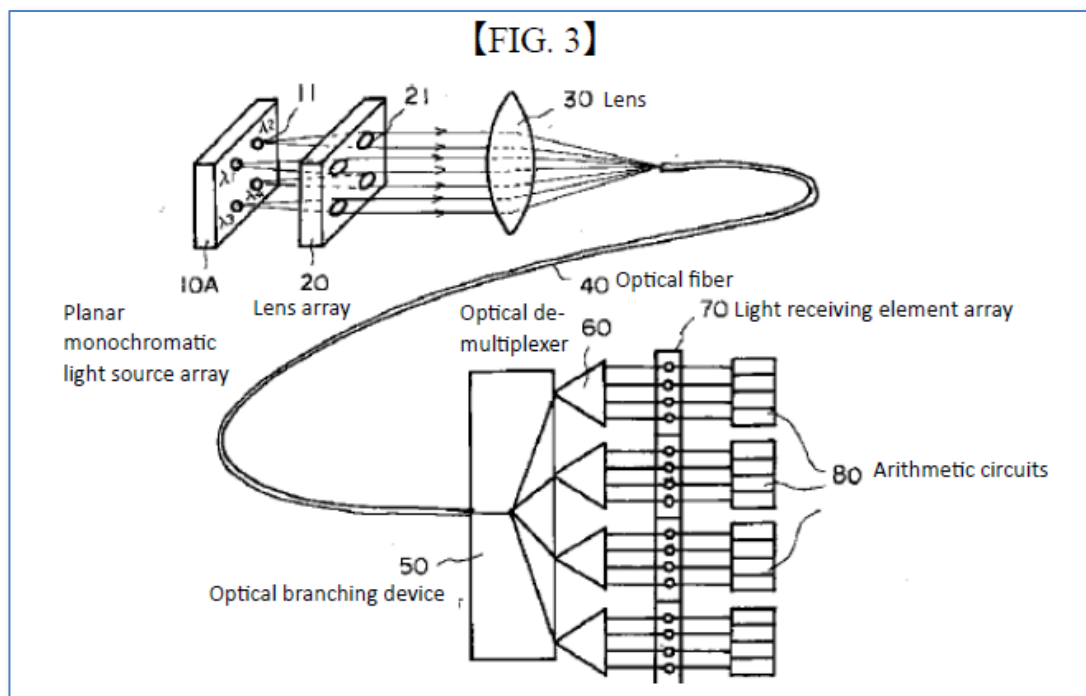
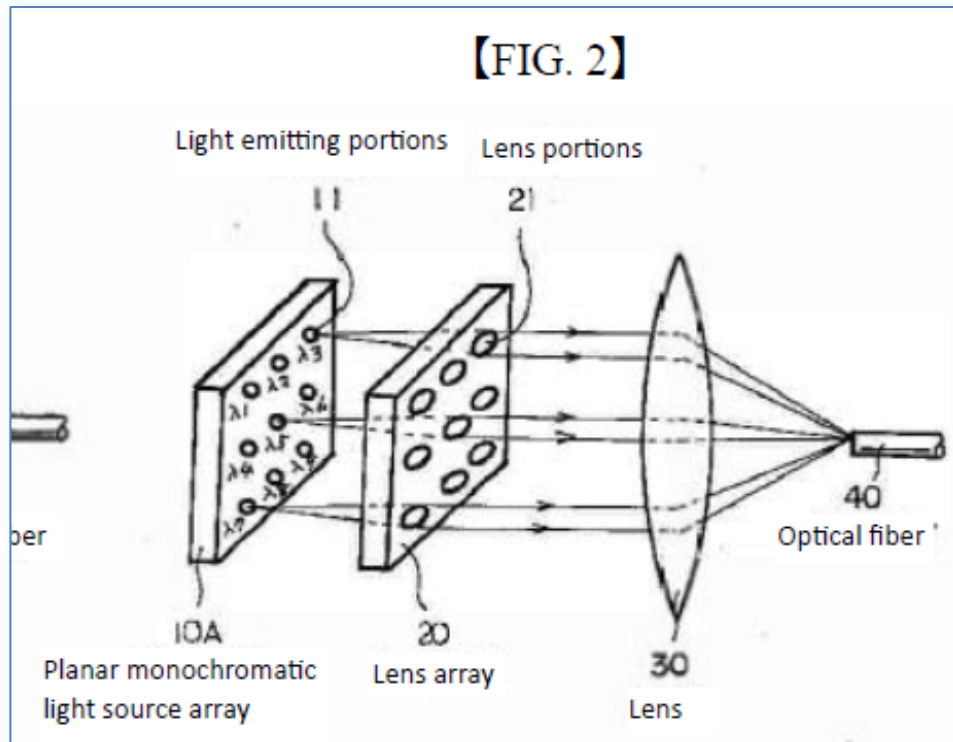
113. Kurita discloses an optical arrangement that utilizes separately placed optical components used for multiplexing multipoint laser sources onto a fiber. EX1004, ¶¶[0005]-[0006], [0015]. Kurita discloses a free space, conceptual design that must be manually set up and aligned. *Id.* at ¶¶[0004], [0010], [0013], [0015]. Kurita discloses that its optical arrangement can be used to input laser light into optical fibers that “are used with multistage switching networks inside optical computers and switchboards, and with optical communications, laser processing, etc.” EX1004, ¶[0001].

114. While the object of the invention of Kurita was to reduce cost by reducing the number of individual optical components used in conventional optical multiplexers (EX1004, ¶¶[0005]-[0006], [0012]), Kurita does not disclose an integrated, compact optical combiner that performs multiplexing. Kurita recognizes that as the number of optical components increase, so does the number of installation man-hours, which can be costly and commercially prohibitive. EX1004, ¶[0004]

(“on account of a large number of parts being needed, it increases installation man-hours, and presents a problem in terms of the cost aspects as well.”).

115. Kurita discloses that “as compared to the optical multiplexer shown in FIG. 4, a lens array 20 is used in lieu of individual lenses and individual optical fibers become unnecessary, and further, on account of the use of lens 30 in lieu of an optical multiplexer....” EX1004, ¶[0012]. Kurita discloses an optical arrangement to multiplex multiple laser signals onto a single fiber comprising of several individual components—(1) “a planar monochromatic light source array 10A wherein plural light emitting portions 11 having fixed oscillation wavelengths are arrayed,” (2) “a lens array 20 having plural lens portions 21 corresponding to the individual light emitting portions 11,” (3) “a lens 30 for focusing the lights from the individual lens portions 21,” and (4) “an optical fiber 40.” EX1004, ¶¶[0015]-[0016]. These components are not integrated into a subassembly.





116. While Kurita may have fewer components than a typical optical multiplexer, it is uneconomic and unmanageable in size. Because of this, aligning Kurita's optical arrangement can be cost prohibitive. Kurita's arrangement is

commercially impractical; it would require manual alignment to deploy the system. Kurita does not teach size and positioning of optical components; thus, every arrangement would require a different setup.

117. Kurita's design is not compatible with such cost-effective integrated components that have been formed as part of a subassembly, as claimed in the '416 Patent. The purpose of the '416 Patent is "to create a compact device capable of combining multiple optical signals into a single optical fiber." EX1001 at 1:43-51; *id.* at 2:11-15 ("The present invention provides, for the first time, an inexpensive, injection molded, one piece optical combiner capable of combining, separately collimating and focusing the output of multiple lasers into a single optical fiber with a uniform, high coupling efficiency."); *id.* at 1:13-16 ("One of the key objects of the present invention is to provide a compact and cost effective optical combiner...."). Kurita is not pertinent to the solution the '416 Patent because it is not compact and is not cost-effective.

118. To develop a compact integrated optical combiner, a POSITA would not look to the system disclosed in Kurita because it discloses an optical system comprising of separate components that must be manually aligned and would be more costly and too large in size.

119. Further, Kurita does not disclose or teach integrating its separate optical components into a single subassembly.

120. Kurita is a Japanese patent published in Japanese. I do not read Japanese. In my analysis, I have relied on the English translation that Petitioner has enclosed with Exhibit 1004.

2. Independent Claim 1

- a. **Claim 1: [1.0] An optical combiner [1.1] usable in data communication systems for multiplexing the outputs of a plurality of n lasers wherein each of said n outputs has a different output wavelength, [1.2] for transmission into and through a stopped single optical fiber, comprising:**

121. I agree with Patent Owner that the claimed optical combiner is “an integrated subassembly of optical components for multiplexing light of different wavelengths, which includes an integrated, pre-aligned connector with a stop to hold the single fiber optic cable.” Petitioner contends Kurita’s “light connection device” is an optical combiner. Petition at 19. Dr. Willner opines that the “optical connection element and device of Kurita is an optical combiner.” EX1003, p. 108. None of the disclosures in Kurita that Petitioner and Dr. Willner rely on disclose an optical combiner as claimed.

122. Petitioner cites to Kurita ¶[0001], which states in its entirety: “The present invention relates to light connection elements and light connection devices for inputting laser lights into and outputting them out of optical fibers that are used with multistage switching networks inside optical computers and switchboards, and with optical communications, laser processing, etc.” EX1004, ¶[0001]. This is not an “optical combiner,” as that term is used in the ’416 Patent.

123. The only “light connection device” that Kurita discloses is a “wavelength multiplex switch” such as the one shown in FIG. 3. EX1004, ¶[0015] (“FIG. 3 being a conceptional configuration diagram for the element in the third example according to the present invention, this one is an example whereby a **light connection device** is composed as a 4x4 wavelength multiplexing switch”). As part of the switch system, Kurita discloses an optical arrangement of individual, separate components that operate to multiplex the light from multiple fibers onto a single

optical fiber. EX1004, ¶¶[0008], [0017], [0015]. Kurita discloses the switch is comprised of “singular,” individual parts. EX1004, ¶[0017] (“switch composed of a planar monochromatic light source array 10A, a lens array 20, and a lens 30, each being singular” as the “number of component parts is small and, further, the number of optical elements through which the lights from individual light emitting portions 11 of the planar monochromatic light source array 10A pass is small, a low cost and low loss multiplexing switch is composed.”). These discrete, individual component parts are not integrated and, thus, do not disclose an optical combiner as claimed.

124. The “light connection device” shown in FIG. 3 and described in paragraph [0015] is the whole switch—from the lasers to the detectors. EX1004, ¶[0015] (“This multiplexing switch is provided with a planar monochromatic light source array 10A wherein plural light emitting portions 11 having fixed oscillation wavelengths are arrayed, a lens array 20 having plural lens portions 21 corresponding to the individual light emitting portions 11, a lens 30 for focusing the lights from the individual lens portions 21, and an optical fiber 40, this composition being set forth to be similar to the second example shown in FIG. 2. And, at the other end of the above-mentioned optical fiber, there is a composition of an optical branching device 50 such as a star coupler, optical multiplexers 60 composed of diffraction grating, a light receiving element array 70 wherein silicon PIN detectors are one-dimensionally arrayed, and arithmetic circuits 80 for deciphering the signals optically-received by the individual light receiving elements.”). The optical components that are combining the light sources onto the fiber are components of the optical switch. Thus, the entire switch system is the “light connection device”.

125. Dr. Willner points to FIGS. 1–3, ¶[0009], and ¶[0018] of Kurita as the “optical combiner.” EX1003, p. 108. Each of these figures and paragraphs confirm that Kurita discloses individual components that perform the multiplexing of lights from multiple light sources on to a fiber.

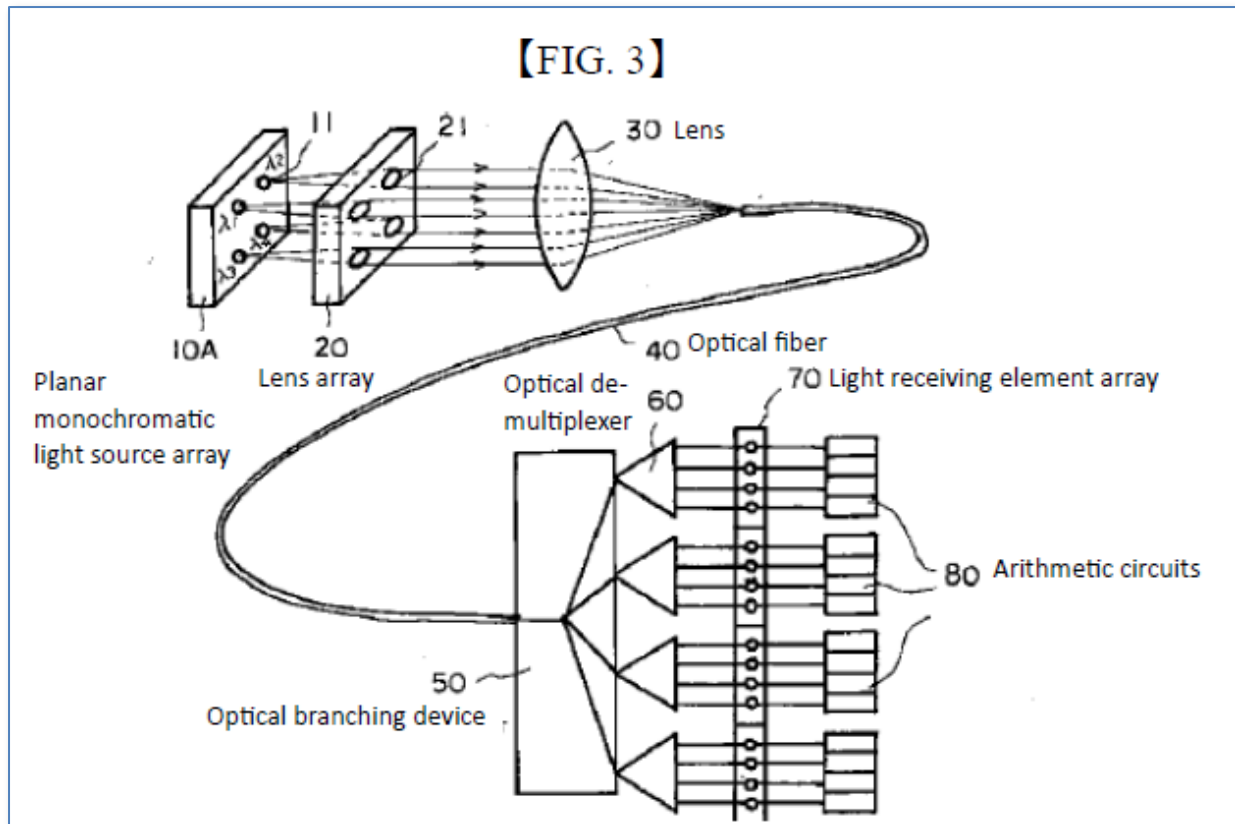
126. Dr. Willner dedicates one conclusory sentence to the claim element “optical combiner.” EX1003, ¶170. He string cites several paragraphs in Kurita - EX1004, ¶¶[0001], [0007]-[0011], [0013]. *See* EX1003, ¶170. Each of these paragraphs in Kurita point to individually placed optical components, for example:

- a. EX1004, ¶[0001] discloses, “The present invention relates to light connection elements and light connection devices for inputting laser lights into and outputting them out of optical fibers that are used with multistage switching networks inside optical computers and switchboards, and with optical communications, laser processing, etc.” Thus, the optical fibers are used in connection with other devices, as shown in FIG. 3 which discloses use of the individually placed components with a switch.
- b. EX1004, ¶[0007] discloses, “Here, plural light emitting portions may be composed as a planar monochromatic light source array wherein they emit lights each of which has a wavelength differing from others. And, specifically, a planar monochromatic light source array and the lens array are composed of surface emitting lasers and of flat-sheet microlenses respectively.” This quote refers to the two separate components—(1) a planar monochromatic light source array composed of surface emitting lasers and (2) the lens array composed of flat-sheet microlenses. These are not the same components. Dr. Willner misquotes this paragraph at p. 109 of his opinion. EX1003, p. 109.
- c. EX1004, ¶[0008] discloses individual optical components: “And, the wavelength multiplex switch as the light connection device according to the present invention is composed of [1] a planar

monochromatic light source array wherein plural light emitting portions are integrally array-formed...[2] a lens array wherein plural lens portions are integrally array-formed...[3] a lens for converging lights...[and] [4] a single optical fiber...”

- d. EX1004, ¶¶[0009]-[0011], [0013] likewise disclose individual components.

127. The optical components of Kurita that are multiplexing the laser beams are not integrated into a subassembly. Each of the individual, singular components (10A, 20, 30, 40) disclosed in Kurita must be manually positioned and aligned. This is apparent from the drawing of the Kurita system shown in FIG. 3. EX1004, FIG. 3. FIG. 3 shows no structure in how to package the components (integrated or otherwise).



128. Kurita discloses a “conceptual configuration diagram” showing discrete optical parts. EX1004, ¶[0010]. Kurita does not disclose that these components are integrated nor does Kurita teach a POSITA how to integrate the individual components into subassembly.

129. Additionally, as can be seen from FIG. 3 above, Kurita does not disclose an optical combiner that includes an integrated, pre-aligned connector with a stop to hold the single fiber optic cable. EX1004, FIG. 3.

130. Moreover, Kurita does not disclose a “stopped single optical fiber.” Dr. Willner recognizes that Kurita does not disclose or use the term “stopped single optical fiber.” EX1003, ¶172. Nevertheless, Dr. Willner argues it would have been obvious to “fix” the fiber or add a structure similar to the “fiber stop or seat 60 formed in ferrule 60” described in the ’416 Patent. EX1003, ¶¶172-173. I disagree.

131. The stop is inside the optical combiner's pre-aligned connector, or ferrule, that allows for passive alignment or pre-alignment. Simply fixing the fiber in place does not satisfy this limitation. Further, Kurita does not teach or suggest pre-aligning the fiber with the focusing lens using a pre-aligned connector with a stop to allow the fiber to be passively aligned. Kurita discloses that the elements are manually placed relative to each other such that there is no pre-alignment or integration of components. Kurita does not disclose that the fiber stays in alignment. Dr. Willner assumes that it does. To be used in a data communication system, the fiber needs to be capable of staying in position when the system is deployed. Kurita does not disclose this. For example, Kurita does not disclose how the fiber would be aligned or kept in alignment, or even fixed. Kurita discloses a free-space system.

132. Finally, the disclosures in Kurita do not enable an integrated optical combiner with integrated optical components with a ferrule and a stop to allow for passive alignment. A POSITA would need to go through a great deal of experimenting to properly align the fiber with the discrete components disclosed in Kurita. The alignment would most likely be carried out in the lab. Kurita discloses it is a "conceptual configuration." EX1004, ¶[0015].

133. Other than for the "stopped single optical fiber," Dr. Willner does not make any other obviousness arguments.

134. Because Kurita does not disclose an integrated optical combiner as claimed or a stopped single optical fiber, it does not disclose elements [1.0] through [1.2].

- b. Claim 1: [1.3] [an optical combiner...comprising:] a plurality of n collimating lenses, [1.4] said lenses being spaced apart and positioned to receive and collimate the output of said n laser output beams, said n laser output beams have n different output wavelengths**

135. Because Kurita does not disclose an optical combiner as claimed in claim [1.0] (see §VII.A.1.2.a Claim [1.0], above), it does not disclose a “an optical combiner...comprising: a plurality of n collimating lenses, said lenses being spaced apart and positioned to receive and collimate the output of said n laser output beams, said n laser output beams have n different output wavelengths....” The optical components of the optical combiner in claim 1 are integrated into the optical combiner. Kurita does not disclose that its plurality of n collimating lenses is integrated into an optical combiner.

136. Petitioner and Dr. Willner rely on “the individual lens portions 21, of the lens array 20,” as “plurality of n collimating lenses,” but the lens array is not integrated into an optical combiner as required by the claim language. EX1003, ¶176.

137. The lens array is one individual component of the switch disclosed in Kurita. EX1004, ¶[0017] (“switch...composed of a planar monochromatic light source array 10A, a lens array 20, and a lens 30” are “component parts” such that “the number of optical elements through which the lights from individual light emitting portions 11 of the planar monochromatic light source array 10A pass is small, a low cost and low loss multiplexing switch is composed.”). At best, Kurita only discloses lenses as part of a lens array, but this array is not integrated into the optical combiner.

138. The lens array must be placed at the corresponding planar positions of the light emitting portions 11. EX1004, ¶[0010] (“Plural light emitting portions 11...and plural lens portions 21...*are placed* at respectively corresponding planar

positions.”). Further, the “light emitting portions” must be “placed at the focal position of each of the lens portions in order for the light from each of the above-mentioned light emitting portions to be collimated.” EX1004, ¶[0008] A POSITA would understand that the components must be manually aligned with one another.

139. Dr. Willner does not make any obviousness arguments with regard to these claim limitations. EX1003, ¶¶176-178.

140. Based on the reasons above, Kurita does not disclose or teach claim elements [1.3] or [1.4].

- c. **Claim 1: [1.5] [an optical combiner...comprising:] focusing means for focusing said n collimated output beams onto a single spot at said stopped single optical fiber, [1.6] said focusing means having n separate radial sectors on its surface, and each of said n collimated beams passes through a separate one of said n sectors of said focusing means whereby said n output beams having n different wavelengths are coupled into said single fiber**

141. Petitioner and Dr. Willner point to lens 30 from FIG. 3 as the focusing means. Dr. Willner applies Petitioner’s construction that the “structure corresponding to the focusing means in the ’416 Patent is a focusing lens, and thus focusing means refers to a focusing lens and equivalents thereof.” EX1003, ¶179.

142. Because Kurita does not disclose an optical combiner disclosed in claim [1.0] (see §IX.A.2.a claim [1.0], above), Kurita does not disclose an optical combiner comprising a “focusing means.” The optical components of the optical combiner in claim 1 must be integrated into the optical combiner, which Kurita does not disclose. Kurita does not disclose that lens 30 is integrated into an optical combiner.

143. Lens 30 in Kuria does not perform the exact function asserted in the claim. The function of the focusing means is “focusing said n collimated output

beams onto a single spot at said stopped single optical fiber.” Kurita does not disclose the claimed function because there is no stop that is part of Kurita’s system, so the collimated output beams are not being focusing onto a single spot at said stopped single optical fiber. *See* §§IX.A.2.a claim [1.2], above. Because Kurita does not disclose the identical function, I understand that it cannot be considered an equivalent structure for the purposes of a §112 ¶ 6 claim.

144. Dr. Willner argues that it would have been obviousness to modify the fiber disclosed in Kurita to be “fixed,” but being fixed does not mean that the fiber is a stopped fiber. Kurita does not disclose a stop. Nor is there any teaching, suggestion or motivation to modify Kurita to add a “stopped single optical fiber.” *See* §IX.A.2.a, claim [1.2], above.

145. Kurita also does not enable to a POSITA how to incorporate a stop into its system for the optical fiber to be physically inserted into an optical combiner. *See*, ¶¶130-132, above.

146. For the structural analysis, Petitioner and Dr. Willner apply Petitioner’s claim construction that the corresponding structure is a focusing lens. Petition at 23. (“The focusing lens 30 of Kurita meets the ‘focusing means’ claim element because the corresponding structure described by the ’416 Patent for the ‘focusing means’ is a focusing lens. *See* above, Section IV(E)(2). Specifically, the focusing lens 30 of Kurita corresponds to the focusing lenses 30, 130, 250, and 350 disclosed in the ’416 Patent, or equivalents thereof.”).

147. Dr. Willner compares the structure of lens 30 with FIGS. 7–9 (focusing lens 250) and 10-11 (focusing lens 350) of the ’416 Patent and opines they are “equivalent.” EX1003, ¶181. I disagree.

148. A simple comparison as shown on page 122 of Dr. Willner’s declaration shows lens 30 of Kurita is not structurally the same or equivalent. He

does not address the corresponding description from the specification that describes FIGS. 7 and 10.

149. In the '416 Patent, each embodiment of the focusing means is integrated into an optical combiner to accomplish the claimed function. *See* §VII.B., above. Kurita's lens 30 is not integrated into an optical combiner.

150. The relevant structure for the embodiment shown in FIG. 7 is: EX1001 at FIGS. 7–9 (focusing lens 250), [Abstract] (“focusing lens housed within a fiber optic connector ferrule”), 3:67-4:2, 4:5-9, 4:10-14, 4:16-19, 4:20-23, cls. 1 & 7, and Embodiment 1. The '416 Patent states that the focusing means in FIG. 7 is “formed on the top surface of the module 216,” which is a single monolithic optical block coupling block.” EX1001, 4:5-6. Further, “[t]he surface of focusing lens 250 is smooth and includes four pie-shaped radial quadrants 251–254.” In describing FIG. 8, the specification describes the focusing lens as having “separate pie-shaped quadrants 252 and 254....” EX1001, 4:16-19.

151. The relevant structure for the embodiment shown in FIG. 10 is: EX1001 at FIGS. 10–11 (focusing lens 350), [Abstract] (“focusing lens housed within a fiber optic connector ferrule”), 4:36-39, 4:42-46, 4:49-51, cls. 1 & 7; and Embodiment 1. In relation to the fourth embodiment shown in FIG. 10, the '416 Patent states, “The focusing lens 350 is supported in its position shown in FIG. 10 by means known to those skilled in the art which are deleted in the interest of brevity.” *Id.* at 4:42-45.

152. As discussed above, FIGS. 7 and 10, only the internal components of the optical combiner are shown. *See* §VII.B., above.

153. Based on these disclosures, a POSITA would understand that the corresponding structure is “lens integrated into the optical combiner that is in alignment with the collimating lenses and the core of the stopped optical fiber” and equivalent structures. EX1001 at 3:32-36, 3:45-49.

154. Kurita's lens 30 is not aligned with an integrated pre-aligned connector. The integration allows the focusing means focus the collimated output beams onto a single spot at the said stopped single optical fiber.

155. Further, Kurita's lens 30 does not disclose *n* separate radial sectors on its surface that each of said *n* collimated beams passes through. Dr. Willner opines that the 2x2 array of lens portion 21 *results in* radially aligned lenses and cites to FIGS. 1–3. EX1003, ¶182. This is not taught in Kurita. Kurita's optical lenses are integrated in rows, and are not integrated in a radial alignment. This is confirmed by FIGS. 1 and 2 in Kurita that show a 3x3 lens array. EX1004, FIGS. 1–2. This alignment shows the lenses are integrated in rows. Thus, Kurita does not teach a radial set up of “*n*” lenses in lens array 20.

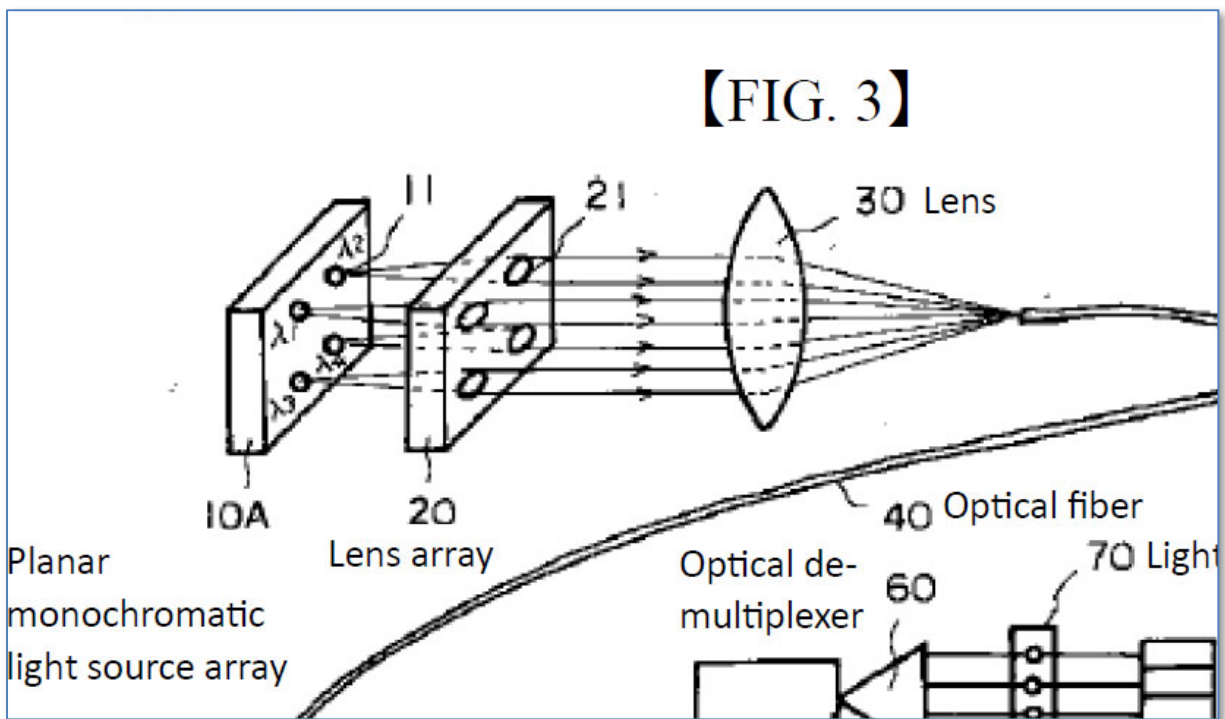
156. Dr. Willner further opines that to the extent Kurita does not disclose that the focusing means has separate *n* radial sectors, it would have been obvious. EX1003, ¶¶183-184. First, Dr. Willner relies on FIG. 3 to teach radial alignment, but as I stated in the above paragraph, FIGS. 1–3 teach that the lenses are integrated in rows and are not a radial setup of “*n*” radial sectors. Second, Dr. Willner contends that a POSITA would have known that aligning the collimating lenses around a center axis would have improved efficiency of the system in Kurita. Kurita does not disclose that a radial alignment of “*n*” would improve efficiency of the linear array of lenses taught in Kurita. Kurita discloses flat-sheet microlenses which may require a linear arrangement over a radial arrangement for any number of reasons including cost of production and setup. For example, rows and columns are a normal layout of arrays as shown in Kurita's 3x3 laser and lens layouts. A complete semiconductor wafer would normally have row-column patterns in a standard environment. Further, Kurita does not disclose pie-shaped radial sectors on lens 30.

157. In sum, in my opinion Kurita does not disclose claim elements [1.5] or [1.6].

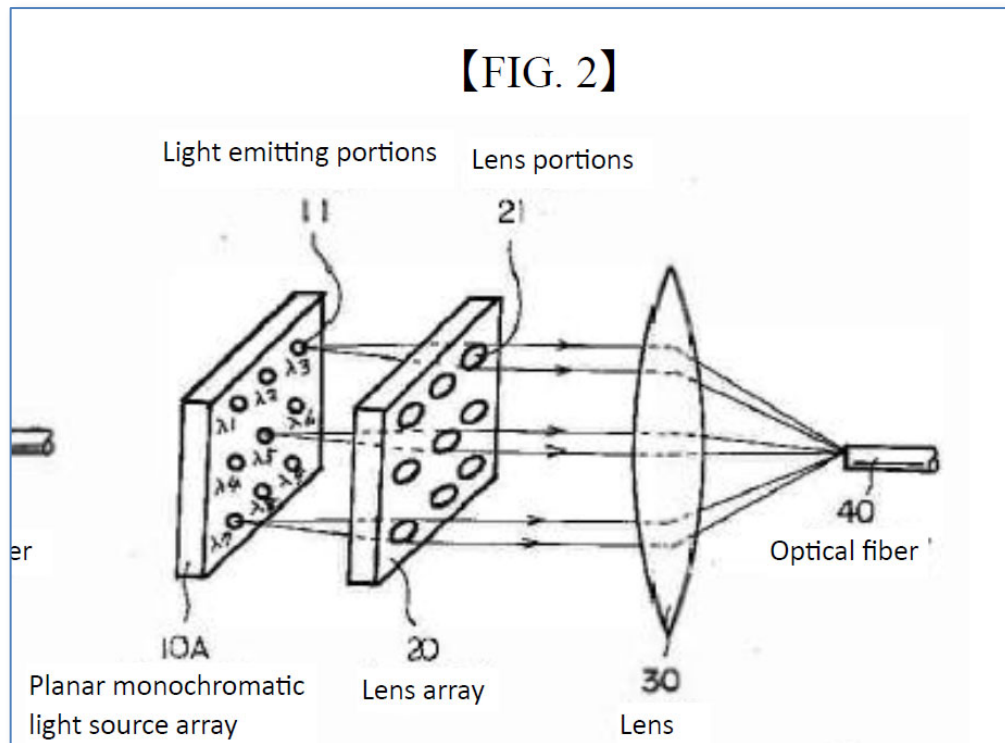
3. Dependent Claim 2: The optical combiner of claim 1 wherein $n=4$ and wherein said four lasers and four collimating lenses are each formed in a two-dimensional, two by two array, wherein said focusing means is a single focusing lens, and wherein each radial sector is a pie-shaped quadrant

158. Because Kurita does not disclose the optical combiner of claim 1 (see §IX.A.2.a-c, claims [1.0]-[1.6], above), Kurita does not disclose an optical combiner “wherein $n=4$ and wherein said four lasers and four collimating lenses are each formed in a two-dimensional, two by two array, wherein said focusing means is a single focusing lens, and wherein each radial sector is a pie-shaped quadrant.”

159. Further, Kurita does not disclose pie-shaped radial sectors on lens 30. Kurita’s optical lenses are integrated in rows, and are not integrated in a radial alignment. EX1004, ¶[0015]. Lens array 20 is not a radial set-up. In other words, the positions of lens portions 21 are not in a radial setup.



160. Petitioner relies on EX1004, [0015], which states “lens 30” of FIG. 3 is “focusing the lights from the individual lens portions 21, and an optical fiber 40, this composition being set forth to be similar to the second example shown in FIG. 2.” [FIG. 2] also does not disclose pie-shaped radial sectors:



161. Because each of FIGS. 1–3 of Kurita disclose the lenses as integrated in rows, a POSITA would understand that Kurita teaches integrating lenses in rows. A POSITA would not conclude, based on these disclosures, that Kurita teaches radial alignment.

162. To the extent that Petitioner claims Kurita “suggests” claim 2, as implied by the heading of its argument, Dr. Willner has only summarily argued it would have been obvious to radially arrange the lenses as he discussed in Claim Element [1.6]. For the reasons I discussed at Claim Element [1.6], Kurita does not teach radial alignment of “n” lenses, or radial sectors that are pie shaped. Kurita

teaches that the collimating lenses are integrated in rows as taught in FIGS.1–3. *See* §IX.A.2.c., claim [1.6].

4. Dependent Claim 6: The optical combiner of claim 1 wherein said optical combiner does not require the use of dielectric filters or waveguides

163. Because Kurita does not disclose the optical combiner of claim 1 (*see* §IX.A.2.a-c, claims [1.0]-[1.6], above), Kurita does not disclose an optical combiner that does not require the use of dielectric filters or waveguides.

5. Claim 7: Kurita does not disclose claim 7

164. Petitioner contends that claim 7 is substantially the same in scope as claim 2 and incorporates by reference its analysis for claims 1–2. Petition at 25. Because Kurita does not satisfy the claim elements of claims 1–2, the same analysis for claims 1–2 applies equally here. *See* §IX.A.2-3, above.

6. Dependent Claim 9: Kurita does not disclose claim 9

165. Petitioner contends that claim 9 differs from claim 6 only in that it depends from claim 7 instead of claim 1. Petition at 25. Because Kurita does not satisfy claims 1–2 or 6, the same analysis for claims 1–2 and 6 applies equally here. *See* §IX.A.2-4, above.

B. Ground 2: Claims Are Not Obvious Over Kurita in view of LaMarche and/or Lemoff

166. I understand that for Ground 2, Petitioner primarily relies on Kurita, making it the primary reference in Ground 2 as well.

167. Petitioner contends that Kurita (EX1004) in view of LaMarche (EX1005) and/or Lemoff (EX1006) disclose or suggest every element of the Challenged Claims of the '416 Patent. EX1003, ¶198. Dr. Willner contends that Kurita as a standalone §103 reference discloses or renders obvious every element of

the Challenged Claims, but as an alternative argument relies on LaMarche and Lemoff for certain claim elements. EX1003, ¶¶198-200.

168. I understand that Petitioner and Dr. Willner rely on LaMarche for two related reasons – 1) to disclose the radial alignment of light sources and collimating lenses which would result in the light passing through separate radial sectors of the focusing lens, and 2) teaching of using radial arrangements of light sources and collimating lenses around a center focal axis of a focusing means. EX1003, ¶200.

169. I understand that Petitioner and Dr. Willner rely on Lemoff for one reason – as teaching the use of a seat and ferrule arrangement for securing an optical fiber. EX1003, ¶201.

170. Other than these teachings from LaMarche and Lemoff, I understand that Petitioner and Dr. Willner rely on Kurita to disclose the remaining claim elements of the Challenged Claims under Ground 2. EX1003, p.141-142 ¶¶220, 229.

171. In my opinion, LaMarche is not in the same field of endeavor as the '416 Patent (discussed below). Further, it is my opinion that the radial alignment of LaMarche does not disclose the radial alignment of integrated collimating lenses as required by the '416 Patent.

172. It is my opinion that Lemoff does not teach the “stopped single optical fiber” as claimed in the '416 Patent.

173. As I discussed above, Kurita does not disclose or teach each and every claim element of the Challenged Claims. *See* §IX.A., above. Further, the combination proposed by Petitioner and Dr. Willner in Grounds 2 do not overcome the shortcomings of Kurita that I discussed above in Ground 1. Thus, in my opinion, Kurita in view of LaMarche and/or Lemoff, even if they were combined as Petitioner and Dr. Willner propose in Ground 2, do not disclose each and every claim limitation of the Challenged Claims.

1. (“Kurita”) (EX1004)

174. Kurita discloses an optical arrangement that utilizes separately placed optical components used for multiplexing multipoint laser sources onto a fiber. EX1004, ¶¶[0005]-[0006], [0015]. Kurita discloses a free space, conceptual design that must be manually set up and aligned. *Id.* at ¶¶[0004], [0010], [0013], [0015]. Kurita discloses that its optical arrangement can be used to input laser light into optical fibers that “are used with multistage switching networks inside optical computers and switchboards, and with optical communications, laser processing, etc.” EX1004, ¶[0001].

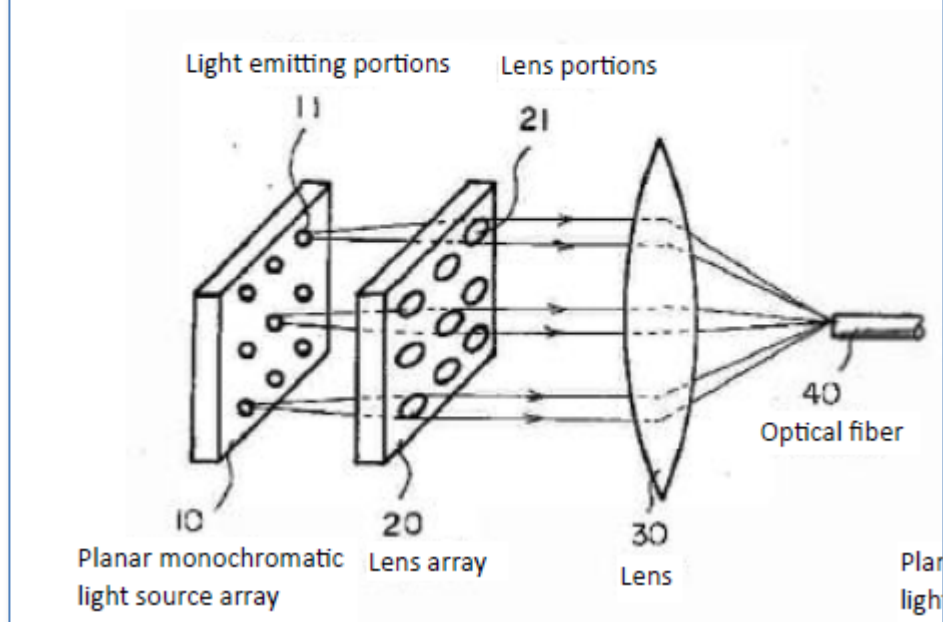
175. While the object of the invention of Kurita was to reduce cost by reducing the number of individual optical components used in conventional optical multiplexers (EX1004, ¶¶[0005]-[0006], [0012]), Kurita does not disclose an integrated, compact optical combiner that performs multiplexing. Kurita recognizes that as the number of optical components increase, so does the number of installation man-hours, which can be costly and commercially prohibitive. EX1004, ¶[0004] (“on account of a large number of parts being needed, it increases installation man-hours, and presents a problem in terms of the cost aspects as well.”).

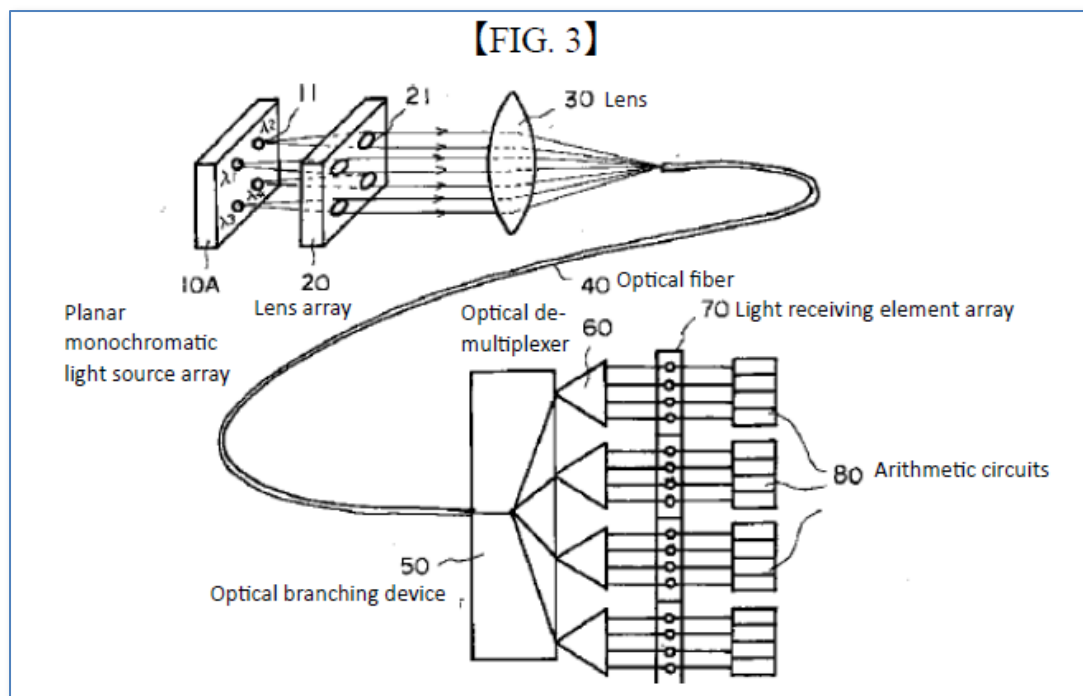
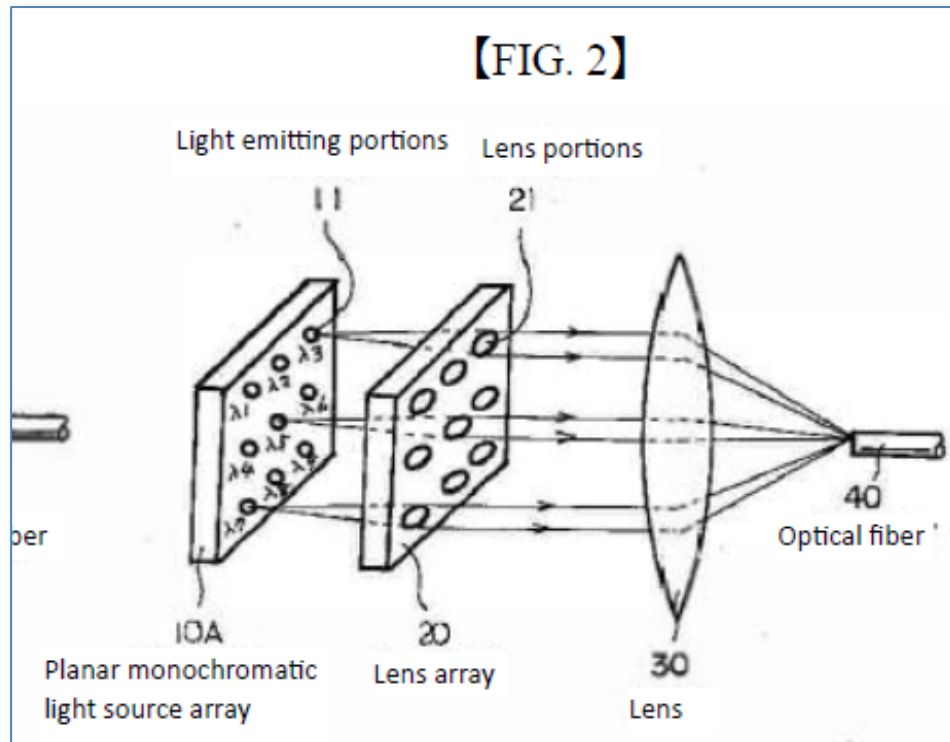
176. Kurita discloses that “as compared to the optical multiplexer shown in FIG. 4, a lens array 20 is used in lieu of individual lenses and individual optical fibers become unnecessary, and further, on account of the use of lens 30 in lieu of an optical multiplexer.” EX1004, ¶[0012]. Kurita discloses an optical arrangement to multiplex multiple laser signals onto a single fiber comprising of several individual components—(1) “a planar monochromatic light source array 10A wherein plural light emitting portions 11 having fixed oscillation wavelengths are arrayed,” (2) “a lens array 20 having plural lens portions 21 corresponding to the individual light emitting portions 11,” (3) “a lens 30 for focusing the lights from the

individual lens portions 21,” and (4) “an optical fiber 40.” EX1004, ¶¶[0015]-[0016]. These components are not integrated into a subassembly.

[Page 4 of 5]

【FIG. 1】





177. While Kurita may have fewer components than a typical optical multiplexer, it is uneconomic and unmanageable in size. Because of this, aligning Kurita's optical arrangement can be cost prohibitive. Kurita's arrangement is

commercially impractical; it would require manual alignment to deploy the system. Kurita does not teach size and positioning of optical components; thus, every arrangement would require a different setup.

178. Kurita's design is not compatible with such cost-effective integrated components that have been formed as part of a subassembly, as claimed in the '416 Patent. The purpose of the '416 Patent is "to create a compact device capable of combining multiple optical signals into a single optical fiber." EX1001 at 1:43-51; *id.* at 2:11-15 ("The present invention provides, for the first time, an inexpensive, injection molded, one piece optical combiner capable of combining, separately collimating and focusing the output of multiple lasers into a single optical fiber with a uniform, high coupling efficiency."); *id.* at 1:13-16 ("One of the key objects of the present invention is to provide a compact and cost effective optical combiner...."). Kurita is not pertinent to the solution the '416 Patent because it is not compact and is not cost-effective.

179. To develop a compact integrated optical combiner, a POSITA would not look to the system disclosed in Kurita because it discloses an optical system comprising of separate components that must be manually aligned and would be more costly and too large in size.

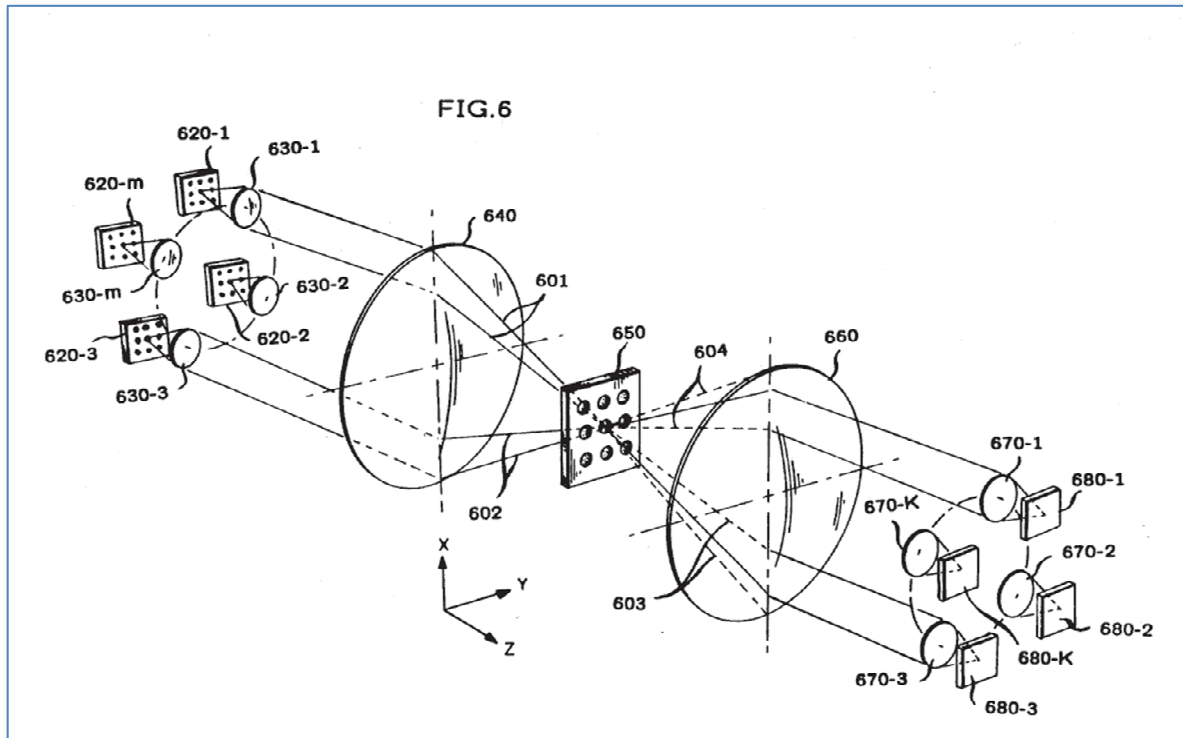
180. Further, Kurita does not disclose or teach integrating its separate optical components into a single subassembly.

181. Kurita is a Japanese patent published in Japanese. I do not read Japanese. In my analysis, I have relied on the English translation that Petitioner has enclosed with Exhibit 1004.

2. ("LaMarche") (EX1005)

182. LaMarche discloses an optical arrangement that utilizes separately placed components for accomplishing "simultaneous broadcasting" of optical

signals in a multipoint-to-multipoint arrangement. EX1005 at 1:11-2:23 (2:18-19: “an array of light emitting devices is imaged to arrays of light detecting devices”); EX1005 at 7:16-25.



EX1005, FIG. 6

183. While LaMarche generally relates to optics, LaMarche’s field of endeavor is different from the ’416 Patent. LaMarche is related to “an optical arrangement for interconnecting, via free space, light emitting devices to light detecting devices” EX1005 at 1:5-8. LaMarche is focused on simultaneous broadcasting signals to and from multiple points. EX1005 at 1:11-2:23. LaMarche does not disclose a system for accomplishing multiplexing. *See* EX1005 at 1:11-2:23.

184. LaMarche is trying to solve the problem of improving signal integrity in “multipoint to multipoint” interconnections. EX1005 at 1:11-2:17 (2:18-19: “an array of light emitting devices is imaged to arrays of light detecting devices”); 7:16-

25. LaMarche discloses when an array of light emitting lenses are imaged to an array of light detective devices, as compared to a single point connected simultaneously to other various points, a higher degree optical signal integrity is accomplished. EX1005 at 1:57-2:23.

185. LaMarche repeatedly states that it is directed to increasing the degree of optical connectivity in a free space environment for multiple point to multiple point interconnections. See EX1005 at 1:5-9 (“This invention relates to optics and, more particularly, to an optical arrangement for interconnecting, via free space, light emitting **devices** to light detecting **devices**.”); EX1005 at 1:46-53 (“Although this arrangement is practical for a large number of point to point interconnections, **multipoint to multipoint interconnections** become unpractical since a large number of optical couplers, taps, and splitters are required and, thus, are constrained by their physical dimensions.”); EX1005 at 1:57-60 (“Attempts to increase the degree of optical connectivity (number of **multipoint ot [sic] multipoint interconnections**) have focused on the utilization of free space as a transmission media.”); EX1005 at 2:17-22 (“Specifically, in the context of free space transmission, where an **array of light emitting devices is imaged to arrays of light detecting devices**, this invention provides a higher degree of connectivity without the prior art limitations that result from wavelength sensitivity or coherence effects....”); EX1005 at 3:5-8 (“The inventive optical arrangements afford **multipoint to multipoint interconnections** by utilizing the concept of pupil division in conjunction with a non-collinear arrangement of lenses.”); EX1005 at 4:1-2 (“An **inventive optical arrangement for multipoint to multipoint interconnections is shown in FIG. 4**”); EX1005 at 4:61-66 (“It is desired to image, that is, connect **each light emitting device in the M NxN arrays, 620-1 through 620-M, to at least one light detecting device of each K NxN arrays, 680-1 through**

680-K, in order to establish multiple interconnections between light emitting and light detecting devices”); *see also* EX1005 at 5:11-12, 6:65-69, 7:11-15.

186. In one embodiment, LaMarche discloses a system where an array of light emitting devices (e.g., 620-1 through 620-M) are optically connected with an array of light detecting devices (e.g., 680-1 through 680-K) on the other side of an array of ball lenses that fans out the light, causing the light to diverge. Each light emitting device is placed at the focal plane of an “input probe lens[]” that collimates the light from the emitting devices. EX1005 at 2:28-45. The collimated light enters into a pupil lens that directs the light to the array of ball lenses. The various light beams exiting the pupil lens are not focused onto a single point or a fiber; the various light beams are focused on to each of the ball lenses in the array. *See* EX1005 at FIG. 6. The array of ball lenses causes the light to diverge or fan out, which is received by the light detecting devices. EX1005 at FIG. 6, 4:43-60, 6:35-44, 6:57-7:15.

187. LaMarche has nothing to do with multiplexing. LaMarche does not disclose wavelength division multiplexing onto a single fiber, or disclose an optical multiplexer or combiner that can accomplish multiplexing. LaMarche’s only reference to wavelength division multiplexing is at 5:20-23, which states that “optical signals simultaneously impinging on the light detecting devices may be...wavelength division multiplexed.” EX1005 at 5:20-23. LaMarche does not disclose or teach how the signals are combined, only that multiplexed signals can be transmitted through its free space optical arrangement.

188. Nor is LaMarche related to single-fiber systems. LaMarche discloses the light emitting devices may be, for example, LEDs, lasers, or illuminated fiber ends that bring in the source light from a laser or LED source away from the experimental set up. EX1005 at 3:26-28. Thus, LaMarche teaches that each of the light emitting devices (e.g., 620-1 through 620-M) and the light receiving devices

(e.g., 680-1 through 680-K) can be fibers. LaMarche therefore teaches an array of multiple fibers that are optically aligned with an array of receiving multiple fibers as part of an experimental free space optical system. This is contrary to the teaching of the '416 Patent that is combining (i.e., multiplexing) light onto a single fiber using an optical combiner.

189. By contrast, the '416 Patent “relates to an optical multiplexing device which spatially combines multi-wavelength light from a plurality of lasers into an optical fiber.” EX1001 at 1:14-16. The '416 Patent discloses an “improved multiplexing device” that “is particularly suited for wavelength division multiplexing systems for the fiber-optic data-communications and telecommunications systems.” EX1001 at 1:17-20. The '416 Patent is not directed to multipoint-to-multipoint optical arrangements used for simultaneous broadcasting light to be received by numerous optical fibers; it is focused on multiplexing light onto a single optical fiber using the claimed optical combiner. Thus, the relevant field of endeavor is wavelength division multiplexing systems, i.e. systems that multi-wavelength light from a plurality of lasers into an optical fiber.

190. Because LaMarche does not relate to wavelength division multiplexing systems that combine multi-wavelength light from a plurality of lasers into a single optical fiber, in my opinion, LaMarche is not in the same field of endeavor as the '416 Patent.

191. Additionally, LaMarche is not pertinent to solving the problem addressed in the '416 Patent. The '416 Patent discloses that, “The present invention provides, for the first time, an inexpensive, injection molded, one piece optical combiner capable of combining, separately collimating and focusing the output of multiple lasers into a single optical fiber with a uniform, high coupling efficiency.” EX1001 at 2:11-15. “One of the key objects of the present invention is to provide a compact and cost effective optical combiner for both single-mode or multimode

fiber optic communication systems, all without requiring the use of dielectric filters and the alignment necessitated by those filters or expensive waveguides.” EX1001 at 2:21-26. This is the opposing of the free-space, expensive, large optical arrangement in LaMarche.

192. LaMarche offers the solution of a particular “optical arrangement” that utilizes “simultaneous broadcasting” of optical signals emitted from “light emitting devices” to communicate with “light detecting devices” on the other side of a ball lens 406 or an array of ball lenses 650 in order to improve interconnectivity in multipoint to multipoint systems. EX1005 at 2:18-19, 2:26-27. The ball lens or lens fan out or broadcast the light it receives from the light emitters. This “fanout or broadcasting capability” to improve interconnectivity is the opposite of the ’416 Patent, which is multiplexing the multiple wavelengths onto a single fiber. EX1005 at 6:41. LaMarche’s solution is highly particularized and uses numerous discrete parts that must be aligned relative to each other for the light from one emitter to be received by the detector on the other side of the ball lens or array of ball lenses. This is contrary to the teaching of the ’416 Patent that is combining light onto a single fiber using an optical combiner.

193. Further, in LaMarche’s arrangement, each of the numerous optical components are individually placed. EX1005, FIG. 6. Because of the required manual alignment, LaMarche’s system is extremely expensive and difficult to set up causing it to be highly susceptible to misalignment. In LaMarche’s own experiment using the optical arrangement shown in FIG. 2, which utilizes only two collimating lenses, the interconnectivity or degree of coupling of the light emitting devices was “highly sensitive to the positioning error of both the ball lenses and/or the light detecting devices.” EX1005 at FIG. 4, 7:47-51. LaMarche further discloses a large system that requires optical corrections. LaMarche discloses that the pupil lenses exhibited a “high degree of field curvature” due to their “large field of view,” which

warranted correction. EX1005 at 7:51-56. A POSITA would understand this to mean that the optical signal integrity may be jeopardized. Optical effects such as aberrations and detrimental issues will affect the optical efficiency of the system. A POSITA understands that corrections will result in more expensive optics and more costly optical design, making the system less commercially practical.

194. LaMarche's large system is costly to set up is inconsistent with the low-cost integrated, compact, pre-aligned solution disclosed by the '416 Patent. LaMarche does not teach integrated optical combiners with passive alignment for WDM. The optical alignment in LaMarche must be accomplished manually.

195. Thus, LaMarche is not pertinent to the problem the '416 Patent is trying to solve.

3. A POSITA would not have been motivated to combine Kurita and LaMarche

196. Even if a POSITA were to consider LaMarche as analogous art to the '416 Patent, a POSITA would not have been motivated to combine LaMarche with Kurita.

197. Petitioner and Dr. Willner argue that a POSITA would have been motivated to use LaMarche's teachings of a radial arrangement of collimating lenses, in the light connection element of Kurita, such that the collimated light from each of the collimating lenses passes through a separate radial sector of a focusing lens. Petition at 29; EX1003, ¶200. Dr. Willner also contends that there are three rationales that support applying LaMarche's teachings to the light connection element of Kurita. EX1003, ¶206. I disagree, as discussed below. There are several reasons why a POSITA would not turn to LaMarche to modify Kurita.

198. First, while Kurita and LaMarche relate to optics, the problems they were trying to solve and the solutions offered were entirely different. Kurita is

focused on a free space optical arrangement to multiplex multiple laser signals onto a single fiber – i.e., *bring signals together to a single fiber* – using fewer components. EX1004, ¶¶[0004]-[0006]. LaMarche, on the other hand, is focused on improving optical signals in multipoint-to-multipoint connections through simultaneously broadcasting – i.e., *fan signals out to be received by multiple light detectors*. EX1005 at 1:13-27. LaMarche discloses using a multitude of optical fibers for an experimental test to collect light from the free space system and convey that light out of the system to remotely positioned photodetectors. See §IX.B.2., above; see also EX1005 at FIG. 6, 4:43-60, 6:35-44, 6:57-7:15. This is contrary to the teaching of the Kurita that utilizes an optical arrangement dependent on one fiber optic cable that multiplexes many channels between the transmit and receive parts of the optical switch.

199. Second, Kurita discourages increasing the number of optical components because it reduces coupling efficiency and increases costs. Kurita teaches that “an increased number of parts in order to build separate optical systems” results in “high optical losses in order to allow the lights to pass through these parts.” EX1004 at ¶¶[0004], [0012]. Kurita teaches how expensive such systems are in terms of man hours needed to accomplish alignment—“on account of a large number of parts being needed, it increases installation man-hours, and presents a problem in terms of the cost aspects as well.” EX1004 at ¶[0004].

200. Kurita discloses a system that uses a smaller number of discrete components to reduce costs and the amount of losses —“light source array 10A, a lens array 20, and a lens 30, each being singular.” EX1004 at ¶[0017]. Kurita discloses that because the “number of component parts is small and, further, the number of optical elements through which the lights from individual light emitting portions 11 of the planar monochromatic light source array 10A pass is small, a low cost and low loss multiplexing switch is composed.” EX1004 at ¶¶[0017], [0019]

(“as it results in the number of component parts being small, it presents effects of allowing the costs for light connection elements being low to be realized as well as lowering the losses due to transmission”); [0020] (“it reduces the number of parts on the part of the composition on the side of entering them into the above-mentioned a single optical fiber, allowing low costs and low losses to be realized.”). Further, the light is multiplexed into a single fiber.

201. By contrast, LaMarche increases the number of separate individual optical components, which is antithesis to the solution provided by Kurita. LaMarche’s discretely placed collimating lenses would increase the number of components needed to multiplex light from lasers onto a single fiber. *See* §IX.B.2., above; *see also* EX1005 at FIG. 6. LaMarche would require six additional discrete parts for the same number of lenses and emitters disclosed in Kurita—four individual lasers, four individual collimating lenses. Not only do the lenses need to be aligned relative to each other, the lenses need to be aligned relative to the other optical components in the arrangement.

202. Because LaMarche discloses more individual components that must be individually aligned, a POSITA would understand that the cost to align LaMarche’s system is much greater than the cost to align Kurita. A POSITA would also understand that the increased number of optical components means an increase in optical losses. *See* EX1004 at ¶¶[0004], [0012], [0017], [0019]. Thus, a POSITA would not have been motivated to modify Kurita in view of LaMarche.

203. Third, a POSITA would understand that the optical arrangement in LaMarche using “simultaneous broadcasting,” even when properly aligned after spending increased man hours and expenditures, results in losses of light and would not have necessarily improved coupling efficiency or achieved greater bandwidths. EX1005 at 2:26. There is inherently a large loss of light in simultaneous broadcasting, which LaMarche acknowledges. EX1005 7:35-41 (“Only a fraction of

the total energy impinging on pupil lens, 408 or 660, is received by probe lenses, 409 and 410, or, 670-1 through 670-K, respectively.”).

204. A POSITA would understand this is a very inefficient design to maintain a certain data rate. LaMarche is an overkill in components in the hopes of capturing enough light by the detectors to maintain a certain data rate. Thus, a POSITA would not look to LaMarche to improve Kurita’s performance.

205. Tellingly, LaMarche issued in 1992 and predates Kurita by 10 years. A POSITA would not look to a decade old reference that is more complex, costly, and difficult to implement from a commercial practical standpoint.

206. For the reasons above, I disagree with Dr. Willner that a POSITA would have been motivated to use LaMarche’s teachings of a radial arrangement of collimating lenses, in the light connection element of Kurita, such that the collimated light from each of the collimating lenses passes through a separate radial sector of a focusing lens. I disagree.

207. At paragraph 203, Dr. Willner argues that LaMarche further teaches, and would have suggested to a POSITA at the time of the invention, that the radial (or non-collinear) arrangement it provides for results in improved coupling efficiency, reduced physical complexity, as well as having other advantages such as being able to achieve high-bandwidth connections. EX1003, ¶203. I disagree.

208. Regarding improved coupling, LaMarche’s disclosure that radial arrangement of collimating lenses improves coupling efficiency is limited to “simultaneous broadcasting” using “pupil division” in multipoint to multipoint optical arrangements. EX1005 at 1:24-26, 1:57-2:27. LaMarche is comparing its optical arrangement to the prior references LaMarche references in the Background of the Invention. EX1005 at 1:10-2:10; EX2012–2015. These references focus on multi-point optical arrangements using various optical techniques that include free space, waveguides, holographs, glass, diffraction gratings, etc. EX2012-2015. They

discuss a single high bandwidth channel, and from this channel, many connections can be made to many points. EX2012-2015; EX1005 at 2:4-10 (“In these optical arrangements, one point is connected over a high bandwidth channel simultaneously to various other points. The degree of connectivity in these instances, however, is outweighed by coupling loss, physical complexity, wavelength sensitivity, or coherence effects...”). In doing so, the one high bandwidth channel serves all of the other channels. With LaMarche, one high bandwidth channel is replaced by multiple radial channels so the high bandwidth is compromised less when it reaches the point destination. Thus, with LaMarche’s multipoint broadcasting, LaMarche is able to improve coupling efficiency, reduce physical complexity, and achieve higher integrity connections as compared to these optical arrangements. EX1005 at 2:13-22 (2:13-15: “This invention overcomes the drawbacks of the prior art methods of interconnections by using...this invention improves a higher degree of interconnectivity without the prior art limitations...”). This has nothing to do with multiplexing of signals onto a single fiber as disclosed in Kurita.

209. Further, a POSITA would understand that the more parts there are to align, the greater the likelihood of losing light. LaMarche adds complexity with numerous components that must each be aligned. In LaMarche all of the components are discrete and individually formed. The input probe lenses 630-1 through 630-M lenses must not only be manually and individually aligned with each other radial, but they also must be individually aligned with the light emitting devices 620-1 through 620-M, the pupil lens 640, *and* the ball lens array 650. EX1005 at 5:28-31. On the other side of the ball lens array, the same thing must occur. All of the individual components must be physically aligned relative to each other.

210. By contrast, Kurita discloses an array of lenses that are pre-aligned with one another and an array of light emitters that are aligned with each other. Kurita’s lenses are physically fixed in an array. EX1004 at ¶[006], FIG. 3; The array shown

has predetermined alignment. The optical arrangement in Kurita does not require aligning the individual lenses as in LaMarche. Kurita must individually align the emitter array and the lens array. Because of this extra alignment step, a POSITA would not switch out the pre-aligned array of lenses and the pre-aligned emitters for the positioning of discrete lenses and emitters as disclosed in LaMarche, even if radially aligned, because of the lower light efficiency inherent in the need to physically align discrete parts. A POSITA would understand that the more parts there are to align, the greater the likelihood of losing light, having poor optical signal integrity, and overall less efficiency. LaMarche will be less light efficient—discrete, individual components that are individual are harder to align, so by nature easy to have less light efficiency, which degrades overall system performance.

211. I also disagree with Dr. Willner's opinion that LaMarche reduces physical complexity. Again, LaMarche's statement regarding physical complexity is a comparison of LaMarche to prior art systems that use a single high bandwidth channel, and from this channel, many connections can be made to many points. EX1005 at 2:4-10 ("In these optical arrangements, one point is connected over a high bandwidth channel simultaneously to various other points. The degree of connectivity in these instances, however, is outweighed by coupling loss, physical complexity, wavelength sensitivity, or coherence effects...").

212. LaMarche increases physical complexity by adding numerous discrete lens and emitters as compared to Kurita. Kurita was focused on reducing the number separately placed components for the system design while LaMarche drastically *increases* the number of separately placed components that must be physically aligned with one another.

213. There is no reason to combine the two arrangements, as discussed above. LaMarche is focused on free space, multipoint to multipoint interconnections using simultaneous broadcast between transmitters and receivers as an improvement

over single to multipoint optical systems that are inefficient. EX1005 at 2:17-27. Kurita is an optical interconnector that utilizes a single optical fiber to drive a more efficient optical switch using free space optics.

214. Dr. Willner claims there are three rationales that support applying LaMarche to Kurita. EX1003, ¶206. I disagree.

215. Dr. Willner claims that the arrangement is applying a known technique to a known device, or combining prior art elements according to known methods to yield predictable results. EX1003, ¶¶207-208. However, neither Kurita nor LaMarche disclose integrally array formed radial optical lenses as he proposes. Kurita's optical lenses are integrated in rows, as can be seen in FIGS. 1–3 of Kurita. LaMarche's optical lenses are separate, discrete lenses that are lined up radially relative to each other and relative to separately discrete light emitters. Thus, Dr. Willner's proposed arrangement—integrally array formed radial optical lenses—is not disclosed in LaMarche or Kurita.

216. Combining Kurita and LaMarche would result in an inoperable optical arrangement. Kurita is a much smaller system design compared to LaMarche as integrated chips are used. LaMarche will be a bigger system as each optical lens needs to be positioned in free space - it makes it large and commercially impractical. LaMarche is at least 2x2x2m in dimension. That's nearly a whole room or optical laboratory. Kurita's free space optical switch could be in the region of 1x1x0.5m.

217. Dr. Willner also contends there is some teaching, suggestion, or motivation that would lead a POSITA to modify Kurita as proposed to arrive at the claimed invention. EX1003, ¶209. As discussed above, a POSITA would not look to LaMarche to improve Kurita. And LaMarche does not disclose that the radial (or non-collinear) arrangement results in improved coupling efficiency, reduced physical complexity, achieve high-bandwidth connections, for an optical

arrangement in Kurita. LaMarche's improvement over the prior art is not related to systems such as Kurita. *See* ¶208, above.

218. At paragraph 210, Dr. Willner argues that Kurita and LaMarche result in a "functioning optical device," but this says nothing about whether a POSITA would modify the optical arrangement of Kurita with LaMarche. EX1003, ¶210. From the perspective of a POSITA, it would be entirely impractical to combine LaMarche and Kurita. A POSITA would understand the difficulty in aligning discrete components. The alignment required for LaMarche is significantly longer, and still commercially impractical, to align as opposed to Kurita. This is very impractical. Further, keeping the alignment is a challenge to maintain good optical efficiency of the performance.

219. LaMarche would also result in going back a decade to work with individual components when, by the time Kurita issued, integrated chips were already available which were smaller and more compact, but still free space connected. Kurita is trying to solve the problem of multiplexing light using separate individual optical systems because "an increased number of parts in order to build separate optical systems result[s] in high optical losses in order to allow the lights to pass through these parts. And, on account of a large number of parts being needed, it increases installation man-hours, and presents a problem in terms of the cost aspect as well." EX1004 at ¶[0004]. Kurita states that the invention is "to provide light connections elements and light connection devices by attempting to reduce the number of component parts and the costs as well as attempting to hold down optical losses." EX1004 at ¶[0005]. This is the antithesis of LaMarche.

220. Finally, even if Kurita and LaMarche were combined as Dr. Willner and Petitioner suggest, the combination of Kurita and LaMarche do not overcome all of the shortcomings in Kurita that were discussed above in Ground 1. Dr. Willner

only relies on LaMarche for its radial aligned collimating lenses. This does not overcome the shortcomings of Kurita as I discussed in Ground 1.

4. (“Lemoff”) (EX1006)

221. Lemoff discloses “a multi-channel optical signal emitter for a wavelength division multiplexed (WDM) communication system that eliminates the use of optical multiplexers or other devices external to the emitter.” EX1006 at 1:52-56. Instead, Lemoff discloses a multi-channel optical signal emitter that includes multiple semiconductor die. Each die is configured to emit a channel of the multi-channel from an “emission aperture” located offset from the center of a die toward an aperture corner of the die. *Id.* at [Abstract], 1:57-65.

222. Lemoff teaches against using optical wavelength multiplexers for short distances. EX1006 at 1:42-48. Lemoff discloses that using WDM is “particularly problematic” in applications requiring “only relatively short distance lengths,” which are “more cost sensitive than other applications.” *Id.* Lemoff discloses, “one problem with WDM is that additional complexity in the design, Fabrication, and packaging of the required devices can dramatically increase production and maintenance costs.” EX1006 at 1:34-37. Lemoff discloses that “an optical wavelength multiplexer is often used to collect the optical signal components from different sources and cause these components to spatially overlap and enter into a single optical fiber;” however, the “optical multiplexer can be a costly, high precision device.” EX1006 at 1:37-41. Lemoff discloses that “complex optical multiplexer...may not be cost effective for such lengths.” EX1006 at 1:46-48.

223. To solve the problems associated with short-distance WDM, Lemoff’s optical signal emitter emulates a WDM multiplexer by situating multiple light emitting emission apertures close together (but not overlapping) at the end of the fiber optic cable “without using an optical multiplexer or other device external to the

emitter.” *Id.* at 1:52-56. Lemoff discloses configuring a die to emit an optical signal from emission apertures that are positioned offset from the center in the direction of the aperture corners of the die, where the aperture corners point toward the center of the signal-emitting area. *Id.* at 1:61-65. As shown in FIGS. 1A and 1B, the fiber is abutted against the emitters, allowing for butt coupling. EX1006, FIGS. 1A & 1B, 3:29-33. Butt coupling is when two structures are immediately adjacent to each other, and physically touching. This means that the light is not entering the fiber at a single spot. The light signals enter into the fiber at different locations or spots as shown in FIGS. 1A and 1B. EX1006, FIGS. 1A & 1B. FIG. 2 shows a second example of the invention using an imaging lens. In this embodiment, the signals are emitted from the emission apertures into the signal-emitting area to an imaging lens that images the light into the fiber. EX1006 at 6:7-11. Lemoff does not disclose the light is focused onto a single spot of the fiber because of the short distance from the emitting area to the signal receiving area. In this regard, Lemoff discourages the use of a “focusing means or focusing said n collimated output beams onto a single spot at said stopped single optical fiber.” In particular, Lemoff’s intended purpose is not to focus the beams onto a single spot. The emission apertures are purposely offset from the center of the die in direction of the aperture corner of the die. EX1006 at 1:57-65, 7:19-31.

224. By contrast, the ’416 Patent is an optical multiplexer, *i.e.*, an optical combiner that multiplexes light of multiple wavelengths for short distance WDM a small package without the need for a complex optical multiplexer. EX1001 at 1:13-16, 1:51-55, 2:11-26, 3:19-21. The ’416 Patent’s claimed optical combiner is an integrated subassembly of optical components for multiplexing light of different wavelengths, which includes an integrated, pre-aligned connector with a stop to hold the single fiber optic cable. *Id.*; *see* §VII.A.1. The optical components include collimating lenses that are geometrically arranged to send light to the integrated

focusing means of the optical combiner, which in turn causes the light from various light sources to converge onto a single spot on the optical fiber. EX1001 at 3:7-15, 3:22-26, FIG. 1 (spot 50). Thus, Lemoff's invention is contrary to the very thing that inventors of the '416 Patent were trying to solve – using a cost-effective optical multiplexer/combiner for short distance WDM.

5. A POSITA Would Not Combine Kurita and Lemoff

225. Lemoff discourages from using optical wavelength multiplexers for short distances because the complexity of the design is often cost prohibitive, particularly because optical wavelength multiplexers require high precision. EX1006 at 1:42-48. Lemoff discloses that using WDM is “particularly problematic” in applications requiring “only relatively short distance links,” which are “more cost sensitive than other applications.” *Id.* at 1:42-45. Lemoff discloses, “one problem with WDM is that additional complexity in the design, Fabrication, and packaging of the required devices can dramatically increase production and maintenance costs.” EX1006 at 1:34-37. Lemoff discloses that “an optical wavelength multiplexer is often used to collect the optical signal components from different sources and cause these components to spatially overlap and enter into a single optical fiber;” however, the “optical multiplexer can be a costly, high precision device.” EX1006 at 1:37-41. Lemoff discloses that “complex optical multiplexer...may not be cost effective for such links.” EX1006 at 1:46-48.

226. Kurita discloses a high-cost method of multiplexing that is comprised of separate, discrete components, that requires costly manual alignment and high precision and long distances to accomplish WDM. EX1004 at ¶[0010]. While Kurita discloses a multiplexing system that decreases the number of overall components in lieu of using a conventional optical multiplexer, Kurita still requires manual alignment of discrete components for WDM, which is expensive to install and would

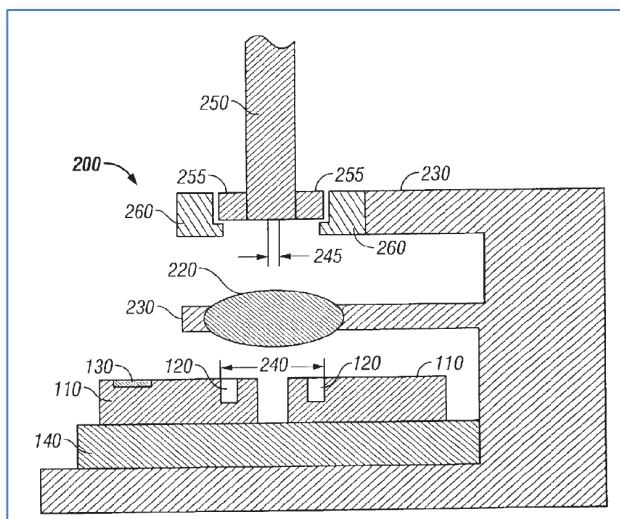
be quite large in size. Because Kurita is an expensive system for multiplexing and needs long distances to accomplish WDM, Lemoff teaches against using the system disclosed in Kurita for short distances.

227. To solve the problems associated with short-distance WDM, Lemoff's optical signal emitter emulates a WDM multiplexer by situating multiple light emitting emission apertures close together (but not overlapping) at the end of the fiber optic cable "without using an optical multiplexer or other device external to the emitter." EX1006 at 1:52-56. Lemoff discloses augmenting the aperture corners to point toward the center of the signal-emitting area. EX1006 at 1:61-65. As shown Lemoff FIGS. 1A and 1B, the fiber is abutted against the emitters, allowing for butt coupling. EX1006 at 3:29-33. Butt coupling is when two structures are immediately adjacent to each other, and physically touching. This means that the light is not entering the fiber at a single spot. The light signals enter into the fiber at different locations.

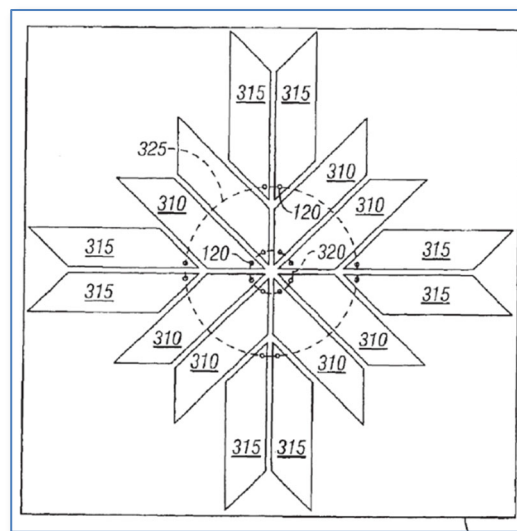
228. FIG. 2 shows a second example of the invention using an imaging lens. EX1006 at FIG. 2. In this embodiment, the signals are emitted from of the emission apertures into the signal-emitting area to an imaging lens that images the light into the fiber. EX1006 at 6:7-11. Lemoff does not disclose that the light is focused onto a single spot of the fiber because of the short distance from the emitting area to the signal receiving area. In this regard, Lemoff discourages the use of a "focusing means or focusing said n collimated output beams onto a single spot at said stopped single optical fiber." In particular, Lemoff's intended purpose is *not to* from focus the beams onto a single spot. EX1006 at 1:37-41. Lemoff uses an unusually large fiber—larger than fibers used in nearly all WDM systems—to allow for the light to enter into the fiber at different locations.

229. Lemoff teaches the use of a geometric design to allow laser generated source spots on different parts of the core fiber without the use of a WDM combiner or multiplexer, which Lemoff teaches is permissible for short distances.

230. Lemoff is a micro-package, approximately 1x1x2 cm in size. Lemoff is designed to go into a fiber optic transceiver, which is a box that is proximately 4x1x.5 cm in size—about the size of a finger. Lemoff discloses using fibers where the core diameter is from 100 μ m-1,000 μ m. EX1006 at 3:34-43. The signal receiving area 245 is the core of the fiber. EX1006 at 6:3-6. Lemoff discloses a signal emitter where the entire signal-emitting area 240 (area of the emitter that encompasses all emission apertures 120) is 100 μ m-2,000 μ m (up to 2mm), around 2x the size of the core of a fiber. EX1006 at 3:34-43, 5:15-49. The entire signal-emitting area 240 corresponds to the outer circle in FIG. 3 and the cross-section is shown in FIG. 2. EX1006, FIGS. 2–3 and 6:3-6.



EX1006 at FIG. 2



EX1006 at FIG. 3

231. Lemoff would not be capable of housing the design disclosed in Kurita. Lemoff would need to be expanded to 1x1x0.5m or larger, making Lemoff entirely unsuitable for its intended purpose of emulating short-distance WDM using an

optical signal emitter arrangement. To modify Lemoff to house the system of Kurita, Lemoff would need to be expanded to 1x1x0.5m or larger, 10-50 times in size, thereby making it not practical for its purpose of emulating WDM using a micro-optical signal emitter arrangement. At that long distance, a POSITA would understand that WDM multiplexer would likely be needed, which is contrary from Lemoff's stated purpose of not using such optical multiplexer. EX1006 at 1:52-56. A POSITA would understand that Kurita's free space system where the components are spaced apart is significantly larger than Lemoff's package assembly. This is because the free space connections between the optical components requires lots of space.

232. Because the optical arrangement in Kurita is so large, a POSITA would not look to Lemoff.

233. Lemoff discloses using fibers where the core diameter is from 100 μ m-1,000 μ m. EX1006 at 3:34-43. Lemoff's fiber is larger than nearly all single-mode or multimode fibers that are commercially available, making Lemoff's receptacle not a size a POSITA would be motivated to combine with Kurita's system.

234. Further the receptacle design in Lemoff would still require manual alignment with Kurita's system because the components are free-space, discrete components. A POSITA would understand that because of the manual alignment, there is no benefit of adding a receptacle or stop to Kurita's system. In other words, a POSITA would not have been motivated to add a ferrule or stop to Kurita because the stop would need to be manually aligned.

235. Additionally, to create a fiber and ferrule like the one disclosed in Lemoff would require extra work—there is an extra glue procedure and optional polishing procedure. EX1006 at 5:59-63. Lemoff discloses a ferrule like the one in EX2017, at p. 317. ("The fiber end may be pushed slightly past the end of the ferrule and then polished to a smooth face.")). Lemoff discloses *if* this polishing procedure

is performed, this may increase coupling, but as I stated above, the ferrule disclosed in Lemoff is not aligned. It is bonded onto the end of the fiber which is free-floating. Nor does Kurita disclose aligning the fiber. Kurita is not a subassembly or a package. There is nothing to plug the ferrule into. Thus, a POSITA would have not been motivated to combine Lemoff's ferrule or receptacle with Kurita.

236. I disagree with Willner that Lemoff is a natural extension of Kurita. They are entirely different in size and the optical arrangement of Kurita would not fit or be operable with the Lemoff micro-package, as discussed above. EX1003, ¶212.

6. Independent Claim 1

a. Claim 1: Kurita does not disclose elements [1.0] through [1.5]

237. For Ground 2, Petitioner relies on Kurita alone to disclose claim elements [1.0]-[1.5]. *See* Petition at 31. Kurita does not disclose claim elements [1.0]-[1.5]. *See* Ground 1, claim [1.0]-[1.5]. *See* §IX.A.2.a-c, above.

b. Claim 1: Kurita in view of LaMarche and/or Lemoff does not disclose element [1.6]

238. For Ground 2, Petitioner relies on LaMarche and/or Lemoff to disclose only claim element [1.6] in combination with Kurita. Petition at 31 (“With respect to Ground 2, LaMarche and/or Lemoff are...relied on to further teach aspects of claim element [1.6].”). Kurita in view of LaMarche and/or Lemoff do not disclose claim [1.6].

239. Petitioner relies on LaMarche to teach a radial arrangement of collimating lenses. As explained above, a POSITA would not have combined Kurita with LaMarche. *See* §IX.B.3, above. For example, Kurita discourages using optical arrangements that increase the number of optical components, because it increases

costs and increases the number of discrete components which Kurita teaches against; thus, a POSTIA would have no reason to combine LaMarche's discrete lens arrangement with Kurita. *See* §IX.B.3, above.

240. Dr. Willner also claims that in combination each of the light sources in Kurita would correspond to collimating lens in radial alignment. EX1003 at ¶224. Dr. Willner relies on FIG. 6 of LaMarche. However, LaMarche does not disclose a one-to-one radial alignment of collimating lenses. LaMarche discloses a single collimating lens for *every array* of lasers. EX1005 at 4:43-49, 5:27-29. Because Kurita discloses an array of lasers, at most LaMarche would teach one collimating lens—one lens per array as disclosed in LaMarche's Figure 6.

241. Nevertheless, rearranging the collimating beams and laser emitters in Kurita to be radial, does not disclose the claimed optical combiner comprising a focusing means, as discussed in Ground 1 which is relied upon in Ground 2 as well. *See* §IX.A.2.c., above.

242. Petitioner relies on Lemoff to disclose the "stopped" fiber. Lemoff does not satisfy the "stopped single optical fiber" element. As explained above, a POSITA would not have combined Kurita with Lemoff. *See* §IX.B.5, above.

243. Further, Lemoff does not satisfy the "stopped single optical fiber" element. Lemoff discloses that, "[d]uring assembly, the end of optical fiber 250 is inserted into ferrule 255, which surrounds and secures the end of the fiber. Then, end of optical fiber 250 and the bottom of the ferrule may be, but need not be, polished together to form a smooth surface, which aids the coupling efficiency." EX1006 at 5:58-65. The "fiber and ferrule" form their own "assembly" which is then "inserted into receptacle 260, which surrounds and secures the fiber and ferrule assembly." EX1006 at 5:63-65. As shown in FIG. 2, the ferrule surrounds the fiber and is flush with the end of the fiber such that there is not a stop that is part of the ferrule. *Id.* at FIG. 2. The fiber does not touch or come in contact with a stop. *Id.* at FIG. 2. Thus,

Lemoff does not disclose a stop inside the ferrule and the fiber is not a stopped optical fiber.

244. Lemoff does not disclose an integrated, pre-aligned connector as required by claim 1's optical combiner limitation. Lemoff's ferrule is pluggable and removable. EX1006 at 5:65-6:2. In my opinion, Lemoff does not disclose an integrated ferrule with a stop that is part of an optical combiner.

245. In Ground 2, Petitioner does not rely on LaMarche or Lemoff to cure any other shortcomings of Kurita. Because Kurita is missing claim elements beyond the ones that Petitioner has depended upon Lemoff and LaMarche to fulfill, this combination does not satisfy all claim limitations for claim 1. *See* Ground 1, claim [1.0]-[1.6]. *See* §IX.A.2.a-c, above.

246. In my opinion Ground 2 does not disclose or teach all of the claim limitations of claim 1 of the '416 Patent.

7. Claim 2: Kurita in view of LaMarche and/or Lemoff does not disclose Claim 2: The optical combiner of claim 1 wherein $n=4$ and wherein said four lasers and four collimating lenses are each formed in a two-dimensional, two by two array, wherein said focusing means is a single focusing lens, and wherein each radial sector is a pie-shaped quadrant

247. Because Kurita, LaMarche, and/or Lemoff do not disclose all elements of claim 1 from which claim 2 depends (*see* Ground 2, §IX.B.6.a-b., claims [1.0]-[1.6], above) this combination does not disclose claim 2. *See also*, §IX.B.7, claim 2, above. *See also* Ground 1, §IX.A.2.a-c., claims [1.0]-[1.6], above.

248. Dr. Willner further relies on LaMarche (and only LaMarche) to disclose a two-by-two array. However, LaMarche discloses discretely placed optical elements and not collimating lenses that are formed in a two-dimensional, two by

two array; the input probe lenses 630-1 through 630-M that Petitioner refers to are not integrated into an optical combiner. EX1005 at 5:27-31.

249. Kurita's optical lenses are integrated in rows, and are not integrated into an optical combiner as claimed. LaMarche's optical lenses are separate, discrete lenses that are lined up radially relative to each other and relative to separately discrete light emitters. Dr. Willner's proposed arrangement—integrally array formed radial optical lenses—is not disclosed in LaMarche or Kurita.

250. Even so, combining Kurita and LaMarche does not satisfy the claimed elements that the collimating lenses are formed in an array, or that they are integrated into an optical combiner.

8. Claim 6: Kurita in view of LaMarche and/or Lemoff does not disclose Claim 6: The optical combiner of claim 1 wherein said optical combiner does not require the use of dielectric filters or waveguides

251. Because Kurita, LaMarche, and/or Lemoff do not disclose all elements of claim 1 from which claim 6 depends (*see* Ground 2, §IX.B.6.a-b., claims [1.0]-[1.6], above) this combination does not disclose claim 6. *See also* Ground 1, §IX.A.2.a-c., claims [1.0]-[1.6], above.

9. Claim 7: Kurita in view of LaMarche and/or Lemoff does not disclose claim 7

252. Petitioner contends that claim 7 is substantially the same in scope as claim 2, and incorporates by reference its analysis for claims 1–2. Petition at 34. Because Kurita, LaMarche, and/or Lemoff do not satisfy the claim elements of claims 1–2, these references individually or in combination do not disclose or render obvious claim 7. *See* §IX.B.6-7, above. *See also* Ground 1, §IX.A.2.a-c., claims [1.0]-[1.6], above.

10. Claim 9: Kurita in view of LaMarche and/or Lemoff does not disclose claim 9

253. Petitioner contends that claim 9 differs from claim 6 only in that it depends from claim 7 instead of claim 1. Petition at 35. Because Kurita, LaMarche, and/or Lemoff do not satisfy claims 1, 2, or 6, these references do not disclose or render obvious claim 9. *See* §IX.B.6-8, above.

C. Ground 3 & 4: Claims Are Not Obvious Over Lemoff in view of LaMarche

254. For Ground 3, Petitioner relies on Lemoff as a standalone §103 reference and for Ground 4 combines relies on Lemoff in view of LaMarche.

1. (“Lemoff”) (EX1006)

255. Lemoff discloses “a multi-channel optical signal emitter for a wavelength division multiplexed (WDM) communication system that eliminates the use of optical multiplexers or other devices external to the emitter.” EX1006 at 1:52-56. Instead, Lemoff discloses a multi-channel optical signal emitter that includes multiple semiconductor die. Each die is configured to emit a channel of the multi-channel from an “emission aperture” located offset from the center of a die toward an aperture corner of the die. *Id.* at [Abstract], 1:57-65.

256. Lemoff teaches against using optical wavelength multiplexers for short distances. EX1006 at 1:42-48. Lemoff discloses that using WDM is “particularly problematic” in applications requiring “only relatively short distance lengths,” which are “more cost sensitive than other applications.” *Id.* Lemoff discloses, “one problem with WDM is that additional complexity in the design, Fabrication, and packaging of the required devices can dramatically increase production and maintenance costs.” EX1006 at 1:34-37. Lemoff discloses that “an optical wavelength multiplexer is often used to collect the optical signal components from

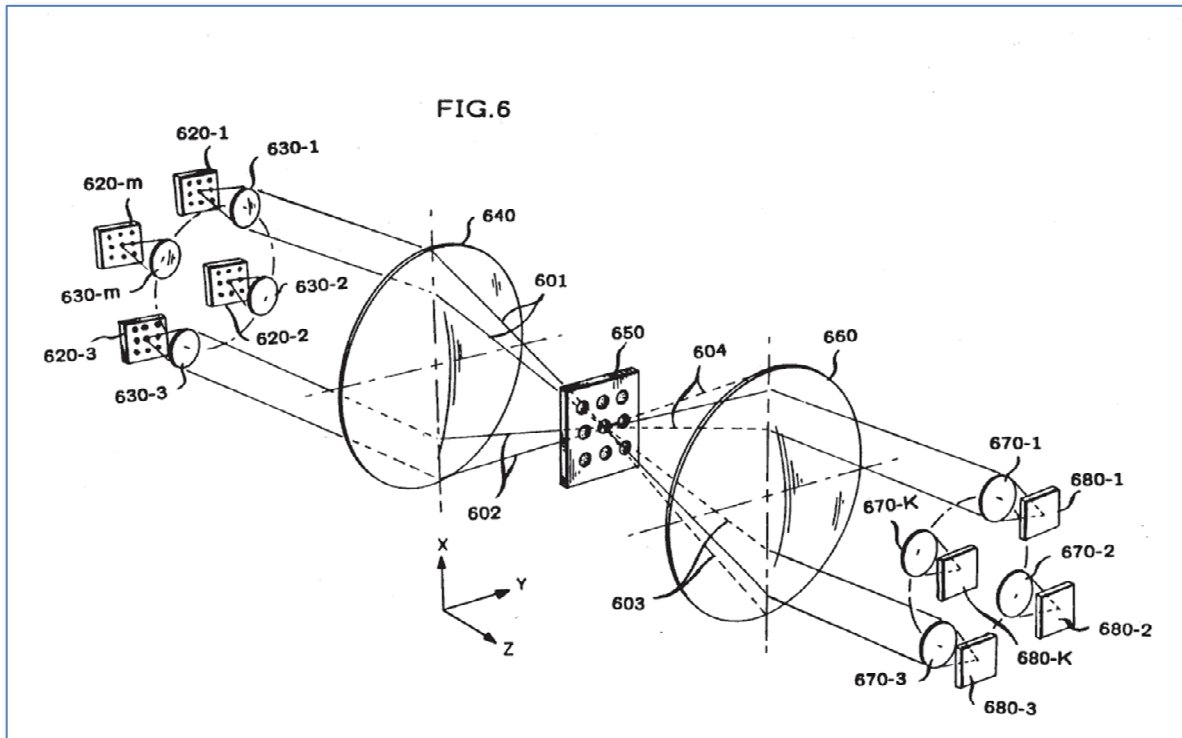
different sources and cause these components to spatially overlap and enter into a single optical fiber;” however, the “optical multiplexer can be a costly, high precision device.” EX1006 at 1:37-41. Lemoff discloses that “complex optical multiplexer...may not be cost effective for such lengths.” EX1006 at 1:46-48.

257. To solve the problems associated with short-distance WDM, Lemoff’s optical signal emitter emulates a WDM multiplexer by situating multiple light emitting emission apertures close together (but not overlapping) at the end of the fiber optic cable “without using an optical multiplexer or other device external to the emitter.” *Id.* at 1:52-56. Lemoff discloses configuring a die to emit an optical signal from emission apertures that are positioned offset from the center in the direction of the aperture corners of the die, where the aperture corners point toward the center of the signal-emitting area. *Id.* at 1:61-65. As shown in FIGS. 1A and 1B, the fiber is abutted against the emitters, allowing for butt coupling. EX1006, FIGS. 1A & 1B, 3:29-33. Butt coupling is when two structures are immediately adjacent to each other, and physically touching. This means that the light is not entering the fiber at a single spot. The light signals enter into the fiber at different locations or spots as shown in FIGS. 1A and 1B. EX1006, FIGS. 1A & 1B. FIG. 2 shows a second example of the invention using an imaging lens. In this embodiment, the signals are emitted from of the emission apertures into the signal-emitting area to an imaging lens that images the light into the fiber. EX1006 at 6:7-11. Lemoff does not disclose the light is focused onto a single spot of the fiber because of the short distance from the emitting area to the signal receiving area. In this regard, Lemoff discourages the use of a “focusing means or focusing said n collimated output beams onto a single spot at said stopped single optical fiber.” In particular, Lemoff’s intended purpose is not to focus the beams onto a single spot. The emission apertures are purposely offset from the center of the die in direction of the aperture corner of the die. EX1006 at 1:57-65, 7:19-31.

258. By contrast, the '416 Patent is an optical multiplexer, *i.e.*, an optical combiner that multiplexes light of multiple wavelengths for short distance WDM a small package without the need for a complex optical multiplexer. EX1001 at 1:13-16, 1:51-55, 2:11-26, 3:19-21. The '416 Patent's claimed optical combiner is an integrated subassembly of optical components for multiplexing light of different wavelengths, which includes an integrated, pre-aligned connector with a stop to hold the single fiber optic cable. *Id.*; *see* §VII.A.1. The optical components include collimating lenses that are geometrically arranged to send light to the integrated focusing means of the optical combiner, which in turn causes the light from various light sources to converge onto a single spot on the optical fiber. EX1001 at 3:7-15, 3:22-26, FIG. 1 (spot 50). Thus, Lemoff's invention is contrary to the very thing that inventors of the '416 Patent were trying to solve – using a cost-effective optical multiplexer/combiner for short distance WDM.

2. (“LaMarche”) (EX1005)

259. LaMarche discloses an optical arrangement that utilizes separately placed components for accomplishing “simultaneous broadcasting” of optical signals in a multipoint-to-multipoint arrangement. EX1005 at 1:11-2:23 (2:18-19: “an array of light emitting devices is imaged to arrays of light detecting devices”); EX1005 at 7:16-25.



EX1005, FIG. 6

260. While LaMarche generally relates to optics, LaMarche's field of endeavor is different from the '416 Patent. LaMarche is related to "an optical arrangement for interconnecting, via free space, light emitting devices to light detecting devices" EX1005 at 1:5-8. LaMarche is focused on simultaneous broadcasting signals to and from multiple points. EX1005 at 1:11-2:23. LaMarche does not disclose a system for accomplishing multiplexing. *See* EX1005 at 1:11-2:23. LaMarche is trying to solve the problem of improving signal integrity in "multipoint to multipoint" interconnections. EX1005 at 1:11-2:17 (2:18-19: "an array of light emitting devices is imaged to arrays of light detecting devices"); 7:16-25. LaMarche discloses when an array of light emitting lenses are imaged to an array of light detective devices, as compared to a single point connected simultaneously to other various points, a higher degree optical signal integrity is accomplished. EX1005 at 1:57-2:23. LaMarche repeatedly states that it is directed to increasing the

degree of optical connectivity in a free space environment for multiple point to multiple point interconnections. See EX1005 at 1:5-9 (“This invention relates to optics and, more particularly, to an optical arrangement for interconnecting, via free space, light emitting **devices** to light detecting **devices**.”); EX1005 at 1:46-53 (“Although this arrangement is practical for a large number of point to point interconnections, **multipoint to multipoint interconnections** become unpractical since a large number of optical couplers, taps, and splitters are required and, thus, are constrained by their physical dimensions.”); EX1005 at 1:57-60 (“Attempts to increase the degree of optical connectivity (number of **multipoint ot [sic] multipoint interconnections**) have focused on the utilization of free space as a transmission media.”); EX1005 at 2:17-22 (“Specifically, in the context of free space transmission, where an **array of light emitting devices is imaged to arrays of light detecting devices**, this invention provides a higher degree of connectivity without the prior art limitations that result from wavelength sensitivity or coherence effects....”); EX1005 at 3:5-8 (“The inventive optical arrangements afford **multipoint to multipoint interconnections** by utilizing the concept of pupil division in conjunction with a non-collinear arrangement of lenses.”); EX1005 at 4:1-2 (“An **inventive optical arrangement for multipoint to multipoint interconnections is shown in FIG. 4**”); EX1005 at 4:61-66 (“It is desired to image, that is, connect **each light emitting device in the M NxN arrays, 620-1 through 620-M, to at least one light detecting device of each K NxN arrays, 680-1 through 680-K**, in order to establish multiple interconnections between light emitting and light detecting devices”); *see also* EX1005 at 5:11-12, 6:65-69, 7:11-15.

261. In one embodiment, LaMarche discloses a system where an array of light emitting devices (e.g., 620-1 through 620-M) are optically connected with an array of light detecting devices (e.g., 680-1 through 680-K) on the other side of an array of ball lenses that fans out the light, causing the light to diverge. Each light

emitting device is placed at the focal plane of an “input probe lens[.]” that collimates the light from the emitting devices. EX1005 at 2:28-45. The collimated light enters into a pupil lens that directs the light to the array of ball lenses. The various light beams exiting the pupil lens are not focused onto a single point or a fiber; the various light beams are focused on to each of the ball lenses in the array. *See* EX1005 at FIG. 6. The array of ball lenses causes the light to diverge or fan out, which is received by the light detecting devices. EX1005 at FIG. 6, 4:43-60, 6:35-44, 6:57-7:15.

262. LaMarche has nothing to do with multiplexing. LaMarche does not disclose wavelength division multiplexing onto a single fiber, or disclose an optical multiplexer or combiner that can accomplish multiplexing. LaMarche’s only reference to wavelength division multiplexing is at 5:20-23, which states that “optical signals simultaneously impinging on the light detecting devices may be...wavelength division multiplexed.” EX1005 at 5:20-23. LaMarche does not disclose or teach how the signals are combined, only that multiplexed signals can be transmitted through its free space optical arrangement. Nor is LaMarche related to single-fiber systems. LaMarche discloses the light emitting devices may be, for example, LEDs, lasers, or illuminated fiber ends that bring in the source light from a laser or LED source away from the experimental set up. EX1005 at 3:26-28. Thus, LaMarche teaches that each of the light emitting devices (e.g., 620-1 through 620-M) and the light receiving devices (e.g., 680-1 through 680-K) can be fibers. LaMarche therefore teaches an array of multiple fibers that are optically aligned with an array of receiving multiple fibers as part of an experimental free space optical system. This is contrary to the teaching of the ’416 Patent that is combining (i.e, multiplexing) light onto a single fiber using an optical combiner. By contrast, the ’416 Patent “relates to an optical multiplexing device which spatially combines multi-wavelength light from a plurality of lasers into an optical fiber.” EX1001 at

1:14-16. The '416 Patent discloses an “improved multiplexing device” that “is particularly suited for wavelength division multiplexing systems for the fiber-optic data-communications and telecommunications systems.” EX1001 at 1:17-20. The '416 Patent is not directed to multipoint-to-multipoint optical arrangements used for simultaneous broadcasting light to be received by numerous optical fibers; it is focused on multiplexing light onto a single optical fiber using the claimed optical combiner. Thus, the relevant field of endeavor is wavelength division multiplexing systems, i.e. systems that multi-wavelength light from a plurality of lasers into an optical fiber. Because LaMarche does not relate to wavelength division multiplexing systems that combine multi-wavelength light from a plurality of lasers into a single optical fiber, in my opinion, LaMarche is not in the same field of endeavor as the '416 Patent.

263. Additionally, LaMarche is not pertinent to solving the problem addressed in the '416 Patent. The '416 Patent discloses that, “The present invention provides, for the first time, an inexpensive, injection molded, one piece optical combiner capable of combining, separately collimating and focusing the output of multiple lasers into a single optical fiber with a uniform, high coupling efficiency.” EX1001 at 2:11-15. “One of the key objects of the present invention is to provide a compact and cost effective optical combiner for both single-mode or multimode fiber optic communication systems, all without requiring the use of dielectric filters and the alignment necessitated by those filters or expensive waveguides.” EX1001 at 2:21-26. This is the opposing of the free-space, expensive, large optical arrangement in LaMarche.

264. LaMarche offers the solution of a particular “optical arrangement” that utilizes “simultaneous broadcasting” of optical signals emitted from “light emitting devices” to communicate with “light detecting devices” on the other side of a ball lens 406 or an array of ball lenses 650 in order to improve interconnectivity in

multipoint to multipoint systems. EX1005 at 2:18-19, 2:26-27. The ball lens or lens fan out or broadcast the light it receives from the light emitters. This “fanout or broadcasting capability” to improve interconnectivity is the opposite of the ’416 Patent, which is multiplexing the multiple wavelengths onto a single fiber. EX1005 at 6:41. LaMarche’s solution is highly particularized and uses numerous discrete parts that must be aligned relative to each other for the light from one emitter to be received by the detector on the other side of the ball lens or array of ball lenses. This is contrary to the teaching of the ’416 Patent that is combining light onto a single fiber using an optical combiner. Further, in LaMarche’s arrangement, each of the numerous optical components are individually placed. EX1005, FIG. 6. Because of the required manual alignment, LaMarche’s system is extremely expensive and difficult to set up causing it to be highly susceptible to misalignment. In LaMarche’s own experiment using the optical arrangement shown in FIG. 2, which utilizes only two collimating lenses, the interconnectivity or degree of coupling of the light emitting devices was “highly sensitive to the positioning error of both the ball lenses and/or the light detecting devices.” EX1005 at FIG. 4, 7:47-51. LaMarche further discloses a large system that requires optical corrections. LaMarche discloses that the pupil lenses exhibited a “high degree of field curvature” due to their “large field of view,” which warranted correction. EX1005 at 7:51-56. A POSITA would understand this to mean that the optical signal integrity may be jeopardized. Optical effects such as aberrations and detrimental issues will affect the optical efficiency of the system. A POSITA understands that corrections will result in more expensive optics and more costly optical design, making the system less commercially practical. LaMarche’s large system is costly to set up is inconsistent with the low-cost integrated, compact, pre-aligned solution disclosed by the ’416 Patent. LaMarche does not teach integrated optical combiners with passive alignment for

WDM. The optical alignment in LaMarche must be accomplished manually. Thus, LaMarche is not pertinent to the problem the '416 Patent is trying to solve.

3. A POSITA would not have been motivated to combine Lemoff and LaMarche

265. Petitioner and Dr. Willner argue that a POSITA would have been motivated to use LaMarche's teachings of a radial arrangement of collimating lenses, in the optical signal emitter 200 of Lemoff. Petition at 37; EX1003 at ¶¶238-246. Dr. Willner also contends that there are three rationales that support applying LaMarche's teachings to the optical signal emitter 200 of Lemoff. EX1003 at ¶242. I disagree, as discussed below. There are several reasons why a POSITA would not turn to LaMarche to modify Lemoff.

266. Lemoff does not disclose, teach, or suggest using collimating lenses as part of the optical imaging element 220. Dr. Willner relies on Lemoff at 6:16-22, but this disclosure does not refer to collimating lenses or collimating light at all. *See* EX1003 at ¶239. EX1006, 6:16-22. The entire phrase reads, "Various embodiments of the invention may use optical imaging elements that include a plano-convex lens, a graded-index (GRIN) lens, a diffractive optical element, a Fresnel lens, another type of lens, or any arrangement of one or more optical components functioning to image the optical signal components from the signal-emitting area onto the signal-receiving area." EX1006, 6:16-22. Lemoff does not disclose that any of these lenses are collimating lenses and certainly not does not describe as lenses that would be set in any particular arrangement, such as a radial arrangement, or an arrangement where each lens would correspond to each emission aperture disclosed in Lemoff (as Dr. Willner opines).

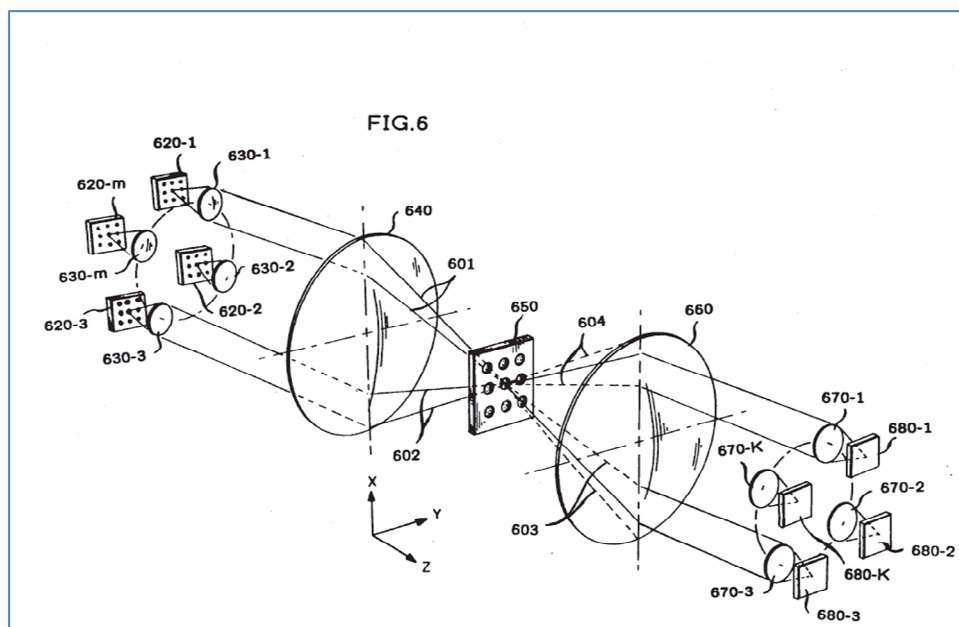
267. Dr. Willner particularly seizes on the language "or any arrangement of one or more optical components functioning to image the optical signal components

from the signal-emitting area onto the signal-receiving area.” EX1003 at ¶238. But the collimating lenses as used in the ’416 Patent do not “function[] to image the optical signal components from the signal-emitting area onto the signal-receiving area.” EX1006 at 6:20-22. In Lemoff, the signal-receiving area is the core of the fiber. EX1006 at 3:31-33 (“End 155 of the optical conduit 150 is the signal-receiving area of the optical conduit”); 3:57-61, 6:3-6. As claimed in the ’416 Patent, the collimating lenses cause the light from the lasers to collimate; the collimated light is then received by the focusing means. *See* EX1001 at cls. 1, 7. The focusing means then images the light to the fiber. *Id.* at cl. 1 (“focusing means for focusing said n collimated output beams onto a single spot at said stopped single optical fiber...”), cl. 7. Thus, the collimated lenses are not “functioning to image the optical signal components from the signal-emitting area onto the signal-receiving area” as Lemoff describes imaging element 220. Therefore a POSITA would not have modified Lemoff to include collimating lenses based on this disclosure.

268. A POSITA would not have been able to practice the claimed invention based on this disclosure in Lemoff without undue experimentation. A POSITA reading this disclosure would not have known to incorporate a plurality of n collimating lenses that are equal to the number of emission apertures, or position the collimating lenses to receive and collimate the laser beams. Further, a POSITA would not have known how to have integrate such collimated lenses into Lemoff’s housing, and doing so would have been difficult optically to accomplish. This hypothetical arrangement of collimating lenses could not have been achieved without undue experimentation.

269. Dr. Willner states that he is applying a known technique to a known device ready for improvement, to yield predictable results (e.g., a functioning optical device). EX1003, ¶¶242, 246. I disagree. Lemoff and LaMarche are not capable of being physically combined. Notably, LaMarche predates Lemoff by over 10 years.

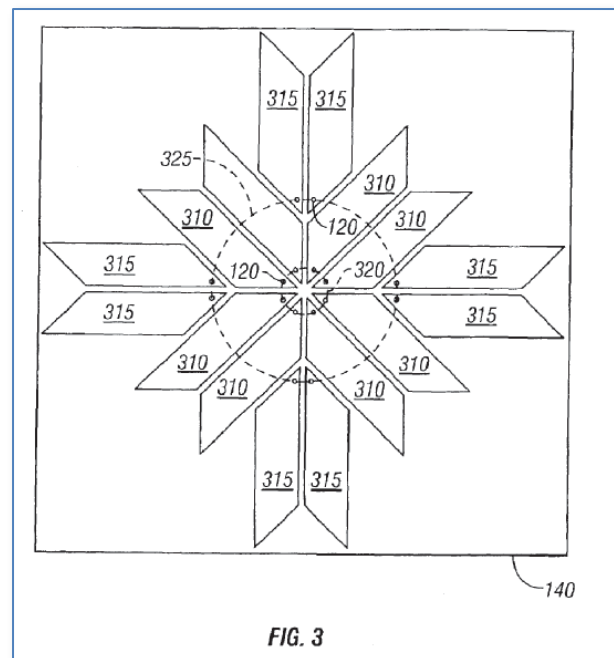
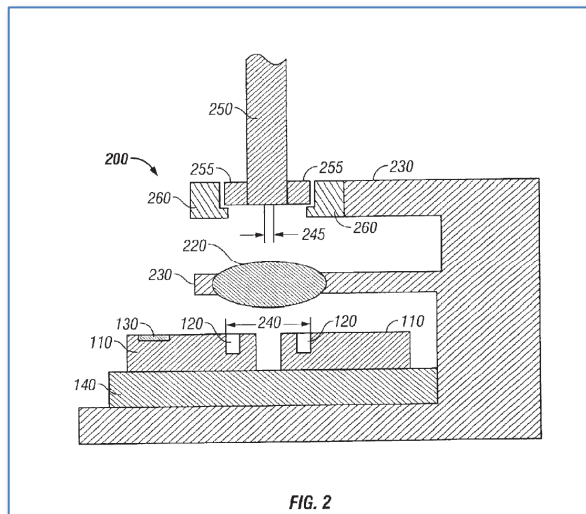
270. Because Lemoff is a micro-package signal emitter, combining it with LaMarche would have led to inoperable results. LaMarche discloses a system that spans over 400mm. EX1005 at 7:16-25. The large “pupil lens” are described as lenses that are 80 mm in diameter, with a focal length of 160 mm. EX1005 at 7:16-25. Thus, the distance from the pupil lens **640** to the ball array **650** would be 160 mm, and the distance from the ball array 650 to pupil lens 660 would be another 160 mm. EX1005 at 7:16-25.



271. LaMarche discloses input probe lens (630-1 to 630-M) (collimating lens) and output probe lenses (670-1 through 670-K) that are 18mm in diameter with a focal length of 40 mm (40,000μm.. EX1005 at 7:16-25. LaMarche discloses that each input probe lens (630-1 to 630-M) are positioned inside the larger pupil lens. EX1005 at 7:16-25. LaMarche discloses optical fibers can be light emitting devices (620-1 thorough 620-M) or light detectors (680-1 through 680-K). EX1005 at 3:36-28, 7:16-30 (experiment uses multiple fibers on either side of the system at 401, 402, 411, 412). Accordingly, LaMarche discloses that the distance from the input probe lens and output probe lens to the fibers is 40mm. This means that the system

disclosed in LaMarche spans for 400mm (40mm + 160mm + 160mm + 40mm). LaMarche is a system that would be placed on an optical bench or used in a lab. It is not a commercially practical solution.

272. Lemoff is a micro-package, approximately 1x1x2 cm. Lemoff is designed to go into a fiber optic transceiver box, which is about 4x1x.5 cm in size – about the size of a finger. Lemoff would not be capable of housing the design disclosed in LaMarche. Lemoff would need to be close to a meter in size to house a system like LaMarche, making Lemoff entirely unsuitable for its intended purpose of emulating WDM using a micro-optical signal emitter. Lemoff discloses a signal emitter where the entire signal-emitting area **240** (area of the emitter that encompasses all emission apertures **120**) is 100μm-2,000μm (up to 2mm), around 2x the size of the core of a fiber. EX1006 at 3:34-43, 5:15-49. The entire signal-emitting area **240** corresponds to the outer circle in FIG. 3 and the cross-section is shown in FIG. 2. EX1006, FIGS. 2–3 and 6:3-6.



EX1006, FIG. 2-3

273. This means that one-half of LaMarche's optical arrangement is more than 100 times larger than the signal-emitting area disclosed in Lemoff $((160,000\mu\text{m}+40,000\mu\text{m})/2000\mu\text{m}=100)$. Because LaMarche's optical arrangement is at least 100 times larger than the micro-package disclosed in Lemoff, a POSITA would not look to LaMarche to improve Lemoff.

274. A POSITA would not look to combine these systems as they are completely different designs that utilize different components, different set-up, different alignment techniques, different structures, and a vastly different size. La Marche's large system would fill an optical bench inside an optics room because it is sized in meters while this would not even be close to fitting into Lemoff's design which is miniaturized, and on the order of centimeters.

275. In Dr. Willner's proposed arrangement, one input probe lens (18mm) would correspond to each aperture **120** shown in FIG. 3. EX1003, ¶¶262-263. But based on the disclosures in Lemoff, each aperture is no more than a few microns. EX1005 at 2:65-3:9. Even looking at the signal-emitter area as a whole (the area of the emitter that encompasses all emission apertures **120**), one input probe lens disclosed in LaMarche is 9 times its size $(18,000\mu\text{m} / 2,000\mu\text{m})$. For Dr. Willner's proposed arrangement applied to FIGS. 2 and 3 (EX1003, ¶¶239, 262-263), **16 input probe lens** would be required. EX1006 at 6:37-45. With one lens nine times the size of the entire emitting area, 16 lenses would result in an area of 288,000 μm , or over 100x larger than the size of the signal-emitter area. Thus, the combination is not commercially practical and would not have resulted in a functional device. As a result, a POSITA would not have looked to LaMarche to modify Lemoff.

276. Lemoff discourages using optical wavelength multiplexers to accomplish WDM for short distances because the complexity of the design is often cost prohibitive for such short distances, particularly because optical wavelength

multiplexers require a high degree of precision. EX1006 at 1:42-48. A POSITA would have understood that multiplexers and demultiplexers were bulky, high cost, and difficult to optically align, and consist of numerous discrete optical components to multiplex light onto a single fiber.

277. Conventional multiplexers usually included thin-film filters, Echelle grating, and arrayed waveguide gratings.

278. Instead, Lemoff emulates WDM for short distances “without using an optical multiplexer or other device external to the emitter” by offering a micro-package device that is less cost than a large multiplexer system. EX1006 at 1:52-65. Lemoff discloses an optical signal emitter that can be used in a WDM setting. EX1006 at [Abstract], 1:52-65. Lemoff discloses that its optical signal emitter includes multiple semiconductor die, which is a chip, or a small block of semiconducting material on which a circuit is usually fabricated. Each die is configured to emit a channel of the multi-channel optical signal from an emission aperture located offset from the center of the die toward an aperture corner of the die. EX1006 at 1:52-65. The die are attached to a substrate with the emission apertures collectively defining a signal-emitting area and the aperture corners of each die pointing toward the center of the signal-emitting area. EX1006 at 1:52-65. FIG. 4 and the corresponding disclosures describe the process for shaping the semiconductor die to form the aperture. EX1006 at 7:19-38.

279. In other words, Lemoff teaches the use of a geometric design to allow laser generated spots on different sections of the core fiber. Lemoff avoids the use of a WDM combiner or multiplexer and this allows the optical package size, cost, and complexity to be reduced while still conveying multiple wavelengths through a single fiber.

280. By contrast, LaMarche is a large optical arrangement with numerous separate, discrete components that are highly dependent on placement, requiring a

high degree of precision and man-hours to align. A POSITA would understand that each of the input probe lens (630-1 to 630-M & 670-1 through 670-m) would need to be manually aligned with the light emitting devices 620-1 thorough 620-M) and the light detectors (680-1 through 680-K). EX1005 at 5:27-31. Each of the input probe lens (630-1 to 630-M & 670-1 through 670-K) would also need to be manually aligned with the pupil lens, and the pupil lens would need to be allied with the ball array 650. EX1005 at 6:45-56. In my experience, this would have taken at least an order of magnitude more work in optical alignment and positioning than Lemoff. LaMarche himself did not set up the entire system in FIG. 6 when he ran his experiment disclosed in LaMarche. He chose to use the arrangement in FIG. 4 with two probe lenses on either side of the ball lens. EX1005 at 7:16-24. LaMarche discloses that “[o]nly a fraction of the total energy impinging on pupil lens, 408 or 660, is received by probe lenses, 409 and 410, or, 670-1 through 670-K, respectively” because “the fraction of power delivered to each probe lens is the ratio of the area of 40 the output probe lens to the area of the pupil lens.” EX1005 at 7:36-41. In addition to these losses, LaMarche disclosed that “it was found that the degree of coupling was highly sensitive to the positioning error of both the ball lenses and/or the light detect-ing devices.” EX1005 at 7:47-51. Thus, a POSITA would recognize that the arrangement in LaMarche inherently has a high amount of loss which is further compounded due to the sensitivity in arrangement. Thus, a POSITA would be discouraged to use the optical arrangement in LaMarche.

281. LaMarche also notes that due to the size of the pupil lens, other optical elements may need to be introduced to correct field curvature. EX1005 at 7: 51-56. A POSITA would understand that introducing additional optical elements will increase costs, making the system less commercially practical.

282. Given Lemoff’s intended purpose to create a small, low cost, signal emitter that can be used for short distances compared to the complexity and size of

the system in LaMarche and its inherent losses and high degree of sensitivity, a POSITA would have been discouraged to combine LaMarche and Lemoff. A POSITA would understand that LaMarche is an extremely expensive optical arrangement, and it is not clear that the system could produce effective optical efficiency, based on the stated drawbacks of the system. EX1005 at 7:36-51.

283. Additionally, Petitioner's proposed modification reduces or eliminates the benefit provided by Lemoff. Lemoff's intended purpose to create a small, low cost, signal emitter that can be used for short distances to emulate WDM without using costly optical multiplexers. In particular, Lemoff's intended purpose is not to focus the beams onto a single spot. Lemoff uses an unusually large fiber—larger than fibers used in nearly all WDM systems—to allow for the light to enter into the fiber at different locations.

284. Lemoff's invention is a compact optical signal emitter with a die with emission apertures located offset from the center of the die, and then attaching the die to a substrate so the aperture corner of the die points toward the center of the signal-emitting area. EX1006 at 1:60-65, 3:3-25, 4:2-17, 5:10-14, 6:59-60. Lemoff teaches the use of a geometric design to allow laser generated spots on different parts of the core fiber without the use of a WDM combiner or multiplexer, which Lemoff teaches is permissible for short distances. To modify Lemoff to house the system of LaMarche, Lemoff would need to be expanded to over a meter in size (100x larger), thereby making it not practical for its purpose of emulating WDM over short distances. At that long distance, a POSITA would understand that WDM multiplexer would likely be needed, which Lemoff discourages. Thus, a POSITA would have no reason to combine LaMarche with Lemoff.

285. I disagree with Dr. Willner that "LaMarche further teaches that the radial (or non-collinear) arrangement it provides for results in improved coupling efficiency, reduced physical complexity, as well as having other advantages such as

being able to achieve high-bandwidth connections.” EX1003, ¶239; *see also* EX1003, ¶245. I have read the sections of LaMarche that Dr. Willner has cited and I disagree. LaMarche’s disclosures would not lead a POSITA to modify Lemoff to include LaMarche’s discrete, radially aligned lenses.

286. LaMarche’s disclosure of radial arrangement of collimating lenses to improve coupling efficiency in “simultaneous broadcasting” using “pupil division” in multipoint to multipoint optical arrangements. EX1005 at 1:57-2:27. LaMarche is comparing its optical arrangement to the prior references LaMarche references in the Background of the Invention. EX1005 at 1:57-2:27. I have reviewed these references. EX2012-EX2015. As LaMarche confirms, these references on focus on multi-point optical arrangements using various optical techniques that include free space, waveguides, holographs, glass, diffraction gratings, etc. They discuss a single high bandwidth channel, and from this channel, many connections can be made to many points. EX1005 at 2:4-10 (“In these optical arrangements, one point is connected over a high bandwidth channel simultaneously to various other points. The degree of connectivity in these instances, however, is outweighed by coupling loss, physical complexity, wavelength sensitivity, or coherence effects...”). In doing so, the one high bandwidth channel serves all of the other channels. With LaMarche, one high bandwidth channel is replaced by multiple radial channels so the high bandwidth is compromised less when it reaches the point destination. Thus, with LaMarche’s multipoint broadcasting, LaMarche is able to improve coupling efficiency, reduce physical complexity, and achieve higher integrity connections *as compared to these optical arrangements*. EX1005 at 2:13-22 (“This invention overcomes the drawbacks of the prior art methods of interconnections by using...this invention improves a higher degree of interconnectivity without the prior art limitations...”). This does not give a reason for a POSITA to combine LaMarche with Lemoff’s system.

287. These disclosures do not suggest to a POSITA that modifying Lemoff to include the discretely placed lenses disclosed in LaMarche would improve coupling efficiency or improve bandwidth in Lemoff's signal emitter. LaMarche uses free space optics where each of its components are individually placed. Such systems suffer alignment and cost issues due to the need to manually align the individual components. Further, LaMarche recognizes the losses inherent in its design. EX1005 at 7:35-51 (“[o]nly a fraction of the total energy impinging on pupil lens“degree of coupling was highly sensitive to the positioning error of both the ball lenses and/or the light detecting devices”). When conducting his optical arrangement experiment, LaMarche himself used only two input probe lenses. EX1005 at 7:16-34.

288. Additionally, LaMarche would lead to *greater* physical complexity than Lemoff—requiring additional optical components. It is known to a POSITA that an increase in components results in increased optical losses. For example, Kurita states that “an increased number of parts in order to build separate optical systems resulting in high optical losses in order to allow the lights to pass through these parts.” EX1004, ¶[0004]. A POSITA would understand that the optical arrangement in LaMarche would increase the number of installation man-hours due to the large number of discrete parts needing to be aligned. As disclosed in Kurita, “on account of a large number of parts being needed, it increases installation man-house, and presents a problem in terms of the cost aspects as well.” EX1004, ¶[0004]. Because of the increased physical complexity, a POSITA would not look to LaMarche to modify Lemoff.

289. While Lemoff and LaMarche are both optical technologies, these two references are unrelated. As discussed above, LaMarche is not in the same field of endeavor as the '416 Patent. Additionally, LaMarche and Lemoff are not in the same field of endeavor. Lemoff is a micro-package for use in a WDM communications

system when trying to accomplish WDM for short distances. *Id.* at 1:42-45, FIGS. 2–3. LaMarche discloses simultaneous broadcasting technique that sends multiple signals from an array of lasers to an array of signal detectors on the other side of an array of ball lenses. LaMarche’s solution is not pertinent to WDM for short distances; it discloses a solution of simultaneous broadcasting from a multitude of laser signal emitters to a multitude of signal detectors. EX1005 at 1:11-2:23, 7:16-25.

290. LaMarche is a large, free space system that is 100x larger than the size of Lemoff. Lemoff discloses a micro package optical signal emitter to be used in WDM systems for short distances, which is the anthesis of LaMarche.

291. Dr. Willner contends that combining LaMarche’s radial arrangement of collimating lenses with Lemoff’s optical signal emitter is combining prior art elements according to known methods to yield predictable results (e.g., a functioning optical device. EX1003, ¶244. I disagree with that statement. As discussed above, Lemoff and LaMarche do not result in a functioning device. Further, neither LaMarche nor Lemoff disclose collimated lenses that are integrated into an optical combiner, as required by the claims and the patented invention of the ’416 Patent. Thus, Dr. Willner’s proposed combination is not in the cited prior art.

292. Finally, as more fully explained below, even if Lemoff and LaMarche were combinable in the way Petitioner and Dr. Willner argues for, the references fail—individually and collectively—to disclose claimed features of the challenged claim.

4. Independent Claim 1

- a. **Claim 1: [1.0] An optical combiner [1.1] usable in data communication systems for multiplexing the outputs of a plurality of n lasers wherein each of said n outputs has a different output wavelength [1.2] for transmission into and through a stopped single optical fiber, comprising:**

293. Petitioner and Dr. Willner only cite to Lemoff for these claim elements. EX1003, ¶¶247- 254 and pp.158-161.

294. Dr. Willner opines that “[t]o the extent the preamble is limiting, Lemoff discloses an optical combiner that has all the properties noted in Claim Elements [1.0], [1.1], and [1.2]. EX1003, ¶247.” Based on this statement, Dr. Willner apparently is not applying any structural limitations to the word “optical combiner” beyond that which is expressly stated in the claims. Dr. Willner has not provided any claim construction that he is applying for “optical combiner.”

295. As discussed above, a POSITA would have interpreted the term “optical combiner” consistent with Patent Owner’s proposed construction of optical combiner – “an integrated subassembly of optical components for multiplexing light of different wavelengths, which includes an integrated, pre-aligned connector with a stop to hold the single fiber optic cable.”

296. For the optical combiner limitation, Dr. Willner cites to EX1006, 1:52-56. EX1003, ¶248. This passage from Lemoff does not disclose an integrated subassembly of optical components for multiplexing light of different wavelengths, which includes an integrated, pre-aligned connector with a stop to hold the single fiber optic cable.

297. First, Lemoff discourages using an optical multiplexer for short distances because of the cost associated with typical optical multiplexers used in WDM. *See* §IX.C.1., above. Instead, Lemoff uses geometric positioning of the spots

(emission apertures) so that different wavelengths can enter the fiber and create a WDM fiber. EX1006, FIGS. 1A–1B, 2–3. Lemoff does not use a combiner at all or combine the wavelengths. This is a different technique than multiplexing or combining the wavelengths. Lemoff does not disclose a combiner or a combiner used for multiplexing different wavelengths of light onto a single spot of a fiber. Lemoff discloses that for short distance WDM, this method is sufficient. EX1006 at 1:42-65.

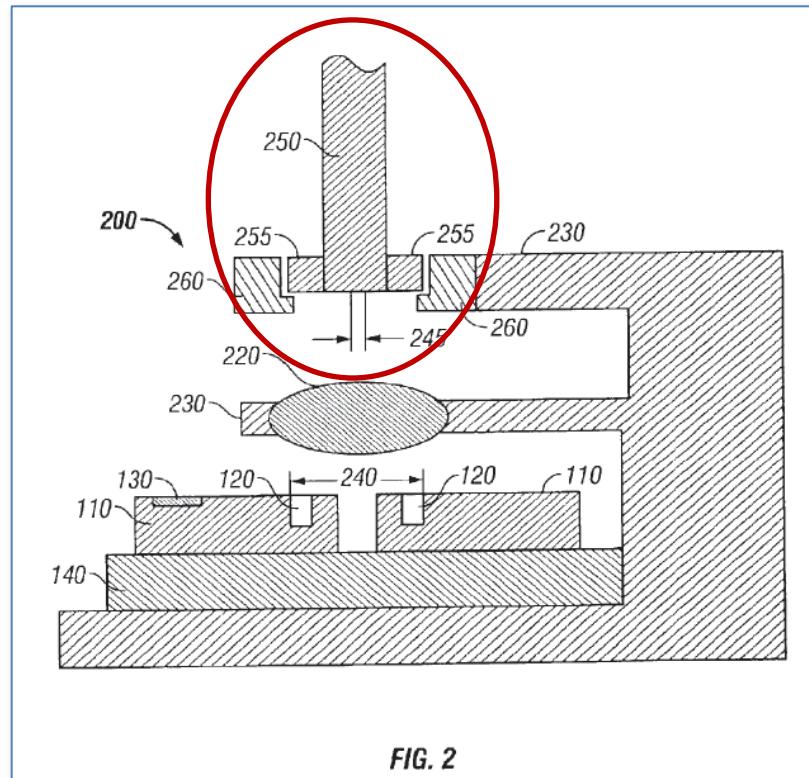
298. Petitioner cites to Lemoff at 1:52-56, but this confirms that Lemoff does not teach the light is combined—the entire quote states that Lemoff can be used to *emulate* WDM because it can be used in a WDM communication system “without using an optical multiplexer or other device external to the emitter.” EX1006 at 1:52-56. Lemoff avoids the use of a combiner, and uses individual spot placement onto the core of the fiber in lieu of overlapping spots. A POSITA would not look to Lemoff as WDM is not implemented using a combiner.

299. Lemoff does not disclose that its optical signal emitter multiplexes the light onto a single spot of a fiber as required by the claims. In one embodiment (FIGS. 1A and 1B), Lemoff discloses that direct butt coupling is used between the signal-emitting area 125 and the optical conduit. EX1006 FIGS. 1A, 1B, 3:26-33. The optical conduit is a fiber. As shown in FIGS. 1A and 1B, the fiber is abutted against the emitters, allowing for butt coupling. EX1006 at 3:29-33. Butt coupling is when two structures are immediately adjacent to each other, and physically touching. This means that the light is not entering the fiber at a single spot. The light signals enter into the fiber, which abuts against the emission apertures, at different locations that correspond to the locations of the emission apertures. At EX1006 7:13-18, each laser is positioned in a different place. Lemoff does not disclose than anything brings the lasers together into a single spot as each laser is simply imaged

to be positioned at the fiber core in its own individual place. EX1006 at 6:3-8 and 4:66-5:9.

300. FIG. 2 shows a second example of the invention using an imaging lens. In this embodiment, the optical signal components emitted from the emission apertures 120 into the signal-emitting area. The imaging element is configured to image the optical signals to the core of the fiber. EX1006 at 6:7-11. Lemoff does not disclose the light is focused onto a single spot.

301. Lemoff does not disclose an integrated, pre-aligned connector. Lemoff's ferrule is pluggable and removable. EX1006 at 5:65-6:2. Lemoff discloses that, "[d]uring assembly, the end of optical fiber 250 is inserted into ferrule 255, which surrounds and secures the end of the fiber. Then, end of optical fiber 250 and the bottom of the ferrule may be, but need not be, polished together to form a smooth surface, which aids the coupling efficiency." EX1006 at 5:58-65. The "fiber and ferrule" form their own "assembly" which is then "inserted into receptacle 260, which surrounds and secures the fiber and ferrule assembly." EX1006 at 5:63-65.



EX1006, FIG. 2.

302. In the '416 Patent, however, the integrated, pre-aligned connector is part of the optical combiner subassembly. By not requiring the fiber to be formed into an assembly, the '416 Patent offers a lower cost, simpler solution that does not require the fiber to be part of a removable ferrule. A removable ferrule is an extra sub-component that adds more parts to the assembly, requires optical alignment, and will increase the cost of the package.

303. Lemoff also does not disclose an optical combiner with a stop that is inside the ferrule where the fiber is inserted. The fiber is flush with the end of the ferrule and does not come into contact with a surface acting as a stop. *Id.* at FIG. 2. Lemoff's "fiber and ferrule assembly" is inserted into the receptacle 260 "which surrounds and secures the fiber and ferrule assembly." EX1006 at 5:63-65.

304. Lemoff does not disclose integrated optical components of the optical combiner, namely a plurality of n collimating lenses or a focusing means. Lemoff's failure to disclose an optical combiner with a plurality of n collimating lenses is discussed in my opinion below regarding Claim Elements [1.3] & [1.4]. *See infra* §IX.C.4.b. Lemoff's failure to disclose a focusing means is discussed in my declaration below at Claim Elements [1.5]-[1.6], which are incorporated herein by reference. *See infra* §IX.C.4.c.

305. Lemoff does not disclose that the outputs of the lasers are transmitted “into and through a stopped single optical fiber.” Dr. Willner acknowledges that Lemoff does not use the term “stopped optical fiber.” EX1003, ¶253. Dr. Willner interprets a “stopped optical fiber” as one that is “fixed” such as that shown in FIG. 2 of Lemoff. EX1003, ¶253. However, in my opinion, a POSITA would have agreed with Patent Owner's construction of “a stopped single optical fiber” which means “a single optical fiber that has been inserted into the optical combiner until it abuts a physical structure that prevents the fiber from being inserted further into the optical combiner.”

306. Dr. Willner relies on optical fiber 250 in FIG. 2 as the single stopped optical fiber (EX1003, ¶¶250, 253), but the fiber is not stopped because the fiber does not come into contact with a stop. FIG. 6 shows an example of a stop 60.

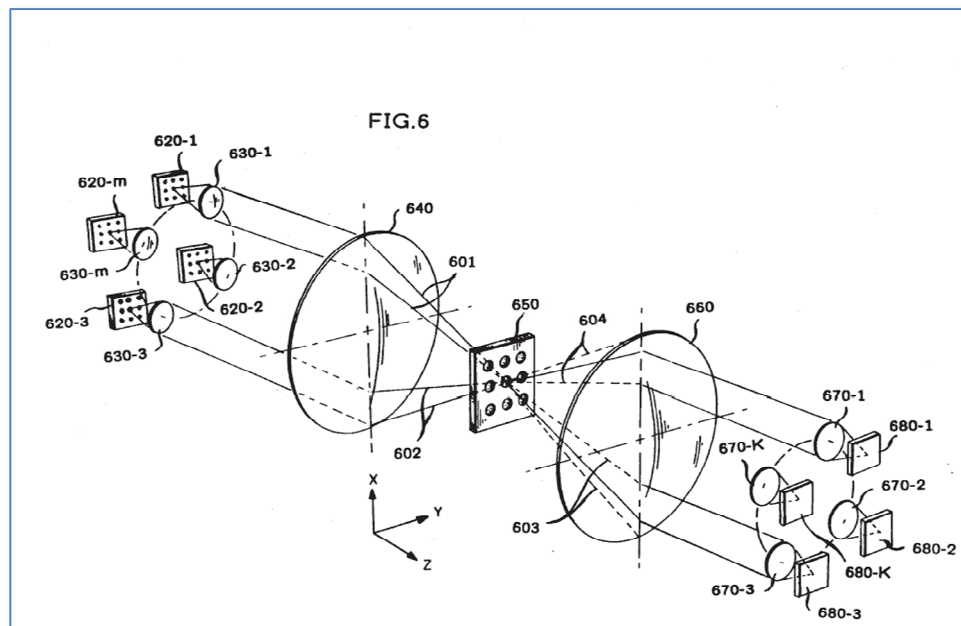
307. Dr. Willner also opines that the “receptacle 260 and ferrule 255” of Lemoff is a “substantially similar structure as used in the '416 Patent.” EX1003, ¶253. It is unclear what Dr. Willner means by this statement. He does not argue it would have been obvious to modify Lemoff to include the integrated pre-aligned connector with a stop. EX1003, ¶253.

308. Dr. Willner concludes that “for all of these reasons, in my opinion, Lemoff alone (Ground 3) and Lemoff and LaMarche (Ground 4) disclose, or would have rendered obvious, Claim Elements [1.0], [1.1], and [1.2],” (EX1003, ¶254) but

in this Section of his opinion he does not address LaMarche, or make any obviousness arguments regarding Lemoff as a standalone §103 reference.

309. Even though Dr. Willner does not address LaMarche with regard to Claim Elements [1.0], [1.1], and [1.2], I note that LaMarche does not disclose an optical combiner as claimed. This is obvious from a review of FIG. 6 of LaMarche. There is no physical integration of the components and no optical combiner.

310. LaMarche discloses a free-space system. *See* EX1005, FIG. 6, 1:5-9, 2:17-22, 4:37-42.



EX1005, FIG. 6.

- b. **Claim 1: [1.3] [an optical combiner...comprising:] a plurality of n collimating lenses, [1.4] said lenses being spaced apart and positioned to receive and collimate the output of said n laser output beams, said n laser output beams have n different output wavelengths**

Ground 3 Lemoff

311. Lemoff does not disclose “a plurality of n collimating lenses.” Lemoff discloses an embodiment including a single lens system. EX1006 at FIG. 2. Dr. Willner’s chart of the claim language color coded and mapped against the disclosures of Lemoff does not show any blue text indicating a plurality of n collimated lenses. EX1003 at pp. 165–66.

312. Dr. Willner argues that Lemoff *suggests* a plurality of collimating lenses, based on a single disclosure in Lemoff at EX1006 6:16-23. EX1003 at ¶¶256-261. I disagree—a POSITA would not have modified Lemoff to include collimating lenses.

313. This passage in Lemoff discloses using a single lens. EX1006 at 6:16-23 (“the invention may use optical imaging elements that include a plano-convex lens, a graded-index (GRIN) lens, a diffractive optical element, a Fresnel lens, another type of lens...”). Each of these lenses are identified in the singular, and none of these lenses that are described as collimating lenses.

314. The second part of this passage states “any arrangement **of one or more optical components** functioning to image the optical signal components from the signal-emitting area onto the signal-receiving area.” *Id.* at 6:19-21. A POSITA would understand that “optical components” can refer to any number of optical components and does not suggest using collimating lenses or “n collimating lenses, said lenses being spaced apart and positioned to receive and collimate the output of said n laser output beams,” as required by claim element [1.3].

315. Lemoff does not enable a POSITA to modify Lemoff to include “an optical combiner comprising...a plurality of n collimating lenses, said lenses being spaced apart and positioned to receive and collimate the output of said n laser output beams.” There is no disclosure that even if collimating lenses were used in some capacity that they would be arranged over each emission aperture in Lemoff. FIG. 3 shows 16 emission apertures that are microns in size. Further, nothing in Lemoff discloses how any such collimated lenses would be integrated into the optical signal emitter or form a subassembly, as required by the claims.

316. Rather than collimating light, Lemoff discloses that the aperture corners 115 of die 110 point toward the center of signal-emitting area 125. EX1006 at 6:61-67 (“in optical signal emitter 300 of FIG. 3, the aperture corners of die 310 and 315 all point toward the center of signal-emitting area 125.”). A POSITA will understand that this causes the signals to point to different parts of the core fiber so the various spots do not overlap with each other. By collimating the light to be multiplexed onto a single spot on the fiber, as the ’416 Patent claims require, this would defeat the intended purpose of Lemoff. Further, Lemoff’s package would need to be larger, which is designing away from being able to utilize in a data communications environment, plus, it is not clear how Lemoff would position and secure such collimating lenses for adequate operation.

317. Further, there is no evidence that adding collimating lenses to Lemoff would lead to an improvement of coupling efficiency, and maximize efficiency. Lemoff discloses a small package and does not require collimating lenses which are typically used for longer distances between optical components to prevent light diverging. If the distance is short, then even if the light diverges, enough light will be caught in a short distance.

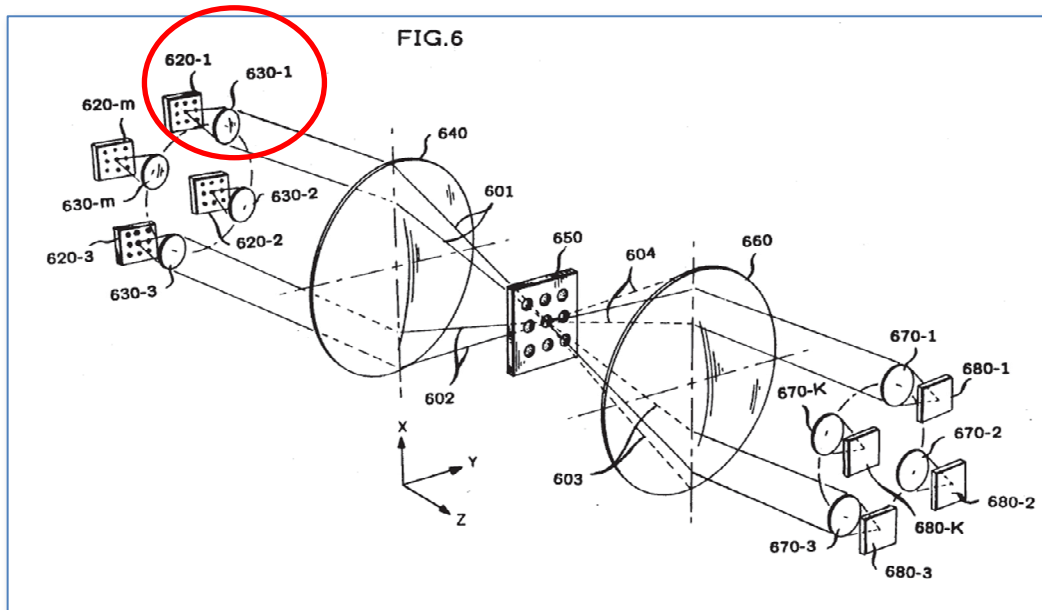
318. Lemoff discloses that no optical imaging element 220 is needed when the signal-emitting area and the signal-receiving area are around the same size. EX1006 at 3:54-65. This is because there is little divergence in Lemoff's system.

319. Dr. Willner's reliance on general principals of optics does not offer a reason why a POSITA would modify Lemoff's design to include collimating lenses corresponding to each emission aperture. Lemoff's design is for a miniaturized low cost assembly package that does not use a WDM combiner. Use of collimating lenses would add size and cost to the design, and it would also involve the design of taking those collimating beams and combining them before the fiber stop. Lemoff teaches against this. Also Lemoff does not teach how to structurally hold and position such collimated lenses irrespective of the optical route from laser to fiber.

Ground 4 Lemoff and LaMarche

320. Dr. Willner contends that it would have been obvious to a POSITA at the time of the invention to modify the optical signal emitter disclosed in Lemoff to include collimating lenses above each of the emission apertures 120 in FIG. 2. EX1002, ¶¶263-264. I disagree that a POSITA would have modified the optical signal emitter disclosed in Lemoff to include 16 collimated lenses because it would not have led to a predictable result. The micro-package disclosed in Lemoff is not combinable with LaMarche. The resulting device would be inoperable. *See* §IX.C.3., ¶¶ 269-275, above.

321. Moreover, LaMarche's radially aligned collimating lenses is not equal to an "n" number of lasers as Dr. Willner contends LaMarche teaches. *See* EX1003, ¶263. Instead, LaMarche discloses one radially aligned collimating lens per *array* of laser emitters in FIG. 6. Thus, LaMarche discloses nine laser emitters per collimating lens. EX1005, 4:43-49, 5:27-38 ("Each of the M N X N arrays of light emitting devices, 620-1 through 620-M, is placed at the focal plane of input probe lenses, 630-1 through 630-M, respectively.")



EX1005, FIG. 6.

322. As discussed above, combining Lemoff and LaMarche would have not led to a predictable result because the resulting device would have been inoperable. *See* §IX.C.3., ¶¶ 269-275, above. Further because the degree of modification necessary to modify Lemoff with collimating lenses from LaMarche would require is significant, the proposed modification. *See* §IX.C.3., ¶¶ 269-280, above.

323. There is no evidence that adding collimating lenses to Lemoff would improve the coupling efficiency, and maximize efficiency. *See* §IX.C.3., ¶¶ 282, 285-291, above.

324. Finally, the combination of Lemoff and LaMarche for Claim Elements [1.3]-[1.4] do not disclose all of the claim elements—neither Lemoff nor LaMarche disclose an optical combiner with integrated collimated lenses. *See* §IX.C.4.a.

- c. **Claim 1: [an optical combiner...comprising:] [1.5] focusing means for focusing said n collimated output beams onto a single spot at said stopped single optical fiber, [1.6] said focusing means having n separate radial sectors on its surface, and each of said n collimated beams passes through a separate one of said n sectors of said focusing means whereby said n output beams having n different wavelengths are coupled into said single fiber**

Ground 3 & Ground 4

325. Petitioner and Dr. Willner rely on Lemoff's optical imaging element 220 as the "focusing means." EX1003, ¶¶265-267. Dr. Willner relies on a "focusing lens and equivalents thereof," as the corresponding structure that performs the claimed function. EX1003, ¶¶265-267. To supply the missing collimating lenses in Lemoff, Dr. Willner argues it would have been obvious to include one for each light emitting aperture 120 as shown in FIG. 1A which contains five emitting apertures 120 that are radially arranged which Dr. Willner claims will result in five radially arranged collimating lenses, which would then in turn teach or suggested Claim Element [1.6]. EX1003, ¶269.

326. In reviewing paragraphs EX1003, ¶¶265-267, there are several flaws in his analysis.

327. Concerning the claimed function, claim 1's claimed function is "focusing said n collimated output beams onto a single spot at said stopped single optical fiber." EX1001, cl. 1. Lemoff does not disclose the exact function in the claim, which I understand must be shown to be considered an equivalent structure for §112 ¶6 claim.

328. First, Lemoff does not disclose "n collimated output beams" because the output beams have not been collimated by collimating lenses, as required by claim limitation's function. Dr. Willner acknowledges that Lemoff does not disclose

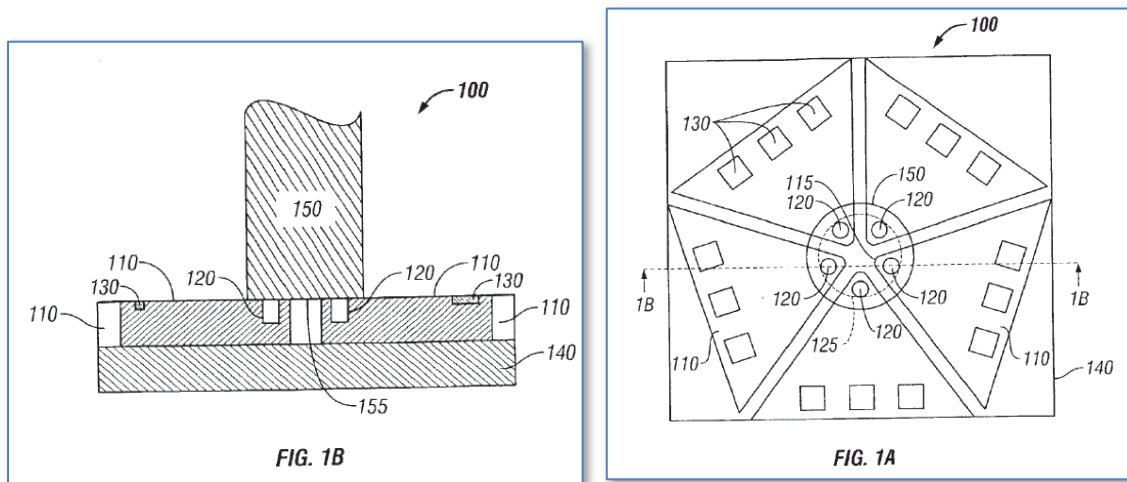
n collimated output beams corresponding to each emitting aperture 120, but argues it would have been obvious to a POSITA to modify Lemoff this way. EX1003, ¶¶268-269.

329. Dr. Willner argues that Lemoff itself suggests including collimating lenses to the optical arrangement shown in FIG. 1A. EX1003 at ¶¶268-269. However, there are several issues with this proposition:

- a. First, FIG. 1A is a different embodiment than shown in FIGS. 2 and 3 which Petitioner and Dr. Willner relied on in Claim Elements [1.3] and [1.4]. *Compare* EX1003 at ¶¶258, 260 with EX1003, ¶¶268-269.
- b. Second, the embodiment shown in FIGS. 1A and 1B does not include an optical imaging element 220 that Petitioner and Dr. Willner point to as an element of the focusing means. The fiber is in the signal-receiving area, which allows for direct butt coupling between the signal-emitting area 125 and the optical conduit (fiber) 150. EX1006 at 3:26-34. Butt coupling is when two structures are immediately adjacent to each other, and physically touching. In FIG. 1B, the fiber 150 is shown flush with the emission apertures. There is no optical imaging element 220 in this embodiment. EX1006 at 3:26-34; FIGS. 1A & 1B. A POSITA would not have incorporated an optical imaging element 220 with collimating lenses into this embodiment because it would have been inoperable—there is no space for the optical imaging element 220 because the fiber is in the signal-emitting area 125. EX1006 at 3:26-34; FIGS. 1A & 1B. Additional components would also result in additional costs and require a more complicated shaping process to shape the die.

Each of the lenses would need to be supported structurally. Because of this a POSITA would not have expected that adding collimating lenses above the emission apertures would result in an improvement—it simply would be inoperable.

- c. Third, Lemoff discourages from using an optical imaging element for this arrangement. The optical conduit in this embodiment is larger than the signal emitting area. EX1006 at 3:26-34. Lemoff discloses that “[r]educing the diameter of the signal-emitting area may advantageously allow the use of an optical fiber with a smaller core diameter, **eliminate [sic] the need for an optical imaging element.**” EX1006 at 3:54-65 (emphasis added). Thus, for this embodiment where the signal-emitting area is smaller than the signal-receiving area, a POSITA would understand that there is no reason to combine Lemoff with an optical imaging element. Thus, a POSITA would not include an optical imaging element 220 to FIG. 1A and 1B.
- d. Fourth, for the reasons stated above, I disagree that it would have been obvious for a POSITA to modify Lemoff in such a way, and Lemoff does not suggest or enable a POSITA to do so. *See* §IX.C.3., ¶¶ 266-268, above.



330. Second, Lemoff does not disclose “focusing...onto a single spot at said stopped single optical fiber.” EX1001, cl. 1. Lemoff does not disclose that the light enters the fiber at a single spot, or that the fiber is a stopped single fiber. FIG. 1B shows laser spots are in different parts of the fiber core. EX1006, FIG. 1B. Lemoff discloses that this arrangement allows for butt coupling, which means the light beams are not combined, but enter the fiber at different locations—the spots shown in FIG. 1A and FIG. 1B at element 120. EX1006, 3:29-33. Butt coupling is when two structures are immediately adjacent to each other, and physically touching.

331. Concerning the corresponding structure, I agree with Patent Owner’s recitation of the corresponding structure that is necessary to perform the claimed function; more structure is necessary than a focusing lens as put forth by Dr. Willner and the Petitioners. Based on the disclosures in the specification of the ’416 Patent, a POSITA would understand that the corresponding structure is “lens integrated into the optical combiner that is in alignment with the collimating lenses and the core of the stopped optical fiber” and equivalent structures. *See* §VII.B., above.

332. Petitioner and Dr. Willner rely on FIGS. 7 and 10 of the '416 Patent as the corresponding structures. *See* EX1003, ¶267; Petition at 44-45. I disagree that Lemoff's optical imaging element 220 corresponds to these structures.

333. The relevant structure for the embodiment shown in FIG. 7 is: EX1001 at FIGS. 7–9 (focusing lens 250), Abstract (“focusing lens housed within a fiber optic connector ferrule”), 3:67-4:2, 4:5-9, 4:10-14, 4:16-19, 4:20-23; cls. 1 & 7, and Embodiment 1. The '416 Patent states that the focusing means in FIG. 7 is “formed on the top surface of the module 216,” which is a single monolithic optical block coupling block.” EX1001 at 4:5-6. Further, “[t]he surface of focusing lens 250 is smooth and includes **four pie-shaped radial quadrants 251–254.**” *Id.* at 4:6-8. In describing FIG. 8, the specification describes the focusing lens as having “**separate pie-shaped quadrants 252 and 254...**” *Id.* at 4:16-19.

334. The relevant structure for the embodiment shown in FIG. 10 is: EX1001, FIGS. 10–11 (focusing lens 350), Abstract (“focusing lens housed within a fiber optic connector ferrule”), 4:36-39, 4:42-46, 4:49-51, cls. 1 & 7; and Embodiment 1. In relation to the fourth embodiment shown in FIG. 10, the '416 Patent states, “The focusing lens 350 is supported in its position shown in FIG. 10 by means known to those skilled in the art which are deleted in the interest of brevity.” EX1001 at 4:42-43.

335. Based on these disclosures, a POSITA would understand that the focusing means must be a lens integrated into the optical combiner that is in alignment with the collimating lenses and the core of the stopped optical fiber to perform the claimed function. Because of the functional requirement that the collimated beams must be focused onto a single spot at said stopped single optical fiber, the distance from the focusing means to the “stop” and the size of the spot on the stopped optical fiber both define the particular optical features of the focusing means. Lemoff's optical imaging element is not aligned with integrated with a pre-

aligned connector, as required by the '416 Patent and does not disclose forming a spot with the optical signals.

336. Further, Lemoff discloses that 16 different channels pass through the optical imaging element 220, which does not form separate radial sectors. EX1006 at 2:24-27, 6:37-42. In FIGS. 1A, there is no optical imaging element, but even if there was, it would have five separate lasers instead of four (as required in FIGS. 7–9), and the lens would not be divided into separate pie-shaped quadrants because the light emitting from the apertures is not collimated. EX1006 at FIG. 1A (emission apertures 120). All laser spots are imaged at the fiber stop in different positions.

337. Lemoff does not disclose a “focusing means having n separate radial sectors on its surface, and each of said n collimated beams passes through a separate one of said n sectors of said focusing means...” EX1001, cl. 1. As explained above, Dr. Willner relies on the optical arrangement in FIGS. 1A and 1B for this limitation, but that arrangement does not include an optical imaging element 220, nor would it have been obvious to add an optical imaging element 220 to this arrangement.

- a. FIGS. 1A and 1B does not include an optical imaging element 220 that Petitioner and Dr. Willner point to as an element of the focusing means. The fiber is in the signal-receiving area, which allows for direct butt coupling between the signal-emitting area 125 and the optical conduit (fiber) 150. EX1006 at 3:26-34. Butt coupling is when two structures are immediately adjacent to each other, and physically touching. In FIG. 2, the fiber 150 is shown flush with the emission apertures. Thus, there is no optical imaging element 220 in this embodiment. EX1006 at 3:26-34; FIGS. 1A & 1B. A POSITA would not have incorporated an optical imaging element 220 with collimating lenses into this embodiment because it would have been inoperable—there is no

space for the optical imaging element 220 because the fiber is in the signal-emitting area 125. EX1006 at 3:26-34; FIGS. 1A & 1B. In FIG. 2, the fiber is shown flush with the emission apertures.

- b. Lemoff discourages using an optical imaging element for this arrangement. The optical conduit in this embodiment is larger than the signal emitting area. EX1006 at 3:26-34. Lemoff discloses that “[r]educing the diameter of the signal-emitting area may advantageously allow the use of an optical fiber with a smaller core diameter, **eliminate [sic] the need for an optical imaging element.**” EX1006 at 3:54-65. Thus, for this embodiment where the signal-emitting area is smaller than the signal-receiving area, a POSITA would have no reason to modify this embodiment in Lemoff to include an optical imaging element. Thus, a POSITA would not include an optical imaging element 220 to FIG. 1A and 1B.
- c. Dr. Willner does not point to any other optical arrangement to establish this Claim Element.

338. To the extent Petitioner or Dr. Willner rely on Lemoff’s disclosures in FIGS. 2 and 3, this optical arrangement does not result in the optical signals passing through separate radial sectors of an optical imaging element 220. The emission apertures form an inner and an outer circle. EX1006 at FIGS. 2 and 3. The light is emitted perpendicular to the surface of the die. The light emitting from the emission aperture is not collimated and light would not enter into separate sectors of the imaging lens. Light as it exists the emission apertures will diverge and become overlapping as it enters into the signal-emitting area. Further, even if the light was collimated, the signals from the inner and outer circles will not form separate radial

sectors on the imaging element 220. EX1006 at FIGS. 2 and 3. Separate radial sectors are pie shaped sectors formed between two radii and the arc of the circle between the two radii. EX2005.

Ground 4

339. For Ground 4, it is unclear what Dr. Willner is relying on for disclosing the identical claimed function and the corresponding structure. *See* EX1003 at ¶¶270-274.

340. At paragraph ¶¶270-271, Dr. Willner opines that it would have been obvious to apply a radial arrangement of collimating lenses disclosed in LaMarche to Lemoff's emission apertures 120 discussed in Ground 3. EX1003, ¶¶270-271. Thus, Dr. Willner seeks to modify Lemoff to include collimating lenses. But because Lemoff does not include collimating lenses it does not disclose the identical function in Claim Element [1.5], which I understand must be shown to be considered an equivalent structure for §112 ¶6 claim.

341. Additionally, the emission apertures 120 discussed in Ground 3 refer to the arrangement in FIGS. 1A and 1B. Lemoff discourages using an imaging element 220 in arrangements such as FIGS. 1A and 1B. As discussed above, there are several issues with this proposition:

- a. First, FIG. 1A is a different embodiment than shown in FIGS. 2 and 3 which Petitioner and Dr. Willner relied on in Claim Elements [1.3] and [1.4]. *Compare* EX1003 at ¶¶258, 260 *with* EX1003, ¶¶268-269.
- b. Second, the embodiment shown in FIGS. 1A and 1B does not include an optical imaging element 220 that Petitioner and Dr. Willner point to as an element of the focusing means. The fiber is in the signal-receiving area, which allows for direct butt coupling between the signal-emitting area 125 and the optical

conduit (fiber) 150. EX1006 at 3:26-34. Butt coupling is when two structures are immediately adjacent to each other, and physically touching. In FIG. 1B, the fiber 150 is shown flush with the emission apertures. There is no optical imaging element 220 in this embodiment. EX1006 at 3:26-34; FIGS. 1A & 1B. A POSITA would not have incorporated an optical imaging element 220 with collimating lenses into this embodiment because it would have been inoperable—there is no space for the optical imaging element 220 because the fiber is in the signal-emitting area 125. EX1006 at 3:26-34; FIGS. 1A & 1B. Additional components would also result in additional costs and require a more complicated shaping process to shape the die. Each of the lenses would need to be supported structurally. Because of this a POSITA would not have expected that adding collimating lenses above the emission apertures would result in an improvement—it simply would be inoperable.

- c. Third, Lemoff discourages from using an optical imaging element for this arrangement. The optical conduit in this embodiment is larger than the signal emitting area. EX1006 at 3:26-34. Lemoff discloses that “[r]educing the diameter of the signal-emitting area may advantageously allow the use of an optical fiber with a smaller core diameter, eliminate [sic] the need for an optical imaging element.” EX1006 at 3:54-65 (emphasis added). Thus, for this embodiment where the signal-emitting area is smaller than the signal-receiving area, a POSITA would understand that there is no reason to combine Lemoff with

an optical imaging element. Thus, a POSITA would not include an optical imaging element 220 to FIG. 1A and 1B.

- d. Fourth, for the reasons stated above, I disagree that it would have been obvious for a POSITA to modify Lemoff in such a way, and Lemoff does not suggest or enable a POSITA to do so. *See* §IX.C.3., ¶¶ 266-268, above.

342. Second, LaMarche's collimating lenses and Lemoff's emission apertures 120 do not disclose a functioning device. LaMarche's collimating lenses are part of a large, free-space system that cannot be combined with Lemoff. *See* §IX.C.3., ¶¶ 269-280, above.

343. LaMarche's collimating lenses would not improve coupling efficiency, reduce physical complexity in Lemoff, or allow high optical integrity connections. *See* §IX.C.3., ¶¶ 282, 285-291, above.

344. At paragraph ¶272, Dr. Willner begins to discuss the pupil lens 640 disclosed in LaMarche. It is unclear if he is relying on the pupil lens 640 as the corresponding structure for performing the function. Dr. Willner does not address the claimed function with regard to LaMarche's pupil lens 640. The pupil lens 640 in LaMarche does not perform the identical function. Pupil lens 640 is not focusing said n collimated output beams onto *a single spot at said stopped single optical fiber*. The light is being focused onto ball lenses, which then broadcasts the signals. EX1005, 6:57-7:7, FIG. 6 ("array 650 increases, i.e., fans out, the divergence angle of each beamlet..."). As seen in FIG. 6, the array of ball lenses is optically aligned with the array of signal emitters 620-1 through 602-M. EX1005 at FIG. 6.

345. At paragraph ¶272, Dr. Willner opines that the pupil lens 640 has a similar structure to that described in the '416 Patent's specification. EX1003, ¶272. He compares LaMarche's pupil lens 640 to FIGS. 7 and 10 of the '416 Patent's specification. I disagree that the pupil lens 640 is the same structure as what is

disclosed in FIGS. 7 and 10 of the '416 Patent, and I disagree that the pupil lens 640 is an equivalent. The pupil lens 640 is not focusing the collimated light into a single spot. As seen in FIG. 6, the array of ball lenses is optically aligned with the array of signal emitters 620-1 through 602-M. EX1005 at FIG. 6. Thus the light emitting from collimating lenses 630-1 through 630-M enter one of the nine ball lenses at lens array 650. EX1005 at FIG. 6. Further, the array of ball lenses is not a fiber.

346. Foremost, the focusing means in the '416 Patent is not a *focusing lens* as Petitioner and Dr. Willner contend. As discussed above, the corresponding structure from the specification is shown in FIGS. 7 and 10 and the corresponding descriptions. *See* §VII.B., above. FIGS. 7 and 10 show a focusing means that is integrated into the optical combiner and form a subassembly and positioned to align the collimated beams to be focused onto a single spot of the stopped fiber.

347. LaMarche's pupil lens 640 is not integrated into an optical combiner. The pupil lens 640 is a discrete, free-floating lens. The pupil lens 640 must be manually aligned to focus the light onto the array of ball lenses. As shown in the '416 Patent FIG. 7, the focusing means is formed on a block and integrated into the optical combiner as part of a complex free space system setup. FIG. 10 also discloses that the focusing lens shown is attached to the housing of the optical combiner so it is held in alignment and capable of performing the claimed function. *Id.*, FIG. 10. Lemoff's pupil lens 640 is also a large lens that is 80 mm diameter and has a focal length of 160 mm. This pupil lens 640 is part of a large optical arrangement that is not equivalent to the focusing means of the '416 Patent, which is a low cost, subassembly with integrated optical components that is miniaturized for ideal implementation into datacom products.

348. At paragraphs ¶¶272 & 273, Dr. Willner switches back to focusing on modifying Lemoff in view of LaMarche to have radial arrangement of collimating lenses for an arbitrary sized lens array. EX1003, ¶¶272-273. Dr. Willner claims that

doing so “may” result in “improved coupling efficiency, reduced physical complexity, as well as having other advantages such as being able to achieve high-bandwidth connections.” EX1003 at ¶272. As discussed above, a POSITA would not expect that LaMarche would improve Lemoff as it would not fit physically due to size mismatch. *See* §IX.C.3, above.

5. Dependent Claim 2: The optical combiner of claim 1 wherein $n=4$ and wherein said four lasers and four collimating lenses are each formed in a two-dimensional, two by two array, wherein said focusing means is a single focusing lens, and wherein each radial sector is a pie-shaped quadrant

349. Because Lemoff and/or LaMarche do not disclose all elements of claim 1 from which claim 2 depends (*see* Ground 3, §IX.C.4.a-c., claim elements [1.0]-[1.6], above) this combination does not disclose claim 2.

350. This claim requires a particular number of collimating lenses and lasers. The claim also makes clear that the collimated lenses are integrated into the optical combiner because the collimating lenses are “formed in a two-dimensional two by two array.” EX1001, cl. 7; *see also* §§VII.A.1 (optical combiner) and IX.C.4.a.

351. Lemoff does not disclose collimating lenses, nor collimating lenses formed in a two-by-two array. A POSITA would not have been motivated to modify Lemoff to include collimating lenses into Lemoff’s optical signal emitter. *See* §§IX.C.1., IX.C.3., and IX.C.4.b, above.

352. Dr. Willner relies on modifying the emission apertures disclosed FIG. 1A from five apertures to four apertures; however, in this arrangement Lemoff discourages using an optical imaging element 220. Thus a POSITA would have no reason to combine any optical imaging element with this Lemoff. *See* §IX.C.3, above.

353. Petitioner further relies on LaMarche for certain aspects of claim 2. LaMarche does not disclose an optical combiner. LaMarche also does not disclose an optical combiner “wherein $n=4$ and wherein said four lasers and four collimating lenses are each formed in a two-dimensional, two by two array.” LaMarche discloses discrete optical elements; the input probe lenses 630-1 through 630-M. Even if $M=4$, the lenses are not formed in an array or integrated into the optical combiner.

354. Further, for the reasons set forth above, a POSITA would not have combined Lemoff and LaMarche. *See* §IX.C.3, above.

355. Even so, combining Lemoff and LaMarche does not satisfy the claimed elements that the collimating lenses are formed in an array, or that they are integrated into an optical combiner that multiplexes multiple laser output beams at different wavelengths. *See* §IX.C.4.a-b., above.

6. Dependent Claim 6: The optical combiner of claim 1 wherein said optical combiner does not require the use of dielectric filters or waveguides

356. Because Lemoff or Lemoff and LaMarche do not satisfy the claim elements of claim 1, these references individually or in combination do not disclose or render obvious claim 6. *See* §IX.C.4.a.-c.

7. Claim 7: Lemoff in view of LaMarche does not disclose Claim 7

357. Petitioner and Dr. Willner rely on Dr. Willner’s opinion from claim 1 and 2 for disclosing claim 7. EX1003, ¶¶282-283 and pp.192-193.

358. Because Lemoff or Lemoff and LaMarche do not satisfy the claim elements of claims 1–2, these references individually or in combination do not disclose or render obvious claim 7. *See* §§IX.C.4.a-c and IX.C.5.

8. Dependent Claim 9: The optical combiner of claim 7 wherein said optical combiner does not require the use of dielectric filters or waveguides

359. Claim 9 is similar to claim 6 only except that it depends from claim 7 instead of claim 1. Because Lemoff or Lemoff and LaMarche does not satisfy claims 1, 6, or 7, these references do not disclose or render obvious claim 9. *See* §§IX.C.4.a-c, IX.C.6, and IX.C.7, above.

D. Ground 5: Bhandarkar Is Not Prior Art

1. The '416 Patent Is Entitled to a Priority Date of July 17, 2003

360. I understand that the provisional application leading to the '416 Patent was filed on February 4, 2004, and the nonprovisional application was filed on January 7, 2005. I understand that during prosecution, applicants established entitlement to a priority date of July 17, 2003, and as a result the Patent Office found that Bhandarkar was not prior art.

361. I understand that Petitioner has argued that the '416 Patent should not be afforded the July 17, 2003, priority date, because (1) conception and diligence in reducing to practice are not sufficiently corroborated; and (2) the provisional application does not provide adequate written description or enablement for some of the claims.

362. I also understand that Dr. Willner has not provided an opinion regarding whether the provisional application satisfies the written description or enablement requirements of §112.

a. Conception and Diligent Reduction to Practice

363. During prosecution, I understand that the Examiner considered whether the inventor laboratory notebooks established conception. I am informed that when the Examiner initially found that the notebooks did not disclose the claim element

of different wavelengths, the applicant submitted documentary evidence that “ $\lambda_1, \lambda_2, \lambda_3, \lambda_4$ ” in the lab notebooks disclosed different wavelengths, which was confirmed by the inventor. The documentary evidence was a published patent referring to different wavelengths using the notation “ $\lambda_1, \lambda_2, \lambda_3, \lambda_4$ ”. EX2018.

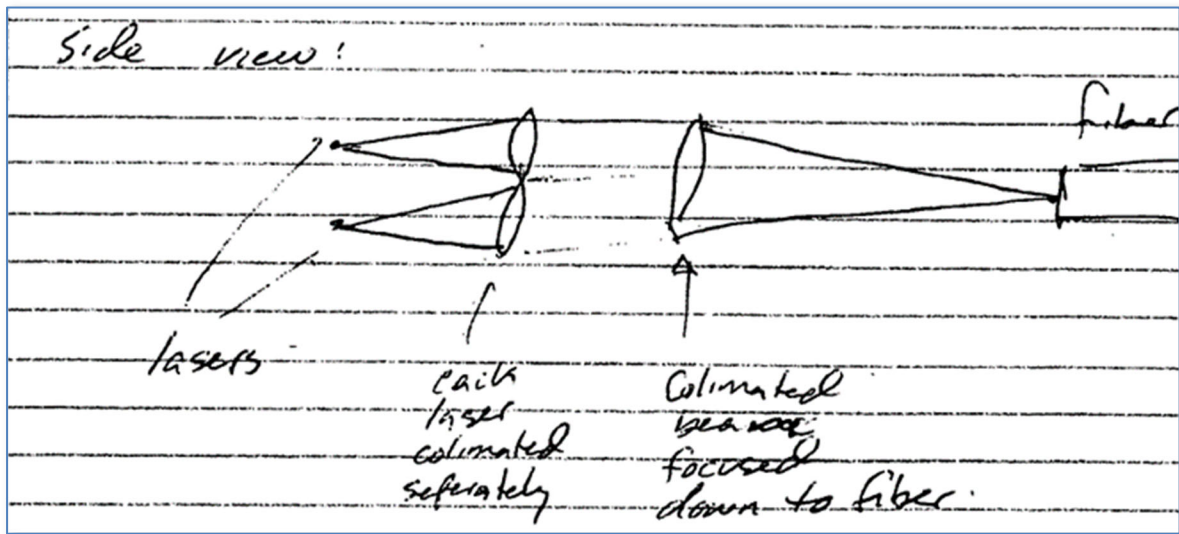
364. A POSITA would understand that this is a typical notation for different wavelengths. This same notation is used in Kurita to denote laser beams with different wavelengths. EX1004, FIGS. 2–5.

365. Additionally, I have reviewed the laboratory notebooks submitted during prosecution that proved conception as of July 17, 2003, and agree that the laboratory notebooks disclose each and every claim limitation of the Challenged Claims, as summarized below.

1. An optical combiner usable in data communication systems for multiplexing the outputs of a plurality of n lasers wherein each of said n outputs has a different output wavelength, for transmission into and through a stopped single optical fiber, comprising:

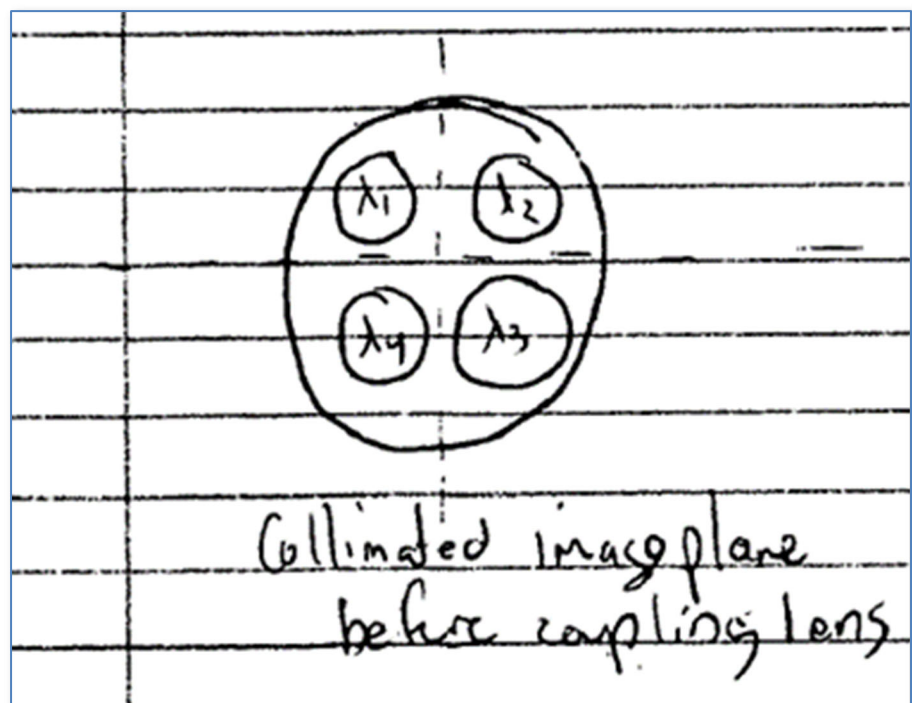
7/17
Concept to make a new mux
without requiring filters. May be
useful to avoid inner core and
provide offset launch.

EX1002, p.79

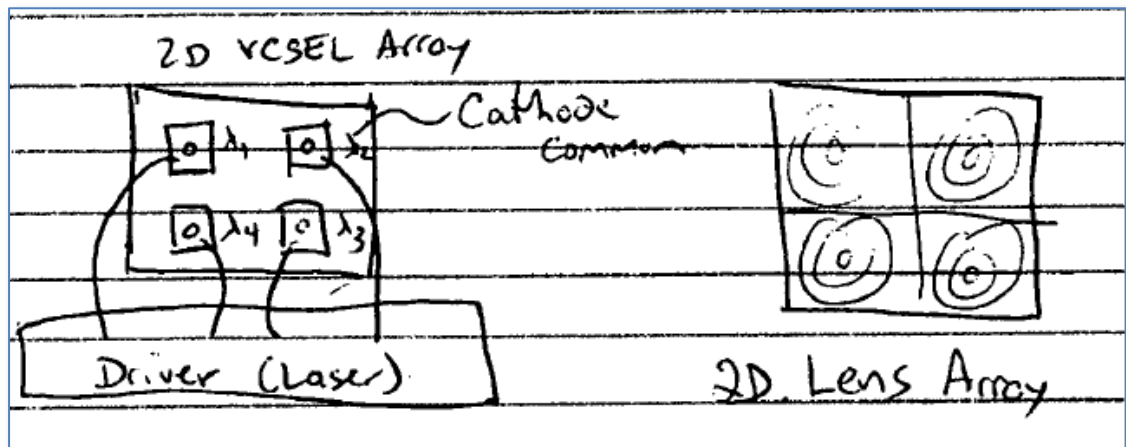


EX1002, p.79

a plurality of n collimating lenses, said lenses being spaced apart and positioned to receive and collimate the output of said n laser output beams, said n laser output beams have n different output wavelengths, and

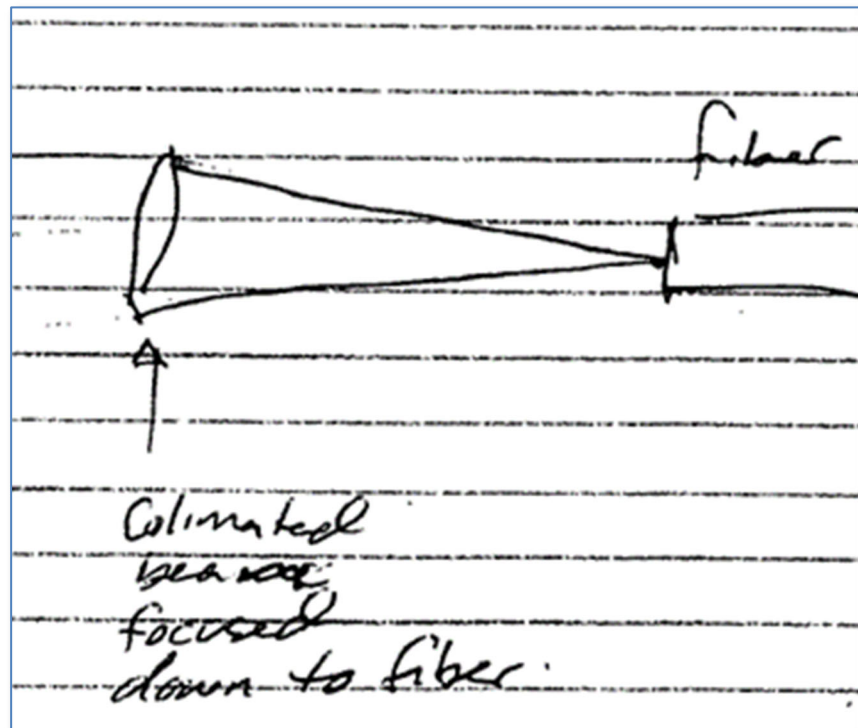


EX1002, p.126

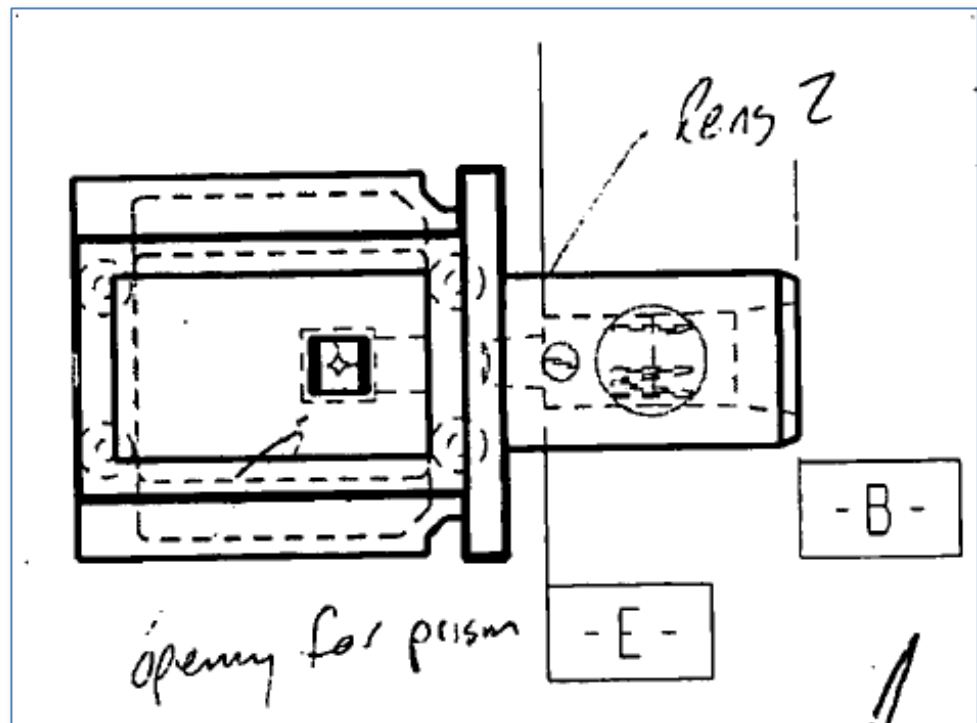


EX1002, p.126

focusing means for focusing said n collimated output beams onto a single spot at said stopped single optical fiber, said focusing means having n separate radial sectors on its surface, and each of said n collimated beams passes through a separate one of said n sectors of said focusing means whereby said n output beams having n different wavelengths are coupled into said single fiber.

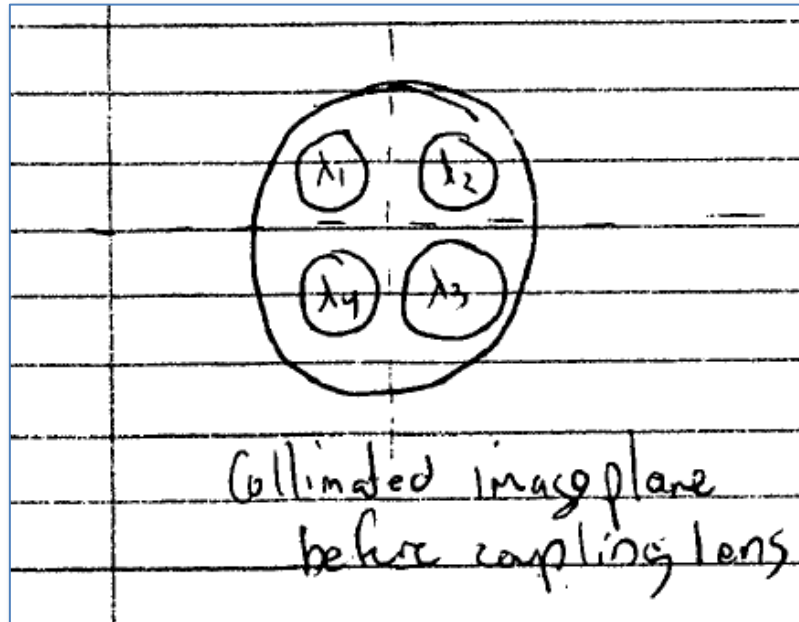


EX1002, p.79

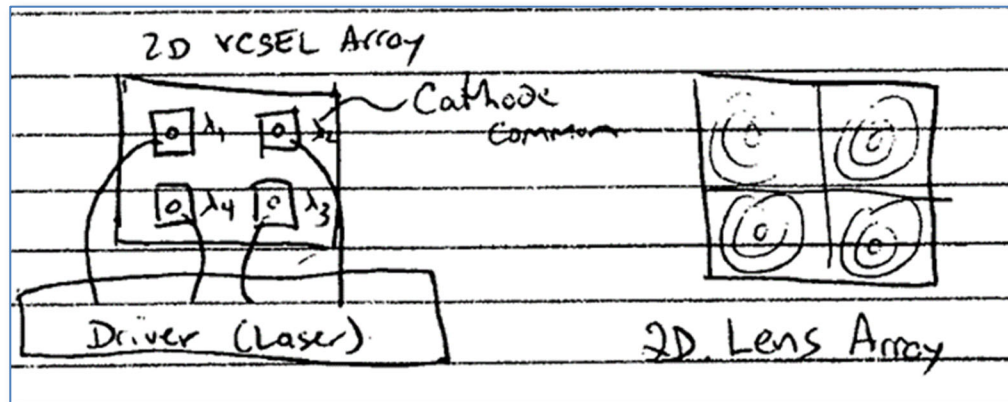


EX1002, p.80

2. The optical combiner of claim 1 wherein $n=4$ and wherein said four lasers and four collimating lenses are each formed in a two-dimensional, two by two array, wherein said focusing means is a single focusing lens, and wherein each radial sector is a pie-shaped quadrant.



EX1002, p.126



EX1002, p.126

Claim [7]

See claims 1 and 2, above.

6. The optical combiner of claim 1 wherein said optical combiner does not require the use of dielectric filters or waveguides.

9. The optical combiner of claim 7 wherein said optical combiner does not require the use of dielectric filters or waveguides.

See, generally, EX1002 at pp. 36, 38, 49, 77–82, 123–128, laboratory notebooks that do not show the use of dielectric filters or waveguides for multiplexing.

b. The '416 Provisional Application Provides Adequate Written Description and Enables the Full Scope the Invention

366. I understand that the Petitioner has argued that the '416 Patent should not be afforded a priority date based on the filing date of the underlying provisional application because: (i) the provisional application does not meet the written description requirement for not mentioning “radial sectors” or the requirement that each of the n collimated beams passes through a “separate radial sector”; and (ii) because the provisional application only discloses a device with four lasers and collimating lenses, it does not enable the full scope of “ n ” lasers and collimating lenses.

367. I understand that Dr. Willner has not provided any opinion in support of Petitioner’s arguments.

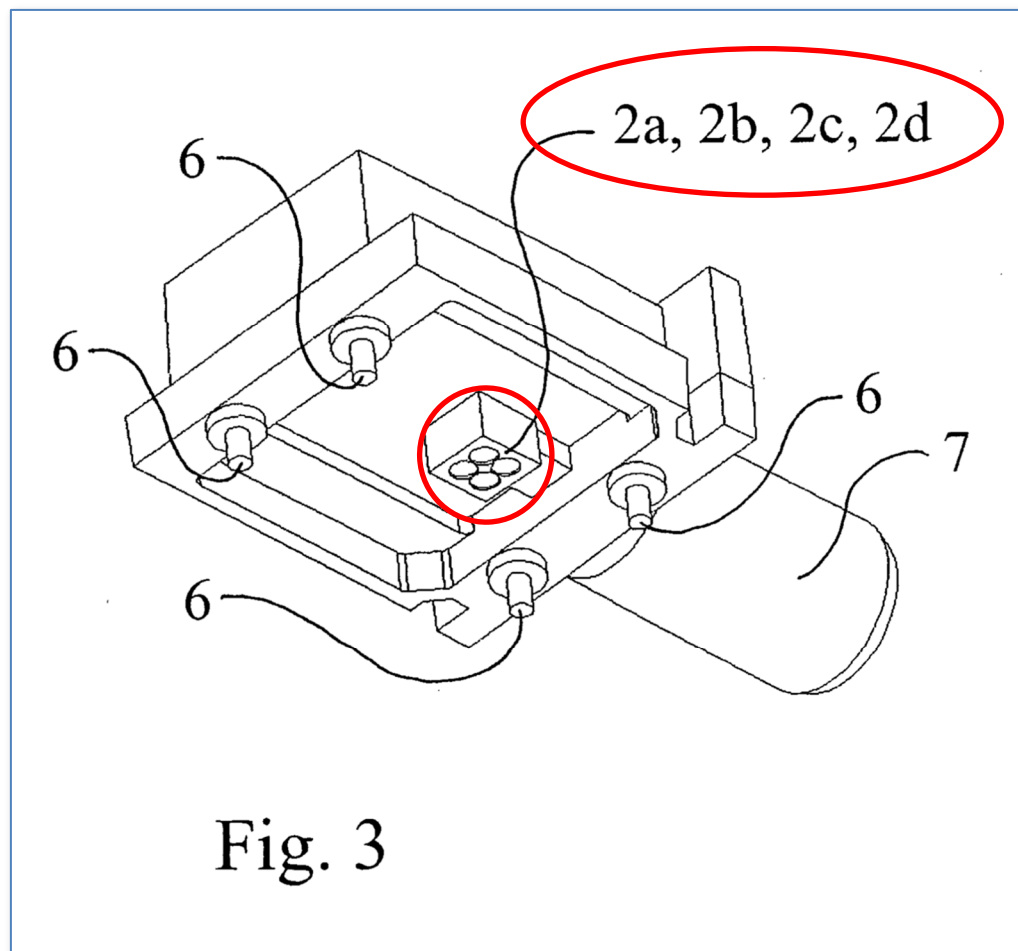
i. The Challenged Claims Are Supported by Written Description in the Provisional Application

368. In my opinion the '416 Patent’s provisional application provides adequate written description for a focusing means having “separate radial sectors on its surface” and the collimated beams passing “through a separate one of said n sectors.” *See* EX1009.

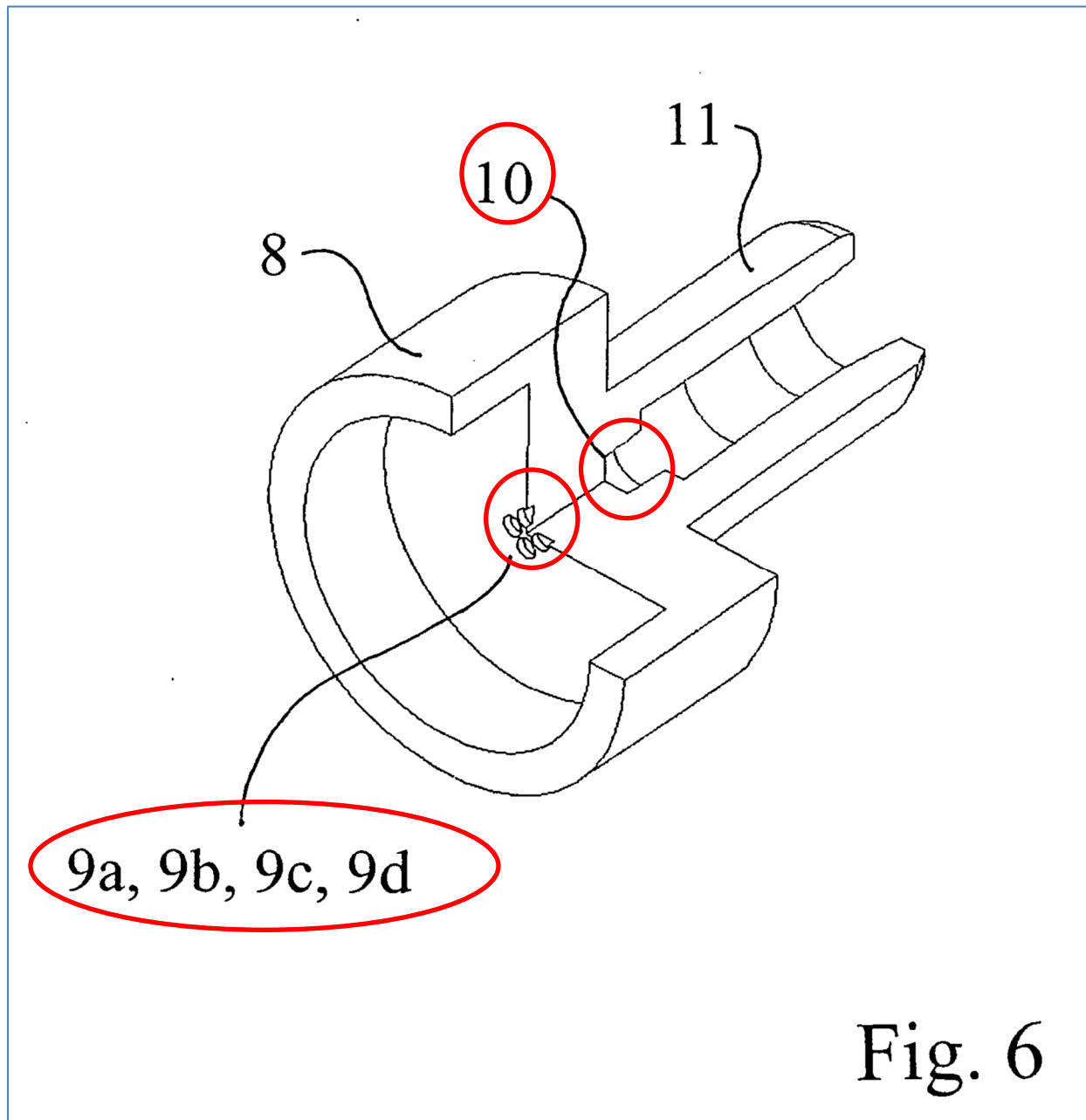
369. The the '416 Patent’s provisional application states that the invention comprises of an optical combiner that consists of “one lens for focusing several *geometrically placed* collimated beams onto the fiber and one or more lenses for collimating light from lasers or fibers and a means for *geometrically arranging* the

plurality of collimated beams for maximum coupling efficiency into the fiber.”
EX1009 at 2 (emphasis added).

370. The provisional application discloses that one such embodiment utilizes
“a two-dimensional array of lenses 9a, 9b, 9c, 9d for collimating the input light
signals...” EX1009 at 3 (e.g., “arranging four (in this embodiment) collimating
lenses 2a, 2b, 2c, 2d”), followed by the focusing lens 10. This is shown in several of
the figures of the provisional application, including FIGS. 3 and 6, shown below:



EX1009, FIG. 3.

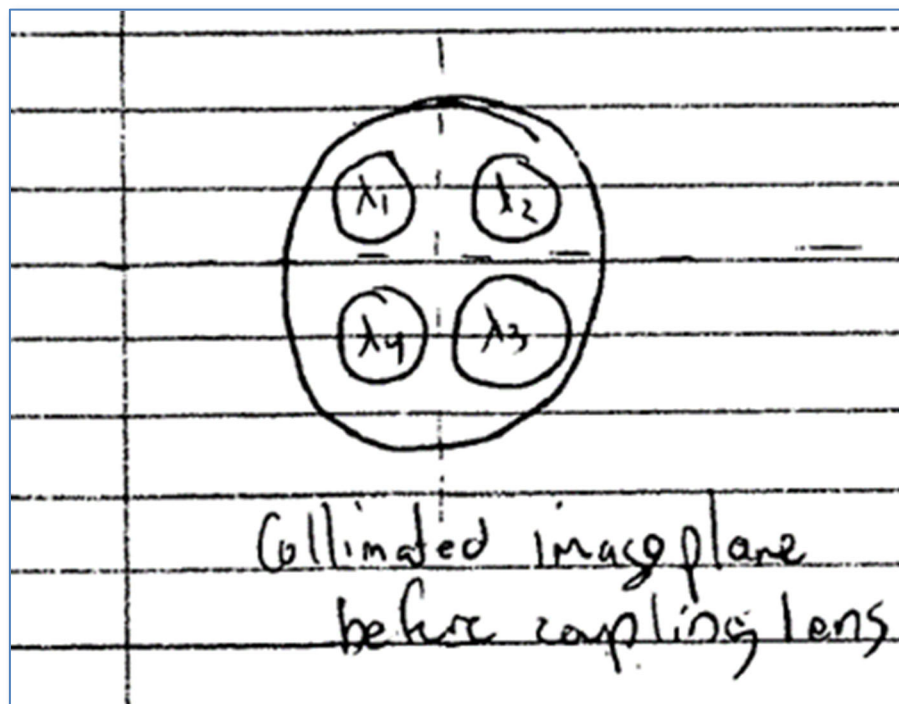


EX1009, FIG. 6

371. FIG. 6 (and FIG. 5) of the provisional application show a cylindrical-like ferrule that supports radial positioning. Additionally, a POSITA would understand that radial positioning as supported in FIG. 6 is a geometrical arrangement.

372. Based on the figures and corresponding descriptions, a POSITA would recognize that the outputs of the two-dimensional array of collimating lenses will intersect with the integrated focusing means (such as focusing lens 10 in FIG. 6) in four pie-shaped segments, or radial rectorors.

373. While not necessary to my opinion that the provisional application clearly allows persons of ordinary skill in the art to recognize that the inventors invented what is claimed, the illustrations in the inventor's notebooks that were submitted during prosecution provide further confirmation that the inventors were in possession of "radial sectors" of the focusing means because the drawing below shows radial alignment. *See, e.g., EX1002, p.126, shown below:*



374. In my opinion the inventors clearly had possession of the claimed invention at the time of the provisional application, and that is reflected in the provisional application itself.

ii. The Challenged Claim Are Enabled by the Provisional Application

375. I understand that Petitioner has argued that the Challenged Claims of '416 Patent are unpatentable for lack of enablement in the provisional application, because the provisional discloses four lasers and collimating lenses, but does not expressly generalize to n . Petition at 56–57.

376. Specifically, I understand that Petitioner contends that even if the provisional application provides support for the “separate radial sector limitation,” that a POSITA would not be capable of understanding n radial sectors based on the disclosures. Petition at 56–57.

377. I disagree with Petitioner’s argument. The '416 Patent fully enables using collimating lenses in a radial alignment. A POSITA would understand that n collimating beams, when geometrically arranged in a circle, such as the 2x2 arrangement of collimated lenses, would also result in in pie-shaped segments, or radial rectors, on the integrated focusing means. How many radial sectors simply depends on the number of collimated lenses placed radially around the center axis.

378. I understand that Dr. Willner has not offered an opinion on whether a POSITA would be able to practice the claimed invention without undue experimentation. Elsewhere in Dr. Willner’s opinion he does opine that a POSITA would recognize a four lens radial arrangement can be extrapolated to n lenses based on what was known in the art at the time of the invention. EX1003, ¶221 (“LaMarche teaches this radial arrangement for an arbitrary number of M input probe lenses 630-1 thorough 630- M ”), 227, 271. Specifically, LaMarche illustrates four lenses in such an arrangement: 630-1, 630-2, 630-3, and 630- M . EX1005, FIG. 6.

379. A POSITA would understand that there is an upper limit to “ n ” number of radial sectors based on the physical size limitations of arranging collimating

lenses in radial alignment relative to the size of the focusing means and the integrated optical combiner.

380. While Petitioner has not challenged any other claims based on written description, I have compared the provisional with the Challenged Claims, showing that the limitations are supported by written description from the provisional application.

381. In my opinion, the provisional application provides adequate written description for the Challenged Claims, as further outlined in the chart below.

Claims of the '416 Patent (EX1001)	Provisional application (EX1009)
1. An optical combiner usable in data communication systems for multiplexing the outputs of a plurality of n lasers wherein each of said n outputs has a different output wavelength, for transmission into and through a stopped single optical fiber, comprising:	FIGS. 1–6; [Abstract]. “The combiner/WDM device described herein utilizes plastic-mold injection to create a compact device capable of combining multiple optical signals into a single 7optical fiber. While a single molded device can be constructed to create the present invention, two or more parts can be combined to accomplish the same function, and may be necessary to achieve certain environmental conditions.”EX1009 at 1:5-9; <i>see also id.</i> at 1:13-16, 2:9-13, 2:19-26, 3:10-11:5
a plurality of n collimating lenses, said lenses being spaced apart and positioned to receive and collimate the output of said n laser output beams, said n laser output beams have n different output wavelengths, and	FIGS. 1–6; [Abstract]. “The combiner 1 in this embodiment shows four input collimating lenses 2a, 2b, 2c, 2d and output focusing lens 3.”

	EX1009 at 1::11-12; <i>see also id.</i> at 3:21-24, 4:2-5
focusing means for focusing said n collimated output beams onto a single spot at said stopped single optical fiber, said focusing means having n separate radial sectors on its surface, and each of said n collimated beams passes through a separate one of said n sectors of said focusing means whereby said n output beams having n different wavelengths are coupled into said single fiber.	“Light sources are located at the focal points of the four input lenses and the light is collimated, reflected off a prism 4 and focused by the focusing lens 3 onto a spot at which a fiber is stopped 5.” EX1009 at 3:12-14 ; <i>see also id.</i> at 2:18-22 (“one lens for focusing several geometrically placed collimated beams onto the fiber...and a means for geometrically arranging the plurality of collimating beams...”) ; <i>see also id.</i> at 3:18-21, 4:14-16.
2. The optical combiner of claim 1 wherein n=4 and wherein said four lasers and four collimating lenses are each formed in a two-dimensional, two by two array, wherein said focusing means is a single focusing lens, and wherein each radial sector is a pie-shaped quadrant.	<i>See</i> claim 1, above. FIGS. 1–6; EX1009 at 4:2-5.
6. The optical combiner of claim 1 wherein said optical combiner does not require the use of dielectric filters or waveguides.	<i>See</i> claim 1, above. <i>See</i> EX1009, generally, <i>see also id.</i> at 1:3-9, 4:13.
7. An optical combiner usable in data communication systems for multiplexing the outputs of a plurality of lasers wherein each of said outputs has a different wavelength, for transmission into and through a stopped single optical fiber, comprising: an array of four lasers, formed in a two-dimensional, two by two array,	<i>See</i> claim 1 and claim 2, above.

each of said lasers having an output beam with a different wavelength, an array of four collimating lenses, said lenses being formed in a two-dimensional, two by two array and positioned to receive and collimate the output of said laser output beams, and focusing means for focusing said collimated output beams onto a single spot at said stopped single optical fiber, said focusing means having four separate quadrants on its surface, and each of said four collimated beams passes through a separate one of said quadrants of said focusing means whereby said output beams of said four lasers are coupled into said single fiber.	
9. The optical combiner of claim 7 wherein said optical combiner does not require the use of dielectric filters or waveguides.	<i>See claim 1 and claim 2 and claim 6, above.</i>

X. REVISION OR SUPPLEMENTATION

382. In this report, I have presented my opinions regarding the invalidity of the claims of the '416 Patent based on the information available to me. My opinions are subject to change in view of opinions provided by the Patent Owner or its expert, or any additional information that I may receive. I reserve the right to supplement my opinions accordingly.

I hereby declare that all statements made herein of my own knowledge are true and that all opinions expressed herein are my own; and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date: November 13, 2023



Michael Lebby, Ph.D.

APPENDIX

A

Michael Lebby



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 the 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 Fellow 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.

Michael Lebby Curriculum Vitae (CV)

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 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 its 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 150 patent litigation cases as a technical expert witness, including over 20 trials and over 60 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.

Starting in January 2024, Dr. Lebby has been voted to become chairman of Optica's Corporate Engagement Council and become a member of the Optica Board of Directors. Dr. Lebby is currently a member of Optica's Corporate Engagement Council which represents the global photonics industry.

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

Michael Lebby Curriculum Vitae (CV)

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 (as per search engine) 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 30 years 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:

2003 – Present **GenusTechnik Inc., CEO and CTO (part-time consulting)**

GenusTechnik Inc. (previously 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. GenusTechnik Inc. 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**

Michael Lebby Curriculum Vitae (CV)

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 (after acquisition by Bookham in 2003), 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 (renamed from AMP, then Tyco Electronics), Director Technology & Business Development (Fiber Optics)**

Michael Lebby Curriculum Vitae (CV)

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)

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 and voted to become Chairman in 2024 that is represented on Optica's Board of Directors.
- 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** (www.linkedin.com/in/lebbby)
- **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.). See at www.linkedin.com/in/lebbby

- 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).
- **Entrepreneur** 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/VCSLs, 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)

Michael Lebby Curriculum Vitae (CV)

- 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 trial 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

Michael Lebby Curriculum Vitae (CV)

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 – Proskauer 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).

Michael Lebby Curriculum Vitae (CV)

- 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 Irradion 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; *Optolom 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 Willis 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 Willis 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 Willis 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 Willis 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 Willis 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 Willis 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 Willis 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)

Michael Lebby Curriculum Vitae (CV)

- 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., Ottomotto 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) – Proskauer 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).

Michael Lebby Curriculum Vitae (CV)

- 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).

Michael Lebby Curriculum Vitae (CV)

- 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)

Michael Lebby Curriculum Vitae (CV)

- 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)

Michael Lebby Curriculum Vitae (CV)

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)

Michael Lebby Curriculum Vitae (CV)

- 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.

Michael Lebby Curriculum Vitae (CV)

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 Winthrop 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; *Collect 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 Collect 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; *Collect 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 Collect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
 - a. Deposition: 0 (Cumulative total: 36)

Michael Lebby Curriculum Vitae (CV)

- 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 Cassidy 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

Michael Lebby Curriculum Vitae (CV)

- 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)

Michael Lebby Curriculum Vitae (CV)

- 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 Emanuel 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)

Michael Lebby Curriculum Vitae (CV)

- 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: 2 (Cumulative total: 54)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 2 (Cumulative total: 12)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, chip-on-board, heat sinks, GaN, InGa_N, AlGa_N (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: 55)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 13)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, chip-on-board, heat sinks, GaN, InGa_N, AlGa_N (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: 55)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 13)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, chip-on-board, heat sinks, GaN, InGa_N, AlGa_N (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: 55)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 13)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGa_N, AlGa_N (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LED cladding 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: 57)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 2 (Cumulative total: 15)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGa_N, AlGa_N (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: 57)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)

Michael Lebby Curriculum Vitae (CV)

- d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaIn (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: 57)
 - 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, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaIn (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: 57)
 - 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, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaIn (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: 58)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 16)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaIn (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: 58)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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: 58)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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: 59)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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: 59)

Michael Lebby Curriculum Vitae (CV)

- b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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: 59)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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: 59)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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: 3Q2022 – 2Q2023; *Canon, Inc., and Canon USA Inc v. WSOU Investments, LLC d/b/a Brazos Licensing and Development.*, Declaration for IPR (IPR2022-01532) for US patent #7,493,030 as petitioner, (retained by Canon Inc) – retained by Orrick LLP
- a. Deposition: 0 (Cumulative total: 59)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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: 3Q2022 – 2Q2023; *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: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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.
140. Active case work: 3Q2022 – Present; *Fujifilm Sonosite., v. Butterfly Network, Inc.*, 1-22-CV-00309 (D. De) Filed 29th Mar 2022), (retained by defendant Butterfly Network, Inc.,) – retained by defendant Akin Gump LLP
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Ultra-sonic equipment that includes displays, especially OLED displays. The electronic circuits and how displays are electronically controlled.
141. Active case work: 3Q2022 – 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: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: LED surface mount packaging, LED GaN/InGaN chips, and associated LED lighting performance specifications.
142. Active case work: 2Q2022 – 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: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: LED surface mount packaging, LED GaN/InGaN chips, and associated LED lighting performance specifications. LED Luminaires.

Michael Lebby Curriculum Vitae (CV)

143. Active case work: 3Q2022 – 4Q2022; *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: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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: 4Q2022 – 2Q2023; *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: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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: 4Q2022 – 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: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: acoustic wave filters, BAW filters (bulk-acoustic-wave) filters for RF applications, devices, fabrication, and characterization
146. Active case work: 4Q2022 – 3Q2023; *LG Electronics Inc., v. TCL Electronics Holdings Ltd. (f/k/a TCL & Multimedia Technology Holdings, Ltd.); & TCL Industries Holdings Co., Ltd.; TCL & Industries Holdings (H.K.) Limited; TTE & Technology, Inc. (d/b/a TCL North & America); TTE Corporation; TCL Moka & International Limited; TCL Moka & Manufacturing S.A. de C.V.; TCL King & Electrical Appliances (Huizhou) Co. Ltd.; & Manufacturas Avanzadas S.A. de C.V.; & TCL Smart Device (Vietnam) Co., Ltd.; & Shenzhen TCL New Technology Co., Ltd.; & TCL Optoelectronics Technology (Huizhou) & Co., Ltd.; TCL Overseas Marketing Ltd.; & and TCL Technology Group Corporation & (f/k/a TCL Corp.), TCL Electronics Holdings Ltd et al.*, 2-22-CV-0122-JRG (W.D. Tx.) Filed 14th Oct 2022), (retained by plaintiff LGE) – retained by plaintiff counsel Baker Botts LLP
 - a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: BLU and backlighting of displays, especially LCD displays. Optical waveguide, reflecting, and transmission technology, optical sheet materials, optical shapes all utilizing LEDs in various optical package designs.
147. Active case work: 1Q2023 – 1Q2023; *NextGen Innovations, LLC v. Nokia of America Corporation et al.*, 2-22-CV-00309-JRG-RSP (E.D. Tex.), (filed: 9th Aug 2022), retained by plaintiff NextGen Innovations LLC., - retained by plaintiff counsel Russ August and Kabat LLP.
 - a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Optical network systems, transceiver modules, passive optical networks, transceiver electronic and optoelectronic components and ICs.
148. Active case work: 1Q2023 – 1Q2023; *NextGen Innovations, LLC v. Infinera et al.*, 2-22-CV-00306-JRG-RSP (E.D. Tex.), (filed: 9th Aug 2022), retained by plaintiff NextGen Innovations LLC., - retained by plaintiff counsel Russ August and Kabat LLP.
 - e. Deposition: 0 (Cumulative total: 60)
 - f. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - g. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - h. Technology: Optical network systems, transceiver modules, passive optical networks, transceiver electronic and optoelectronic components and ICs.
149. Active case work: 3Q2023 – Present; *Ikea North America Services LLC., Ikea US Retail LLC., v. Everlight Electronics et al.*, 2-23-CV-00126-ADA (E.D. Tx.) Filed 27th Mar 2023), (retained by defendant Ikea US Retail LLC et al.) – retained by defendant counsel Flaster Greenberg LLP
 - a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: LED surface mount packaging, LED GaN/InGaN chips, and associated LED lighting performance specifications.
150. Active case work: 1Q2023 – Present; *Jiaxing Super Lighting Electric Appliance Co., LTD and Obert Inc. v. Current Lighting Solutions, LLC d/b/a GE Current.*, 6-22-CV-00534-ADA (W.D. Tx.) Filed 16th Sep 2022), (retained by defendant GE Current) – retained by defendant counsel Norton Rose Fulbright US LLP.
 - a. Deposition: 0 (Cumulative total: 60)

Michael Lebby Curriculum Vitae (CV)

- b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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.
151. Active case work: 1Q2023 – 2Q2023; *Jiaxing Super Lighting Electric Appliance Co., LTD and Obert Inc. v. Current Lighting Solutions, LLC d/b/a GE Current.*, Declaration for IPR petition (IPR2023-00272) for US patent #10,830,397 as petitioner, (retained by Current Lighting) – retained by counsel Norton Rose Fulbright US LLP.
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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.
152. Active case work: 1Q2023 – 2Q2023; *Jiaxing Super Lighting Electric Appliance Co., LTD and Obert Inc. v. Current Lighting Solutions, LLC d/b/a GE Current.*, Declaration for IPR petition (IPR2023-00984) for US patent #9,841,174 as petitioner, (retained by Current Lighting) – retained by counsel Norton Rose Fulbright US LLP.
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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.
153. Active case work: 1Q2023 – 2Q2023; *Jiaxing Super Lighting Electric Appliance Co., LTD and Obert Inc. v. Current Lighting Solutions, LLC d/b/a GE Current.*, Declaration for IPR petition (IPR2023-00983) for US patent #10,487,991 as petitioner, (retained by Current Lighting) – retained by counsel Norton Rose Fulbright US LLP.
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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.
154. Active case work: 1Q2023 – 2Q2023; *Jiaxing Super Lighting Electric Appliance Co., LTD and Obert Inc. v. Current Lighting Solutions, LLC d/b/a GE Current.*, Declaration for IPR petition (IPR2023-00676) for US patent #9,939,140 as petitioner, (retained by Current Lighting) – retained by counsel Norton Rose Fulbright US LLP.
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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.
155. Active case work: 1Q2023 – Present; *US Conec. Ltd. v. Senko Advanced Components Inc.*, 1-23-CV-00083-UNA (D. De). Filed 24th Jan 2023), (retained by defendant US Conec Ltd.) – retained by defendant counsel Troutman Pepper Hamilton Sanders LLP.
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Fiber optic adapters, fiber optic connectors (simplex, duplex, quad, multi-fiber), fiber trays, racks, and fiber cabinet equipment. Single mode and multimode connector design, and fiber optic connector standards.
156. Active case work: 1Q2023 – 2Q2023; *US Conec. Ltd. v. Senko Advanced Components Inc.*, Declaration for IPR petition (IPR2023-00XXX) for US patent #11,307,369 as petitioner (retained by defendant US Conec Ltd.) – retained by defendant counsel Alston and Bird LLP (pending).
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Fiber optic adapters, fiber optic connectors (simplex, duplex, quad, multi-fiber), fiber trays, racks, and fiber cabinet equipment. Single mode and multimode connector design, and fiber optic connector standards.
157. Active case work: 1Q2023 – 2Q2023; *Inneos LLC., v. Opticis Co., Ltd.*, 8-23-CV-00185-JWH-ADS (C.D. Ca). Filed 30th Jan 2023), (retained by plaintiff GE Current) – retained by plaintiff counsel Womble Bond Dickinson (US) LLP.
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)

Michael Lebby Curriculum Vitae (CV)

- c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: VCSEL transceiver WDM (wavelength division multiplexing) modules, package design, optics, freeform, diffractive, refractive, and optical filters. Multimode fiber optics designs.
158. Active case work: 1Q2023 – 1Q2023; *Viavi Solutions Inc., v Zhejiang Crystal-Optech Co. Ltd.*, 2-21-CV-0378-JRG (E.D. Tx) (filed: 3rd Aug 2022), retained by complainant Viavi Solutions Inc., – retained by counsel Venable, LLP.
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - 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.
159. Active case work (pending): 1Q2023 – 2Q2023; *Signify North America Corporation and Signify Holding BV., v Satco Products Inc.*, 2-19-CV-06125-JMA-SIL (E.D. NY) (filed: 30th Oct 2022), retained by defendant Satco Products Inc., – retained by defendant counsel Pillsbury Winthrop Shaw Pittman, LLP
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: LED backlights, optical techniques for light distribution. Display panels, and LED packaging.
160. Active case work: 1Q2023 – 1Q2023; *Becton Dickinson and Company v. Beckman Coulter Inc.*, 1-21-CV-00833-CLC-JFH (D. De), (filed: 3rd Jan 2023), retained by plaintiff Becton Dickinson and Company, - retained by plaintiff counsel Quinn Emanuel Urquhart & Sullivan, LLP.
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Optical filters, sensors, micro-fluidics, lasers, optical test and measurement. Optical instrumentation for fluorescence analysis, characterization of fluorescent material.
161. Active case work: 2Q2023 – 2Q2023; *138 East LCD Advancements Limited v. Chongqing HKC Optoelectronics Technology Ltd.*, Declaration for IPR patent owner response (IPR2023-00476) for US patent #7,335,913 as patent owner, (retained by 138 East LCD Advancements Ltd.) – retained by counsel Robins Kaplan LLP
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: LCD display layouts, designs for optical and electronic fabrication, design, IC (drivers, electrical wiring, electrodes), and packaging.
162. Active case work: 2Q2023 – 2Q2023; *138 East LCD Advancements Limited v. Chongqing HKC Optoelectronics Technology Ltd.*, Declaration for IPR patent owner response (IPR2023-00475) for US patent #7,116,390 as patent owner, (retained by 138 East LCD Advancements Ltd.) – retained by counsel Robins Kaplan LLP
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: LCD display layouts, designs for optical and electronic fabrication, design, IC (drivers, electrical wiring, electrodes), and packaging.
163. Active case work: 2Q2023 – 3Q2023; *Samsung Display Company Limited v. Mianyang BOE Optoelectronics Technology Co., Ltd.*, ITC 337-TA-1351 (filed: 27th Jan 2023), “Certain Active Matrix Organic Light-Emitting Diode Display Panels And Modules For Mobile Devices, And Components Thereof”, (retained by plaintiff Samsung Display Company Ltd.) – retained by counsel Covington and Burling LLP.
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Active matrix OLED display panels and modules for mobile products and devices.
164. Active case work: 2Q2023 – Present; *Hesai Group, Hesai Technology Co., Ltd. and Hesai Inc. v. Ouster*, ITC 337-TA-1363 (filed: 11th May 2023), “Certain LiDAR (Light Detection And Ranging) Systems And Components Thereof”, (retained by respondent Hesai et al.) – retained by counsel Quinn Emanuel Urquhart & Sullivan, LLP.
- a. Deposition: 1 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Optical and electrical device, optics, and package designs for LIDAR based self-driving vehicles. Rotating LIDAR unit, magnetic rotor/stator design, electronic pcbs, bulk, micro-optics, and optical and electronic system design.

ISSUED utility PATENTS and PUBLISHED PATENT APPLICATIONS ISSUED:

Current combined total = 335

1	US-11614670-B2	Preview	PDF	Electro-optic polymer devices having high performance claddings, and methods of preparing the same	Yi; Youngwoo et al.	2023-03-28	21
2	US-11520175-B2	Preview	PDF	Active region-less modulator and method	Lebby; Michael et al.	2022-12-06	62
3	US-11506918-B2	Preview	PDF	Hybrid EO polymer modulator with ALD sealant layer	Lebby; Michael et al.	2022-11-22	18
4	US-11495670-B2	Preview	PDF	Integrated epitaxial metal electrodes	Pelzel; Rodney et al.	2022-11-08	25
5	US-11435603-B2	Preview	PDF	TFP optical transition device and method	Leonberger; Frederick J. et al.	2022-09-06	32
6	US-11435604-B2	Preview	PDF	Hybrid EO polymer modulator with silicon photonics	Lebby; Michael et al.	2022-09-06	21
7	US-20220246822-A1	Preview	PDF	Josephson Junction using Molecular Beam Epitaxy	Lebby; Michael S. et al.	2022-08-04	10
8	US-20220187638-A1	Preview	PDF	HYBRID EO POLYMER MODULATOR WITH ALD SEALANT LAYER	Lebby; Michael et al.	2022-06-16	18
9	US-20220187637-A1	Preview	PDF	HYBRID EO POLYMER MODULATOR WITH SILICON PHOTONICS	Lebby; Michael et al.	2022-06-16	22
10	US-20220113566-A1	Preview	PDF	TFP OPTICAL TRANSITION DEVICE AND METHOD	Leonberger; Frederick J. et al.	2022-04-14	32
11	US-11262605-B2	Preview	PDF	Active region-less polymer modulator integrated on a common PIC platform and method	Lebby; Michael et al.	2022-03-01	32

Michael Lebby Curriculum Vitae (CV)

12 US-20220052249-A1	Preview PDF	A-axis Josephson Junctions with Improved Smoothness	Lebby; Michael S. et al.	2022-02-17	40
13 US-11201278-B2	Preview PDF	Josephson Junction using molecular beam epitaxy	Lebby; Michael S. et al.	2021-12-14	10
14 US-11201451-B2	Preview PDF	Porous distributed Bragg reflectors for laser applications	Hammond; Rich et al.	2021-12-14	20
15 US-11067748-B2	Preview PDF	Guide transition device and method	Lebby; Michael et al.	2021-07-20	24
16 US-11063114-B2	Preview PDF	III-N to rare earth transition in a semiconductor structure	Dargis; Rytis et al.	2021-07-13	23
17 US-11042051-B2	Preview PDF	Direct drive region-less polymer modulator methods of fabricating and materials therefor	Lebby; Michael et al.	2021-06-22	25
18 US-20210141251-A1	Preview PDF	ACTIVE REGION-LESS MODULATOR AND METHOD	Lebby; Michael et al.	2021-05-13	63
19 US-20210141250-A1	Preview PDF	ACTIVE REGION-LESS MODULATOR AND METHOD	Lebby; Michael et al.	2021-05-13	29
20 US-10989871-B2	Preview PDF	Protection layers for polymer modulators/waveguides	Becker; Richard et al.	2021-04-27	12
21 US-20210005720-A1	Preview PDF	ELECTRONIC DEVICE WITH 2-DIMENSIONAL ELECTRON GAS BETWEEN POLAR-ORIENTED RARE-EARTH OXIDE LAYER GROWN OVER A SEMICONDUCTOR	Dargis; Rytis et al.	2021-01-07	23
22 US-10886694-B2	Preview PDF	Hermetic capsule and method	Lebby; Michael	2021-01-05	17
23 US-10825912-B2	Preview PDF	Integrated epitaxial metal electrodes	Pelzel; Rodney et al.	2020-11-03	20
24 US-20200285085-A1	Preview PDF	DIRECT DRIVE REGION-LESS POLYMER MODULATOR METHODS OF FABRICATING AND MATERIALS THEREFOR	Lebby; Michael et al.	2020-09-10	25
25 US-10754093-B2	Preview PDF	Fabrication process of polymer based photonic apparatus and the apparatus	Liu; Zhiming et al.	2020-08-25	12

Michael Lebby Curriculum Vitae (CV)

26 US-20200183201-A1	Preview PDF	ACTIVE REGION-LESS POLYMER MODULATOR INTEGRATED ON A COMMON PIC PLATFORM AND METHOD	Lebby; Michael et al.	2020-06-11	31
27 US-20200183245-A1	Preview PDF	ELECTRO-OPTIC POLYMER DEVICES HAVING HIGH PERFORMANCE CLADDINGS, AND METHODS OF PREPARING THE SAME	Yi; Youngwoo et al.	2020-06-11	21
28 US-20200161417-A1	Preview PDF	III-N TO RARE EARTH TRANSITION IN A SEMICONDUCTOR STRUCTURE	Dargis; Rytis et al.	2020-05-21	20
29 US-20200150363-A1	Preview PDF	CONDUCTIVE MULTI-FIBER/PORT HERMETIC CAPSULE AND METHOD	Lebby; Michael	2020-05-14	27
30 US-20200119516-A1	Preview PDF	HERMETIC CAPSULE AND METHOD	Lebby; Michael	2020-04-16	16
31 US-10615141-B2	Preview PDF	Snictide buffer structures and devices for GaN base applications	Clark; Andrew et al.	2020-04-07	16
32 US-10605987-B2	Preview PDF	Re-based integrated photonic and electronic layered structures	Clark; Andrew et al.	2020-03-31	42
33 US-20200091398-A1	Preview PDF	JOSEPHSON JUNCTION USING MOLECULAR BEAM EPITAXY	Lebby; Michael S. et al.	2020-03-19	10
34 US-20200088939-A1	Preview PDF	GUIDE TRANSITION DEVICE AND METHOD	Lebby; Michael et al.	2020-03-19	23
35 US-20200088941-A1	Preview PDF	PROTECTION LAYERS FOR POLYMER MODULATORS/WAVEGUIDES	Becker; Richard et al.	2020-03-19	12
36 US-10591755-B2	Preview PDF	Direct-drive polymer modulator methods of fabricating and materials therefor	Becker; Richard et al.	2020-03-17	20
37 US-20200083668-A1	Preview PDF	GUIDE TRANSITION DEVICE WITH DIGITAL GRATING DEFLECTORS AND METHOD	Lebby; Michael et al.	2020-03-12	15
38 US-10573686-B2	Preview PDF	Epitaxial AlN/cREO structure for RF filter applications	Wang; Wang Nang et al.	2020-02-25	19
39 US-10574025-B2	Preview PDF	Hermetic capsule and method for a monolithic photonic integrated circuit	Lebby; Michael	2020-02-25	17

Michael Lebby Curriculum Vitae (CV)

40	US-10566944-B2	Preview	PDF Layer structures for RF filters fabricated using rare earth oxides and epitaxial aluminum nitride	Pelzel; Rodney et al.	2020-02-18	28
41	US-10527786-B2	Preview	PDF Polymer modulator and laser integrated on a common platform and method	Leonberger; Frederick J et al.	2020-01-07	27
42	US-10520673-B2	Preview	PDF Protection layers for polymer modulators/waveguides	Becker; Richard et al.	2019-12-31	12
43	US-10509164-B2	Preview	PDF Guide transition device and method	Lebby; Michael et al.	2019-12-17	23
44	US-10511146-B2	Preview	PDF Guide transition device with digital grating deflectors and method	Lebby; Michael et al.	2019-12-17	16
45	US-20190353843-A1	Preview	PDF FABRICATION PROCESS OF POLYMER BASED PHOTONIC APPARATUS AND THE APPARTUS	Liu; Zhiming et al.	2019-11-21	12
46	US-20190305039-A1	Preview	PDF EPITAXIAL AIN/cREO STRUCTURE FOR RF FILTER APPLICATIONS	Wang; Wang Nang et al.	2019-10-03	18
47	US-10431729-B2	Preview	PDF Josephson junction using molecular beam epitaxy	Lebby; Michael S. et al.	2019-10-01	10
48	US-20190278036-A1	Preview	PDF EMBEDDED HERMETIC CAPSULE AND METHOD	Lebby; Michael	2019-09-12	22
49	US-20190237930-A1	Preview	PDF HERMETIC CAPSULE AND METHOD	Lebby; Michael	2019-08-01	17
50	US-20190227233-A1	Preview	PDF RE-based Integrated Photonic and Electronic Layered Structures	Clark; Andrew et al.	2019-07-25	41
51	US-20190221993-A1	Preview	PDF POROUS DISTRIBUTED BRAGG REFLECTORS FOR LASER APPLICATIONS	Hammond; Rich et al.	2019-07-18	19
52	US-20190204506-A1	Preview	PDF PROTECTION LAYERS FOR POLYMER MODULATORS/WAVEGUIDES	Becker; Richard et al.	2019-07-04	12
53	US-10332857-B2	Preview	PDF Rare earth pnictides for strain management	Clark; Andrew et al.	2019-06-25	30
54	US-20190172923-A1	Preview	PDF Integrated Epitaxial Metal Electrodes	Pelzel; Rodney et al.	2019-06-06	24

Michael Lebby Curriculum Vitae (CV)

55	US-20190148913-A1	Preview PDF	GUIDE TRANSITION DEVICE WITH DIGITAL GRATING DEFLECTORS AND METHOD	Lebby; Michael et al.	2019-05-16	16
56	US-20190139761-A1	Preview PDF	Prictide Buffer Structures and Devices for GaN Base Applications	Clark; Andrew et al.	2019-05-09	15
57	US-20190122885-A1	Preview PDF	GROUP III SEMICONDUCTOR EPITAXY FORMED ON SILICON VIA SINGLE CRYSTAL REN AND REO BUFFER LAYERS	Dargis; Rytis et al.	2019-04-25	13
58	US-20190079243-A1	Preview PDF	GUIDE TRANSITION DEVICE AND METHOD	Lebby; Michael et al.	2019-03-14	24
59	US-20190074365-A1	Preview PDF	Integrated Epitaxial Metal Electrodes	Pelzel; Rodney et al.	2019-03-07	20
60	US-20190064436-A1	Preview PDF	POLYMER MODULATOR AND LASER INTEGRATED ON A COMMON PLATFORM AND METHOD	Leonberger; Frederick J et al.	2019-02-28	26
61	US-20190028081-A1	Preview PDF	LAYER STRUCTURES FOR RF FILTERS FABRICATED USING RARE EARTH OXIDES AND EPITAXIAL ALUMINUM NITRIDE	Pelzel; Rodney et al.	2019-01-24	28
62	US-10162111-B1	Preview PDF	Multi-fiber/port hermetic capsule sealed by metallization and method	Lebby; Michael	2018-12-25	34
63	US-10128350-B2	Preview PDF	Integrated epitaxial metal electrodes	Pelzel; Rodney et al.	2018-11-13	20
64	US-20180259798-A1	Preview PDF	DIRECT-DRIVE POLYMER MODULATOR METHODS OF FABRICATING AND MATERIALS THEREFOR	Becker; Richard et al.	2018-09-13	20
65	US-10075143-B2	Preview PDF	Layer structures for RF filters fabricated using rare earth oxides and epitaxial aluminum nitride	Pelzel; Rodney et al.	2018-09-11	29
66	US-20180138284-A1	Preview PDF	Integrated Epitaxial Metal Electrodes	Pelzel; Rodney et al.	2018-05-17	19
67	US-20180012858-A1	Preview PDF	RARE EARTH INTERLAYS FOR MECHANICALLY LAYERING DISSIMILAR SEMICONDUCTOR WAFERS	Clark; Andrew et al.	2018-01-11	15
68	US-20180013053-A1	Preview PDF	Josephson Junction using Molecular Beam Epitaxy	Lebby; Michael S. et al.	2018-01-11	10
69	US-20170353002-A1	Preview PDF	Rare Earth Pnictides for Strain Management	Clark; Andrew et al.	2017-12-07	29
70	US-20170141750-A1	Preview PDF	LAYER STRUCTURES FOR RF FILTERS FABRICATED USING RARE EARTH OXIDES AND EPITAXIAL ALUMINUM NITRIDE	Pelzel; Rodney et al.	2017-05-18	29
71	US-9496132-B2	Preview PDF	Nucleation of III-N on REO templates	Arkun; Erdem et al.	2016-11-15	9
72	US-9443939-B2	Preview PDF	Strain compensated REO buffer for III-N on silicon	Dargis; Rytis et al.	2016-09-13	7
73	US-20160133708-A1	Preview PDF	STRAIN COMPENSATED REO BUFFER FOR III-N ON SILICON	Dargis; Rytis et al.	2016-05-12	7

Michael Lebby Curriculum Vitae (CV)

74	US-9236249-B2	Preview PDF	III-N material grown on REN epitaxial buffer on Si substrate	Dargis; Rytis et al.	2016-01-12	9
75	US-9105471-B2	Preview PDF	Rare earth oxy-nitride buffered III-N on silicon	Clark; Andrew et al.	2015-08-11	7
76	US-20150014676-A1	Preview PDF	III-N MATERIAL GROWN ON REN EPITAXIAL BUFFER ON Si SUBSTRATE	Dargis; Rytis et al.	2015-01-15	10
77	US-20140357014-A1	Preview PDF	HIGH EFFICIENCY SOLAR CELL USING IIIB MATERIAL TRANSITION LAYERS	LEBBY; MICHAEL et al.	2014-12-04	10
78	US-8889978-B2	Preview PDF	III-V semiconductor interface with graded GeSn on silicon	Roucka; Radek et al.	2014-11-18	12
79	US-8878188-B2	Preview PDF	REO gate dielectric for III-N device on Si substrate	Dargis; Rytis et al.	2014-11-04	8
80	US-8872308-B2	Preview PDF	AlN cap grown on GaN/REO/silicon substrate structure	Arkun; Erdem et al.	2014-10-28	5
81	US-8835955-B2	Preview PDF	III ₀ .sub.xN.sub.y on single crystal SOI substrate and III n growth platform	Arkun; Erdem et al.	2014-09-16	10
82	US-8823055-B2	Preview PDF	REO/ALO/AlN template for III-N material growth on silicon	Arkun; Erdem et al.	2014-09-02	7
83	US-8823025-B1	Preview PDF	III-N material grown on AlO/AlN buffer on Si substrate	Arkun; Erdem et al.	2014-09-02	5
84	US-20140239307-A1	Preview PDF	REO GATE DIELECTRIC FOR III-N DEVICE ON Si SUBSTRATE	DARGIS; RYTIS et al.	2014-08-28	8
85	US-20140231817-A1	Preview PDF	III-N MATERIAL GROWN ON ALO/ALN BUFFER ON Si SUBSTRATE	Arkun; Erdem et al.	2014-08-21	5
86	US-20140231818-A1	Preview PDF	AlN CAP GROWN ON GaN/REO/SILICON SUBSTRATE STRUCTURE	Arkun; Erdem et al.	2014-08-21	5
87	US-20140225123-A1	Preview PDF	REO/ALO/AlN TEMPLATE FOR III-N MATERIAL GROWTH ON SILICON	Arkun; Erdem et al.	2014-08-14	10
88	US-8794010-B2	Preview PDF	Laser cooling of modified SOI wafer	Williams; David L. et al.	2014-08-05	12
89	US-20140167057-A1	Preview PDF	REO/ALO/AlN TEMPLATE FOR III-N MATERIAL GROWTH ON SILICON	Arkun; Erdem et al.	2014-06-19	7
90	US-8748900-B1	Preview PDF	Re-silicide gate electrode for III-N device on Si substrate	Dargis; Rytis et al.	2014-06-10	10
91	US-8680507-B1	Preview PDF	AlN inter-layers in III-N material grown on DBR/silicon substrate	Arkun; Erdem et al.	2014-03-25	6
92	US-20140076390-A1	Preview PDF	III-V SEMICONDUCTOR INTERFACE WITH GRADED GeSn ON SILICON	Roucka; Radek et al.	2014-03-20	13

Michael Lebby Curriculum Vitae (CV)

93	US-20140077240-A1	Preview PDF	IV MATERIAL PHOTONIC DEVICE ON DBR	Roucka; Radek et al.	2014-03-20	5
94	US-20140077338-A1	Preview PDF	Si-Ge-Sn ON REO TEMPLATE	Roucka; Radek et al.	2014-03-20	5
95	US-20140077339-A1	Preview PDF	DELTA DOPING AT Si-Ge INTERFACE	Roucka; Radek et al.	2014-03-20	5
96	US-20140053894-A1	Preview PDF	GRADED GeSn ON SILICON	Roucka; Radek et al.	2014-02-27	13
97	US-8637763-B2	Preview PDF	Solar cells with engineered spectral conversion	Lebby; Michael et al.	2014-01-28	18
98	US-8636844-B1	Preview PDF	Oxygen engineered single-crystal REO template	Dargis; Rytis et al.	2014-01-28	10
99	US-8633569-B1	Preview PDF	AlN inter-layers in III-N material grown on REO/silicon substrate	Arkun; Erdem et al.	2014-01-21	5
100	US-20140008644-A1	Preview PDF	OXYGEN ENGINEERED SINGLE-CRYSTAL REO TEMPLATE	Dargis; Rytis et al.	2014-01-09	10
101	US-8623747-B1	Preview PDF	Silicon, aluminum oxide, aluminum nitride template for optoelectronic and power devices	Arkun; Erdem et al.	2014-01-07	6
102	US-20130334536-A1	Preview PDF	SINGLE-CRYSTAL REO BUFFER ON AMORPHOUS SiO _x	Dargis; Rytis et al.	2013-12-19	7
103	US-8559097-B2	Preview PDF	Integrated pump laser and rare earth waveguide amplifier	Williams; David L. et al.	2013-10-15	10
104	US-8553741-B2	Preview PDF	Integrated rare earth devices	Lebby; Michael	2013-10-08	9
105	US-20130248853-A1	Preview PDF	NUCLEATION OF III-N ON REO TEMPLATES	Arkun; Erdem et al.	2013-09-26	8
106	US-8542437-B1	Preview PDF	Earth abundant photonic structures	Lebby; Michael S. et al.	2013-09-24	21
107	US-20130214282-A1	Preview PDF	III-N ON SILICON USING NANO STRUCTURED INTERFACE LAYER	Arkun; Erdem et al.	2013-08-22	7
108	US-8501635-B1	Preview PDF	Modification of REO by subsequent III-N EPI process	Clark; Andrew et al.	2013-08-06	10
109	US-20130153918-A1	Preview PDF	REO-Si TEMPLATE WITH INTEGRATED REO LAYERS FOR LIGHT EMISSION	Clark; Andrew et al.	2013-06-20	9
110	US-8455756-B2	Preview PDF	High efficiency solar cell using IIIB material transition layers	Lebby; Michael et al.	2013-06-04	10
111	US-20130099357-A1	Preview PDF	STRAIN COMPENSATED REO BUFFER FOR III-N ON SILICON	Dargis; Rytis et al.	2013-04-25	7

Michael Lebby Curriculum Vitae (CV)

112	US-20130071960-A1	Preview	PDF INTEGRATED RARE EARTH DEVICES	LEBBY; MICHAEL	2013-03-21	10
113	US-20130062609-A1	Preview	PDF III-N FET ON SILICON USING FIELD SUPPRESSING REO	Smith; Robin et al.	2013-03-14	10
114	US-20130062610-A1	Preview	PDF LATTICE MATCHED CRYSTALLINE REFLECTOR	Clark; Andrew et al.	2013-03-14	11
115	US-8394194-B1	Preview	PDF Single crystal reo buffer on amorphous SiO ₂	Dargis; Rytis et al.	2013-03-12	7
116	US-20130032858-A1	Preview	PDF RARE EARTH OXY-NITRIDE BUFFERED III-N ON SILICON	Clark; Andrew et al.	2013-02-07	8
117	US-8331410-B2	Preview	PDF Spontaneous/stimulated light emitting .mu.-cavity device	Lebby; Michael et al.	2012-12-11	8
118	US-8331413-B2	Preview	PDF Integrated rare earth devices	Lebby; Michael	2012-12-11	9
119	US-20120280276-A1	Preview	PDF Single Crystal Ge On Si	Dargis; Rytis et al.	2012-11-08	6
120	US-20120256232-A1	Preview	PDF Multilayer Rare Earth Device	Clark; Andrew et al.	2012-10-11	24
121	US-20120183767-A1	Preview	PDF HEXAGONAL REO TEMPLATE BUFFER FOR III-N LAYERS ON SILICON	Dargis; Rytis et al.	2012-07-19	10
122	US-20120145243-A1	Preview	PDF SOLAR CELLS WITH MAGNETICALLY ENHANCED UP-CONVERSION	Williams; David L. et al.	2012-06-14	13
123	US-20120147906-A1	Preview	PDF LASER COOLING OF MODIFIED SOI WAFER	Williams; David L. et al.	2012-06-14	12
124	US-20120104443-A1	Preview	PDF III _{0.5} OxNy ON SINGLE CRYSTAL SOI SUBSTRATE AND III _{0.5} n GROWTH PLATFORM	Clark; Andrew et al.	2012-05-03	9
125	US-20120104567-A1	Preview	PDF III _{0.5} OxNy ON REO/Si	Clark; Andrew et al.	2012-05-03	6
126	US-20120090672-A1	Preview	PDF REO-Ge Multi-Junction Solar Cell	LEBBY; MICHAEL S. et al.	2012-04-19	16
127	US-20120085399-A1	Preview	PDF REO-Ge Multi-Junction Solar Cell	Lebby; Michael S. et al.	2012-04-12	17
128	US-20120073648-A1	Preview	PDF Photovoltaic conversion using rare earths plus Group IV Sensitizers	Clark; Andrew et al.	2012-03-29	18
129	US-20120019902-A1	Preview	PDF INTERGRATED PUMP LASER AND RARE EARTH WAVEGUIDE AMPLIFIER	Williams; David L. et al.	2012-01-26	10
130	US-20110290313-A1	Preview	PDF SOLAR CELLS WITH ENGINEERED SPECTRAL CONVERSION	LEBBY; MICHAEL et al.	2011-12-01	19

Michael Lebby Curriculum Vitae (CV)

131	US-8049100-B2	Preview PDF	Multijunction rare earth solar cell	Clark; Andrew et al.	2011-11-01	24
132	US-8039738-B2	Preview PDF	Active rare earth tandem solar cell	Clark; Andrew et al.	2011-10-18	25
133	US-8039737-B2	Preview PDF	Passive rare earth tandem solar cell	Clark; Andrew et al.	2011-10-18	17
134	US-20110220173-A1	Preview PDF	ACTIVE SOLAR CONCENTRATOR WITH MULTI-JUNCTION DEVICES	LEBBY; MICHAEL	2011-09-15	15
135	US-20110203666-A1	Preview PDF	HIGH EFFICIENCY SOLAR CELL USING IIIB MATERIAL TRANSITION LAYERS	Lebby; Michael et al.	2011-08-25	10
136	US-20110188533-A1	Preview PDF	INTEGRATED RARE EARTH DEVICES	LEBBY; MICHAEL	2011-08-04	10
137	US-7968384-B2	Preview PDF	Stacked transistors and process	Atanakov; Petar B. et al.	2011-06-28	7
138	US-7967653-B2	Preview PDF	Full color display	Lebby; Michael et al.	2011-06-28	11
139	US-20110108908-A1	Preview PDF	MULTILAYERED BOX IN FDSOI MOSFETS	Lebby; Michael et al.	2011-05-12	34
140	US-7821066-B2	Preview PDF	Multilayered BOX in FDSOI MOSFETS	Lebby; Michael et al.	2010-10-26	33
141	US-20100122720-A1	Preview PDF	Passive Rare Earth Tandem Solar Cell	Clark; Andrew et al.	2010-05-20	17
142	US-20100116315-A1	Preview PDF	Active rare earth tandem solar cell	Clark; Andrew et al.	2010-05-13	25
143	US-20100112736-A1	Preview PDF	FULL COLOR DISPLAY	Lebby; Michael et al.	2010-05-06	12
144	US-20100109047-A1	Preview PDF	Multijunction rare earth solar cell	Clark; Andrew et al.	2010-05-06	23
145	US-20100084680-A1	Preview PDF	SPONTANEOUS/STIMULATED LIGHT EMITTING .mu.-CAVITY DEVICE	Lebby; Michael et al.	2010-04-08	8
146	US-7643526-B1	Preview PDF	Spontaneous/stimulated light emitting .mu.-cavity device	Lebby; Michael et al.	2010-01-05	8
147	US-20090291535-A1	Preview PDF	STACKED TRANSISTORS AND PROCESS	Atanackovic; Petar B. et al.	2009-11-26	7
148	US-7605531-B1	Preview PDF	Full color display including LEDs with rare earth active areas and different radiative transistions	Lebby; Michael et al.	2009-10-20	11
149	US-7579623-B2	Preview PDF	Stacked transistors and process	Atanackovic; Petar B. et al.	2009-08-25	7

Michael Lebby Curriculum Vitae (CV)

150	US-7538016-B2	Preview PDF	Signal and/or ground planes with double buried insulator layers and fabrication process	Atanackovic; Petar B. et al.	2009-05-26	8
151	US-7388230-B1	Preview PDF	Selective colored light emitting diode	Lebby; Michael et al.	2008-06-17	9
152	US-20080135924-A1	Preview PDF	Multilayered box in FDSOI MOSFETS	Lebby; Michael et al.	2008-06-12	34
153	US-7365357-B2	Preview PDF	Strain inducing multi-layer cap	Atanackovic; Petar B. et al.	2008-04-29	6
154	US-20080093670-A1	Preview PDF	SIGNAL AND/OR GROUND PLANES WITH DOUBLE BURIED INSULATOR LAYERS AND FABRICATION PROCESS	Atanackovic; Petar B. et al.	2008-04-24	8
155	US-7355269-B1	Preview PDF	IC on non-semiconductor substrate	Lebby; Michael et al.	2008-04-08	4
156	US-7323396-B2	Preview PDF	Signal and/or ground planes with double buried insulator layers and fabrication process	Atanackovic; Petar B. et al.	2008-01-29	7
157	US-20070018166-A1	Preview PDF	Stacked transistors and process	Atanackovic; Petar B. et al.	2007-01-25	8
158	US-20070018203-A1	Preview PDF	Strain inducing multi-layer cap	Atanackovic; Petar B. et al.	2007-01-25	6
159	US-20060246691-A1	Preview PDF	Signal and/or ground planes with double buried insulator layers and fabrication process	Atanackovic; Petar B. et al.	2006-11-02	8
160	US-6999644-B1	Preview PDF	Discrete optoelectric package	Lebby; Michael S. et al.	2006-02-14	17
161	US-6966703-B1	Preview PDF	Self eject latch mechanism for an optical transceiver module	Lebby; Michael S. et al.	2005-11-22	9
162	US-6795461-B1	Preview PDF	Optoelectric module	Blair; Thomas H. et al.	2004-09-21	19
163	US-6663296-B1	Preview PDF	Optoelectric module	Blair; Thomas H. et al.	2003-12-16	14

Michael Lebby Curriculum Vitae (CV)

164	US-6412989-B1	Preview PDF	Directable laser transmission module	Hartman; Davis Howard et al.	2002-07-02	8
165	US-6243056-B1	Preview PDF	Transceiver with miniature virtual image display	Jachimowicz; Karen E. et al.	2001-06-05	12
166	US-6228440-B1	Preview PDF	Perishable media information storage mechanism and method of fabrication	Dailey; Conan B. et al.	2001-05-08	7
167	US-6158884-A	Preview PDF	Integrated communicative watch	Lebby; Michael S. et al.	2000-12-12	9
168	US-6161106-A	Preview PDF	Perishable media system and method of operation	Dailey; Conan B. et al.	2000-12-12	7
169	US-6156582-A	Preview PDF	Method of fabricating top emitting ridge VCSEL with self-aligned contact and sidewall reflector	Shieh; Chan-Long et al.	2000-12-05	6
170	US-6131017-A	Preview PDF	Dual system portable electronic communicator	Lebby; Michael S. et al.	2000-10-10	8
171	US-6122023-A	Preview PDF	Non-speckle liquid crystal projection display	Chen; Diana et al.	2000-09-19	8
172	US-6121068-A	Preview PDF	Long wavelength light emitting vertical cavity surface emitting laser and method of fabrication	Ramdani; Jamal et al.	2000-09-19	7
173	US-6115618-A	Preview PDF	Portable electronic device with removable display	Lebby; Michael S. et al.	2000-09-05	6
174	US-6111839-A	Preview PDF	Optical pickup head including a coherent first order mode laser light source	Milster; Tom D. et al.	2000-08-29	7
175	US-6096666-A	Preview PDF	Holographic textile fiber	Jachimowicz; Karen E. et al.	2000-08-01	6
176	US-6097748-A	Preview PDF	Vertical cavity surface emitting laser semiconductor chip with integrated drivers and photodetectors and method of fabrication	Huang; Rong-Ting et al.	2000-08-01	11
177	US-6097528-A	Preview PDF	Microscanner for portable laser diode displays	Lebby; Michael S. et al.	2000-08-01	8

Michael Lebby Curriculum Vitae (CV)

178	US-6091754-A	Preview PDF	VCSEL having integrated photodetector for automatic power control	Jiang; Wenbin et al.	2000-07-18	5
179	US-6084697-A	Preview PDF	Integrated electro-optical package	Lebby; Michael S. et al.	2000-07-04	9
180	US-6080690-A	Preview PDF	Textile fabric with integrated sensing device and clothing fabricated thereof	Lebby; Michael S. et al.	2000-06-27	8
181	US-6069593-A	Preview PDF	Display carrier and electronic display control for multiple displays in a portable electronic device	Lebby; Michael S. et al.	2000-05-30	6
182	US-6064780-A	Preview PDF	Interconnect substrate with a single contact accessible in an upper and an end surface	Blair; Thomas H. et al.	2000-05-16	6
183	US-6061380-A	Preview PDF	Vertical cavity surface emitting laser with doped active region and method of fabrication	Jiang; Wenbin et al.	2000-05-09	8
184	US-6061485-A	Preview PDF	Method for wavelength division multiplexing utilizing donut mode vertical cavity surface emitting lasers	Jiang; Wenbin et al.	2000-05-09	7
185	US-6029073-A	Preview PDF	Display carrier with binocular viewing for a portable electronic device	Lebby; Michael S. et al.	2000-02-22	7
186	US-6026111-A	Preview PDF	Vertical cavity surface emitting laser device having an extended cavity	Jiang; Wenbin et al.	2000-02-15	6
187	US-6022760-A	Preview PDF	Integrated electro-optical package and method of fabrication	Lebby; Michael S. et al.	2000-02-08	12
188	US-6021146-A	Preview PDF	Vertical cavity surface emitting laser for high power single mode operation and method of fabrication	Jiang; Wenbin et al.	2000-02-01	7
189	US-6021147-A	Preview PDF	Vertical cavity surface emitting laser for high power single mode operation and method of fabrication	Jiang; Wenbin et al.	2000-02-01	7
190	US-6008067-A	Preview PDF	Fabrication of visible wavelength vertical cavity surface emitting laser	Ramdani; Jamal et al.	1999-12-28	5
191	US-5978398-A	Preview PDF	Long wavelength vertical cavity surface emitting laser	Ramdani; Jamal et al.	1999-11-02	5

Michael Lebby Curriculum Vitae (CV)

192	US-5974071-A	Preview PDF	VCSEL with integrated photodetectors for automatic power control and signal detection in data storage	Jiang; Wenbin et al.	1999-10-26	8
193	US-5966399-A	Preview PDF	Vertical cavity surface emitting laser with integrated diffractive lens and method of fabrication	Jiang; Wenbin et al.	1999-10-12	7
194	US-5959315-A	Preview PDF	Semiconductor to optical link	Lebby; Michael S. et al.	1999-09-28	6
195	US-5956363-A	Preview PDF	Long wavelength vertical cavity surface emitting laser with oxidation layers and method of fabrication	Lebby; Michael S. et al.	1999-09-21	7
196	US-5956364-A	Preview PDF	Vertical cavity surface emitting laser with shaped cavity mirror and method of fabrication	Jiang; Wenbin et al.	1999-09-21	6
197	US-5953355-A	Preview PDF	Semiconductor laser package with power monitoring system	Kiely; Philip et al.	1999-09-14	6
198	US-5946121-A	Preview PDF	IrDA data link with VCSEL light source	Jiang; Wenbin et al.	1999-08-31	4
199	US-5943359-A	Preview PDF	Long wavelength VCSEL	Ramdani; Jamal et al.	1999-08-24	5
200	US-5943357-A	Preview PDF	Long wavelength vertical cavity surface emitting laser with photodetector for automatic power control and method of fabrication	Lebby; Michael S. et al.	1999-08-24	7
201	US-5939773-A	Preview PDF	Semiconductor laser package including a lead frame and plastic resin housing	Jiang; Wenbin et al.	1999-08-17	8
202	US-5936929-A	Preview PDF	Optical submodule and method for making	Jiang; Wenbin et al.	1999-08-10	7
203	US-5923696-A	Preview PDF	Visible light emitting vertical cavity surface emitting laser with gallium phosphide contact layer and method of fabrication	Ramdani; Jamal et al.	1999-07-13	7
204	US-5914973-A	Preview PDF	Vertical cavity surface emitting laser for high power operation and method of fabrication	Jiang; Wenbin et al.	1999-06-22	7
205	US-5906004-A	Preview PDF	Textile fabric with integrated electrically conductive fibers and clothing fabricated thereof	Lebby; Michael S. et al.	1999-05-25	7
206	US-5905750-A	Preview PDF	Semiconductor laser package and method of fabrication	Lebby; Michael S. et al.	1999-05-18	10
207	US-5903586-A	Preview PDF	Long wavelength vertical cavity surface emitting laser	Ramdani; Jamal et al.	1999-05-11	5

Michael Lebby Curriculum Vitae (CV)

208	US-5898722-A	Preview PDF	Dual wavelength monolithically integrated vertical cavity surface emitting lasers and method of fabrication	Ramdani; Jamal et al.	1999-04- 8 27
209	US-5886972-A	Preview PDF	Recording information in a phase change optical medium with a vertical cavity surface emitting laser	Jiang; Wenbin et al.	1999-03- 5 23
210	US-5883912-A	Preview PDF	Long wavelength VCSEL	Ramdani; Jamal et al.	1999-03- 5 16
211	US-5881084-A	Preview PDF	Semiconductor laser for package with power monitoring system	Huang; Rong-Ting et al.	1999-03- 8 09
212	US-5848086-A	Preview PDF	Electrically confined VCSEL	Lebby; Michael S. et al.	1998-12- 7 08
213	US-5838703-A	Preview PDF	Semiconductor laser package with power monitoring system and optical element	Lebby; Michael S. et al.	1998-11- 9 17
214	US-5838707-A	Preview PDF	Ultraviolet/visible light emitting vertical cavity surface emitting laser and method of fabrication	Ramdani; Jamal et al.	1998-11- 8 17
215	US-5835521-A	Preview PDF	Long wavelength light emitting vertical cavity surface emitting laser and method of fabrication	Ramdani; Jamal et al.	1998-11- 7 10
216	US-5831960-A	Preview PDF	Integrated vertical cavity surface emitting laser pair for high density data storage and method of fabrication	Jiang; Wenbin et al.	1998-11- 7 03
217	US-5821571-A	Preview PDF	Dual sided integrated electro-optical package	Lebby; Michael S. et al.	1998-10- 13 13
218	US-5818404-A	Preview PDF	Integrated electro-optical package	Lebby; Michael S. et al.	1998-10- 18 06
219	US-5815524-A	Preview PDF	VCSEL including GaTIP active region	Ramdani; Jamal et al.	1998-09- 5 29
220	US-5796769-A	Preview PDF	Red light vertical cavity surface emitting laser	Ramdani; Jamal et al.	1998-08- 6 18
221	US-5789733-A	Preview PDF	Smart card with contactless optical interface	Jachimowicz; Karen E. et al.	1998-08- 7 04
222	US-5774486-A	Preview PDF	Waveguide power monitoring system for vertical cavity surface emitting lasers	Jiang; Wenbin et al.	1998-06- 6 30
223	US-5764671-A	Preview PDF	VCSEL with selective oxide transition regions	Lebby; Michael S. et al.	1998-06- 10 09
224	US-5757741-A	Preview PDF	CD ROM head with VCSEL or VCSEL array	Jiang; Wenbin et al.	1998-05- 11 26
225	US-5757829-A	Preview PDF	Flip chip power monitoring system for vertical cavity surface emitting lasers	Jiang; Wenbin et al.	1998-05- 6 26
226	US-5757836-A	Preview PDF	Vertical cavity surface emitting laser with laterally integrated photodetector	Jiang; Wenbin et al.	1998-05- 8 26

Michael Lebby Curriculum Vitae (CV)

227 US-5751757-A	Preview PDF VCSEL with integrated MSM photodetector	Jiang; Wenbin et al.	1998-05- 5 12
228 US-5751471-A	Preview PDF Switchable lens and method of making	Chen; Diana et al.	1998-05- 8 12
229 US-5748665-A	Preview PDF Visible VCSEL with hybrid mirrors	Jiang; Wenbin et al.	1998-05- 7 05
230 US-5748161-A	Preview PDF Integrated electro-optical package with independent menu bar	Lebby; Michael S. et al.	1998-05- 22 05
231 US-5742630-A	Preview PDF VCSEL with integrated pin diode	Jiang; Wenbin et al.	1998-04- 6 21
232 US-5741724-A	Preview PDF Method of growing gallium nitride on a spinel substrate	Ramdani; Jamal et al.	1998-04- 5 21
233 US-5739800-A	Preview PDF Integrated electro-optical package with LED display chip and substrate with drivers and central opening	Lebby; Michael S. et al.	1998-04- 19 14
234 US-5732103-A	Preview PDF Long wavelength VCSEL	Ramdani; Jamal et al.	1998-03- 5 24
235 US-5719892-A	Preview PDF Hybrid mirror structure for a visible emitting VCSEL	Jiang; Wenbin et al.	1998-02- 8 17
236 US-5719893-A	Preview PDF Passivated vertical cavity surface emitting laser	Jiang; Wenbin et al.	1998-02- 7 17
237 US-5710441-A	Preview PDF Microcavity LED with photon recycling	Ackley; Donald E. et al.	1998-01- 5 20
238 US-5708280-A	Preview PDF Integrated electro-optical package and method of fabrication	Lebby; Michael S. et al.	1998-01- 12 13
239 US-5706306-A	Preview PDF VCSEL with distributed Bragg reflectors for visible light	Jiang; Wenbin et al.	1998-01- 6 06
240 US-5703664-A	Preview PDF Integrated electro-optic package for reflective spatial light modulators	Jachimowicz; Karen E. et al.	1997-12- 13 30
241 US-5699073-A	Preview PDF Integrated electro-optical package with carrier ring and method of fabrication	Lebby; Michael S. et al.	1997-12- 19 16
242 US-5661075-A	Preview PDF Method of making a VCSEL with passivation	Grodzinski; Piotr et al.	1997-08- 9 26
243 US-5654228-A	Preview PDF VCSEL having a self-aligned heat sink and method of making	Shieh; Chan-Long et al.	1997-08- 7 05
244 US-5644369-A	Preview PDF Switchable lens/diffuser	Jachimowicz; Karen E. et al.	1997-07- 8 01
245 US-5638392-A	Preview PDF Short wavelength VCSEL	Ramdani; Jamal et al.	1997-06- 6 10

Michael Lebby Curriculum Vitae (CV)

246 US-5636298-A	Preview PDF Coalescing optical module and method for making	Jiang; Wenbin et al.	1997-06- 8 03
247 US-563886-A	Preview PDF Short wavelength VCSEL with Al-free active region	Ramdani; Jamal et al.	1997-05- 6 27
248 US-5625734-A	Preview PDF Optoelectronic interconnect device and method of making	Thomas; Ronald E. et al.	1997-04- 7 29
249 US-5574744-A	Preview PDF Optical coupler	Gaw; Craig A. et al.	1996-11- 7 12
250 US-5563900-A	Preview PDF Broad spectrum surface-emitting led	Ackley; Donald E. et al.	1996-10- 7 08
251 US-5557626-A	Preview PDF Patterned mirror VCSEL with adjustable selective etch region	Grodzinski; Piotr et al.	1996-09- 8 17
252 US-5555341-A	Preview PDF Waveguide with an electrically conductive channel	Sharma; Ravinder K. et al.	1996-09- 7 10
253 US-5550941-A	Preview PDF Optoelectronic interface module	Lebby; Michael S. et al.	1996-08- 8 27
254 US-5545359-A	Preview PDF Method of making a plastic molded optoelectronic interface	Ackley; Donald E. et al.	1996-08- 9 13
255 US-5546413-A	Preview PDF Integrated light emitting device	Lebby; Michael S. et al.	1996-08- 10 13
256 US-5543958-A	Preview PDF Integrated electro-optic package for reflective spatial light modulators	Lebby; Michael S. et al.	1996-08- 14 06
257 US-5540799-A	Preview PDF Method of fabricating optical waveguide from a laminate	Lebby; Michael S. et al.	1996-07- 6 30
258 US-5538919-A	Preview PDF Method of fabricating a semiconductor device with high heat conductivity	Lebby; Michael S. et al.	1996-07- 8 23
259 US-5539200-A	Preview PDF Integrated optoelectronic substrate	Lebby; Michael S. et al.	1996-07- 6 23
260 US-5539554-A	Preview PDF Integrated electro-optic package for reflective spatial light	Lebby; Michael S. et al.	1996-07- 14 23
261 US-5534888-A	Preview PDF Electronic book	Lebby; Michael S. et al.	1996-07- 8 09
262 US-5530715-A	Preview PDF Vertical cavity surface emitting laser having continuous grading	Shieh; Chan-Long et al.	1996-06- 7 25
263 US-5521992-A	Preview PDF Molded optical interconnect	Chun; Christopher K. Y. et al.	1996-05- 10 28
264 US-5517348-A	Preview PDF Voltage controlled transparent layer for a bi-directional device	Lebby; Michael S.	1996-05- 5 14

Michael Lebby Curriculum Vitae (CV)

265 US-5511138-A	Preview PDF	Interlocking waveguide and method of making	Lebby; Michael S. et al.	1996-04-23	8
266 US-5498883-A	Preview PDF	Superluminescent edge emitting device with apparent vertical light emission and method of making	Lebby; Michael S. et al.	1996-03-12	7
267 US-5493437-A	Preview PDF	External communication link for a credit card pager	Lebby; Michael S. et al.	1996-02-20	10
268 US-5491491-A	Preview PDF	Portable electronic equipment with binocular virtual display	Lebby; Michael S. et al.	1996-02-13	11
269 US-5486946-A	Preview PDF	Integrated electro-optic package for reflective spatial light modulators	Jachimowicz; Karen E. et al.	1996-01-23	14
270 US-5485318-A	Preview PDF	Dual image manifestation apparatus with integrated electro-optical package	Lebby; Michael S. et al.	1996-01-16	17
271 US-5482658-A	Preview PDF	Method of making an optoelectronic interface module	Lebby; Michael S. et al.	1996-01-09	8
272 US-5482891-A	Preview PDF	VCSEL with an intergrated heat sink and method of making	Shieh; Chan-Long et al.	1996-01-09	6
273 US-5478774-A	Preview PDF	Method of fabricating patterned-mirror VCSELs using selective growth	Ackley; Donald E. et al.	1995-12-26	7
274 US-5473716-A	Preview PDF	Fiber bundle interconnect and method of making same	Lebby; Michael S. et al.	1995-12-05	8
275 US-5468656-A	Preview PDF	Method of making a VCSEL	Shieh; Chan-Long et al.	1995-11-21	9
276 US-5469185-A	Preview PDF	Remote sensory unit and driver	Lebby; Michael S. et al.	1995-11-21	7
277 US-5468582-A	Preview PDF	Fused optical layer and method of making	Blair; Thomas H. et al.	1995-11-21	7
278 US-5466633-A	Preview PDF	Optical reading head and method for making same	Ackley; Donald E. et al.	1995-11-14	11
279 US-5467215-A	Preview PDF	Integrated electro-optic package for reflective spatial light modulators	Lebby; Michael S. et al.	1995-11-14	13
280 US-5452387-A	Preview PDF	Coaxial optoelectronic mount and method of making same	Chun; Christopher K. Y. et al.	1995-09-19	5
281 US-5446752-A	Preview PDF	VCSEL with current blocking layer offset	Ackley; Donald E. et al.	1995-08-29	10
282 US-5437092-A	Preview PDF	Method of making contact areas on an optical waveguide	Hartman; Davis H. et al.	1995-08-01	7
283 US-5432809-A	Preview PDF	VCSEL with Al-free cavity region	Grodzinski; Piotr et al.	1995-07-11	7

Michael Lebby Curriculum Vitae (CV)

284 US-5432630-A	Preview PDF	Optical bus with optical transceiver modules and method of manufacture	Lebby; Michael S. et al.	1995-07-11	16
285 US-5428704-A	Preview PDF	Optoelectronic interface and method of making	Lebby; Michael S. et al.	1995-06-27	16
286 US-5422901-A	Preview PDF	Semiconductor device with high heat conductivity	Lebby; Michael S. et al.	1995-06-06	7
287 US-5416870-A	Preview PDF	Optoelectronic interface device and method with reflective surface	Chun; Christopher K. Y. et al.	1995-05-16	8
288 US-5408547-A	Preview PDF	Optical read/write head	Lebby; Michael S. et al.	1995-04-18	10
289 US-5400423-A	Preview PDF	Molded star coupler and method of making same	Chun; Christopher K. Y. et al.	1995-03-21	5
290 US-5400352-A	Preview PDF	Semiconductor laser and method therefor	Lebby; Michael S. et al.	1995-03-21	5
291 US-5389312-A	Preview PDF	Method of fabricating molded optical waveguides	Lebby; Michael S. et al.	1995-02-14	8
292 US-5390275-A	Preview PDF	Molded waveguide and method for making same	Lebby; Michael S. et al.	1995-02-14	9
293 US-5388120-A	Preview PDF	VCSEL with unstable resonator	Ackley; Donald E. et al.	1995-02-07	5
294 US-5369529-A	Preview PDF	Reflective optoelectronic interface device and method of making	Kuo; Shun-Meen et al.	1994-11-29	7
295 US-5369415-A	Preview PDF	Direct retinal scan display with planar imager	Richard; Fred V. et al.	1994-11-29	6
296 US-5367593-A	Preview PDF	Optical/electrical connector and method of fabrication	Lebby; Michael S. et al.	1994-11-22	10
297 US-5361317-A	Preview PDF	Assembly with fixture aligning and affixing an optical fiber to an optical device	Hartman; Davis H. et al.	1994-11-01	7
298 US-5359686-A	Preview PDF	Interface for coupling optical fibers to electronic circuitry	Galloway; David et al.	1994-10-25	17
299 US-5358880-A	Preview PDF	Method of manufacturing closed cavity LED	Lebby; Michael S. et al.	1994-10-25	6
300 US-5359618-A	Preview PDF	High efficiency VCSEL and method of fabrication	Lebby; Michael S. et al.	1994-10-25	6
301 US-5359669-A	Preview PDF	Remote retinal scan identifier	Shanley; Charles W. et al.	1994-10-25	7
302 US-5351257-A	Preview PDF	VCSEL with vertical offset operating region providing a lateral waveguide and current limiting and method of fabrication	Lebby; Michael S. et al.	1994-09-27	10

Michael Lebby Curriculum Vitae (CV)

303	US-5351331-A	Preview PDF	Method and apparatus for splicing optical fibers with signal I/O	Chun; Christopher K. Y. et al.	1994-09-27	11
304	US-5349210-A	Preview PDF	Optical reading head with angled array	Ackley; Donald E. et al.	1994-09-20	10
305	US-5348616-A	Preview PDF	Method for patterning a mold	Hartman; Davis H. et al.	1994-09-20	12
306	US-5345524-A	Preview PDF	Optoelectronic transceiver sub-module and method for making	Lebby; Michael S. et al.	1994-09-06	9
307	US-5345527-A	Preview PDF	Intelligent opto-bus with display	Lebby; Michael S. et al.	1994-09-06	11
308	US-5345530-A	Preview PDF	Molded waveguide and method for making same	Lebby; Michael S. et al.	1994-09-06	8
309	US-5337391-A	Preview PDF	Optoelectronic sub-module and method of making same	Lebby; Michael S.	1994-08-09	10
310	US-5337397-A	Preview PDF	Optical coupling device and method for making	Lebby; Michael S. et al.	1994-08-09	7
311	US-5335300-A	Preview PDF	Method of manufacturing I/O node in an optical channel waveguide and apparatus for utilizing	Hartman; Davis H. et al.	1994-08-02	10
312	US-5325451-A	Preview PDF	Modular optical waveguide and method for making	Hartman; Davis et al.	1994-06-28	5
313	US-5324964-A	Preview PDF	Superluminescent surface light emitting device	Ackley; Donald E. et al.	1994-06-28	5
314	US-5323477-A	Preview PDF	Contact array imager with integral waveguide and electronics	Lebby; Michael S. et al.	1994-06-21	10
315	US-5313545-A	Preview PDF	Molded waveguide with a unitary cladding region and method of making	Kuo; Shun-Meen et al.	1994-05-17	11
316	US-5309537-A	Preview PDF	Optoelectronic coupling device and method of making	Chun; Christopher K. Y. et al.	1994-05-03	11
317	US-5286982-A	Preview PDF	High contrast ratio optical modulator	Ackley; Donald E. et al.	1994-02-15	7
318	US-5282071-A	Preview PDF	Contact areas on an optical waveguide and method of making	Hartman; Davis H. et al.	1994-01-25	8
319	US-5276762-A	Preview PDF	Magnetic holding methods for optical fiber I/O assembly	Hartman; Davis H. et al.	1994-01-04	4
320	US-5276754-A	Preview PDF	Optoelectronic mount and method for making	Blair; Thomas H. et al.	1994-01-04	7
321	US-5271083-A	Preview PDF	Molded optical waveguide with contacts utilizing leadframes and method of making same	Lebby; Michael S. et al.	1993-12-14	10
322	US-5265184-A	Preview PDF	Molded waveguide and method for making same	Lebby; Michael S. et al.	1993-11-23	8
323	US-5249245-A	Preview PDF	Optoelectronic mount including flexible substrate and method for making same	Lebby; Michael S. et al.	1993-09-28	10

Michael Lebby Curriculum Vitae (CV)

324 US-5230030-A	Preview PDF	Interface coupling electronic circuitry	Hartman; Davis H. et al.	1993-07-20	6
325 US-5228101-A	Preview PDF	Electrical to optical links using metalization	Lebby; Michael S. et al.	1993-07-13	6
326 US-5225816-A	Preview PDF	Electrical connector with display	Lebby; Michael S. et al.	1993-07-06	4
327 US-5218465-A	Preview PDF	Intelligent interconnects for broadband optical networking	Lebby; Michael S. et al.	1993-06-08	6
328 US-5172384-A	Preview PDF	Low threshold current laser	Goronkin; Herbert et al.	1992-12-15	14
329 US-5170448-A	Preview PDF	Optical waveguide apparatus and method for partially collecting light	Ackley; Donald E. et al.	1992-12-08	7
330 US-5125054-A	Preview PDF	Laminated polymer optical waveguide interface and method of making same	Ackley; Donald E. et al.	1992-06-23	6
331 US-5116461-A	Preview PDF	Method for fabricating an angled diffraction grating	Lebby; Michael S. et al.	1992-05-26	5
332 US-5067829-A	Preview PDF	Dynamic optical beam steering	Jaskie; James E. et al.	1991-11-26	7
333 US-5068007-A	Preview PDF	Etching of materials in a noncorrosive environment	Rogers; Stephen P. et al.	1991-11-26	6
334 US-5045908-A	Preview PDF	Vertically and laterally illuminated p-i-n photodiode	Lebby; Michael S.	1991-09-03	5
335 US-5034092-A	Preview PDF	Plasma etching of semiconductor substrates	Lebby; Michael S. et al.	1991-07-23	5

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. Lebbya**, “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 Dargis^b, Radek Rouckab, Robin S. Smith^b and Andrew Clark^b “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 Gd₂O₃ 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 Gd₂O₃ and Er₂O₃ 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 Lebbya** , “Epitaxial Si and Gd₂O₃ 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 Lebbya** 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.
16. Williams, D.; Clark, A.; Arkun, E.; Jamora, A.; Vosters, G.; **Lebby, M.**, “Silicon light emitting device based on rare earth oxide superlattice,” 2010 7th IEEE International Conference on Group IV Photonics, Beijing, Sept. 2010.
17. **Lebby, M.**, “Photonic integration: what is the Holy Grail?” *Compound Semiconductor* , vol.15 , no.7 , pp.25-32, Oct. 2009, <http://www.compoundsemiconductor.net/csc/magazine.php?mon=1&year=2009>.
18. **Lebby, M.S.**, “Green photonics technology and markets,” *Electronics Letters*, vol. 45 , no. 20, pp.1007, Sept. 2009. DOI: [10.1049/el.2009.2563](https://doi.org/10.1049/el.2009.2563), Print ISSN 0013-5194, Online ISSN 1350-911X.
19. Yang, A.; **Lebby, M.**; Varsa, E., “Photonics Industry-University Collaborations (PICs) Final Technical Rept. 22 Apr-30 Jul 2008, Optoelectronics Industry Development Association, June 2009.
20. **Lebby, M.S.**, “Testimony before the US-China Economic and Security Review Commission on the optoelectronics industry”, 24th March, 2009 (<http://www.oida.org/news/oida-news/2009/381>)
21. **Lebby, M.**; Clayton, R., “Growing at light speed [Optoelectronics],” *Circuits Assembly*, vol. 18, no. 9, pp. 44-5, Sept. 2007.

22. Huff, D.B.; **Lebby, M.S.**, “Fiber optic sensing technology: emerging markets and trends,” Proceedings of the SPIE - The International Society for Optical Engineering, vol. 6619, pp. 661902 (7 pp.), July 2007.
23. **Lebby, M.S.** and Clayton, R, Optoelectronics Roadmap OIDA-iNEMI, IEEE Packaging and Assembly, May 2007.
24. **Lebby, Michael**, “A new model for the optoelectronic indium-based semiconductor industry,” Optics and Photonics News, May 2006.
25. **Lebby, M.**, “Optical components and their role in optical networks,” 2001 Proceedings. 51st Electronic Components and Technology Conference, 2001.
26. **Lebby, M.**, “OEICs: commercialization at last,” Compound Semiconductor, vol. 7, no. 6, pp. 81-2, 85, July 2001.
27. **M. S. Lebby** & W. B. Jiang. “Packaging of Optical Components and Systems,” Wiley Encyclopedia of Electrical and Electronics Engineering, Vol 15 pp 499-516. John G. Webster (Ed.), John Wiley & Sons, New Jersey, 1999.
28. W. B. Jiang, & **M. S. Lebby**, “Optical Sources: Light-emitting diodes and laser technology,” Handbook of fiber optic data communication, C. DeCusatis, et al, (Ed.), Academic Press, 1998.
29. W. B. Jiang, & **M. S. Lebby**, “Semiconductor laser and light emitting diode fabrication,” Handbook of fiber optic data communication, C. DeCusatis, et al, (Ed.), Academic Press, 1998.
30. Berry, G.; Summers, H.D.; Blood, P.; Claisse, P.; **Lebby, M.**, “Optical bistability in vertical cavity surface emitting lasers with a simple intra-cavity epitaxial absorber layer,” Conference Digest. ISLC 1998 NARA. 1998 IEEE 16th International Semiconductor Laser Conference, 1998.
31. Jiang, W.; Norton, L.; Kiely, P.; Schwartz, D.; Gable, B.; **Lebby, M.**; Raskin, G., “Vertical cavity surface emitting laser-based parallel optical data link,” Optical Engineering, vol. 37, no. 12, pp. 3113-18, Dec. 1998.
32. Robertsson, M.E.; Hagel, O.J.; Gustafsson, G.; Dabek, A.; Popall, M.; Cergel, L.; Wennekers, P.; Kiely, P.; **Lebby, M.**; Lindahl, T., “O/e-MCM packaging with new, patternable dielectric and optical materials,” 1998 Proceedings. 48th Electronic Components and Technology Conference, pp. 1413-21, May 1998.
33. Popall, M.; Dabek, A.; Robertsson, M.E.; Gustafsson, G.; Hagel, O.-J.; Olsowski, B.; Buestrich, R.; Cergel, L.; **Lebby, M.**; Kiely, P.; Joly, J.; Lambert, D.; Schaub, M.; Reichl, H., “ORMOCERs™-new photo-patternable dielectric and optical materials for MCM-packaging,” 1998 Proceedings. 48th Electronic Components and Technology Conference, May 1998.
34. Claisse, P.R.; Jiang, W.; Kiely, P.A.; Roll, M.; Boughter, L.; Sanchez, P.; Cotney, D.; **Lebby, M.**; Webb, B.; Lawrence, B., “Automatic power control of a VCSEL using an angled lid TO56 package,” 1998 Proceedings. 48th Electronic Components and Technology Conference, May 1998.
35. **Lebby, M. S.**, “VCSEL Devices and Packaging for Fiber Optic Transceivers,” Integrated Photonics Research, paper MD1, March 30th, 1998.

36. **Lebby, M.S.**; Claisse, P.; Jiang, W.; Kiley, P.; Roll, M.; Boughter, L.; Sanchez, P.; Lawrence, B., "VCSEL devices and packaging," Proceedings of the SPIE - The International Society for Optical Engineering, vol. 3289, pp.2-12, Jan. 1998.
37. Popall, M.; Dabek, A.; Robertsson, M.E.; Gustafsson, G.; Hagel, O.-J.; Olsowski, B.; Buestrich, R.; Cergel, L.; **Lebby, M.**; Kiely, P.; Joly, J.; Lambert, D.; Schaub, M.; Reichl, H., "ORMOCERs - new photo-patternable dielectric and optical materials for MCM-packaging," Proceedings of the 1998 48th Electronic Components & Technology Conference, Jan. 1998.
38. **Lebby, M.**, "Optoelectronic Devices and Packaging Technology," 4th IEEE Workshop on AST Phoenix Research Center, IEEE, Jan 1998.
39. Jiang, W.; Claisse, P.; Gaw, C.; Kiely, P.; Lawrence, B.; **Lebby, M.**; Roll, M., "Vertical cavity surface emitting laser packaging with auto power control," 1997 Proceedings. 47th Electronic Components and Technology Conference, pp. 368-70, May 1997.
40. Gaw, C.A.; Jiang, W.; **Lebby, M.**; Kiely, P.A.; Claisse, P.R., "Characteristics of VCSELs and VCSEL arrays for optical data links," Proceedings of the SPIE - The International Society for Optical Engineering, vol. 3004, pp. 122-33, Feb. 1997.
41. Raskin, G.; **Lebby, M.S.**; Carney, F.; Kazakia, M.; Schwartz, D.B.; Gaw, C.A., "Parallel interconnect for a novel system approach to short distance high information transfer data links," Proceedings of the SPIE - The International Society for Optical Engineering, vol. 3038, pp. 165-74, Feb. 1997.
42. Jiang, W.; Gaw, C.; Kiely, P.; Lawrence, B.; **Lebby, M.**; Claisse, P.R., "Effect of proton implantation on the degradation of GaAs/AlGaAs vertical cavity surface emitting lasers," Electronics Letters, vol. 33, no.2, pp. 137-9, Jan. 1997.
43. Jiang, W.; Gaw, C.; Kiely, P.; Lawrence, B.; **Lebby, M.**; Ramdani, J.; Claisse, P., "Relative intensity noise of 780 nm vertical cavity surface emitting lasers," Proceedings of the 1997 Pacific Rim Conference on Lasers and Electro-Optics, CLEO/Pacific Rim, No. 46984, Jan. 1997.
44. Schwartz, D.B.; Chun, C.K.Y.; Foley, B.M.; Hartman, D.H.; **Lebby, M.**; Lee, H.C.; Chan Long Shieh; Kuo, S.M.; Shook, S.G.; Webb, B., "A low-cost high-performance optical interconnect," (1996), http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=533892.
45. **Lebby, M.**; Gaw, C.A.; Jiang, W.; Kiely, P.A.; Claisse, P.R.; Grula, J., "Key challenges and results of VCSELs in data links," Conference Proceedings. LEOS '96 9th Annual Meeting. IEEE Lasers and Electro-Optics Society 1996 Annual Meeting, pp. 167-8, vol. 2, Nov. 1996.
46. Schwartz, D.B.; Carney, F.; Chun, C.K.Y.; Claisse, P.; Foley, B.M.; Gaw, C.; Hartman, D.H.; Kiely, P.; Knapp, J.; Wenbin Jiang; Shun Meen Kuo; **Lebby, M.**; Planer, S.; Norton, L.J.; Raskin, G.; Sauvageau, J.; Chan Long Shieh; Shook, S.G.; Tapp, S., "Low-cost high-performance optical interconnect," CLEO '96. Summaries of Papers Presented at the Conference on Lasers and Electro-Optics., vol. 9. 1996 Technical Digest Series. Conference Edition, June 1996.
47. **Lebby, M.**; Gaw, C.A.; Jiang, W.; Kiely, P.A.; Chan Long Shieh; Claisse, P.R.; Ramdani, J.; Hartman, D.H.; Schwartz, D.B.; Grula, J., "Characteristics of VCSEL arrays

- for parallel optical interconnects,” 1996 Proceedings. 46th Electronic Components and Technology Conference, pp. 279-91, May 1996.
48. **Lebby, M.**, “Characteristics of VCSEL Parallel Optical Interconnecters,” IEEE, May 1996.
 49. **Lebby, M.**; Gaw, C.A.; Jiang, W.; Kiely, P.A.; Chan Long Shieh; Claisse, P.R.; Ramdani, J.; Hartman, D.H.; Schwartz, D.B.; Grula, J., “Use of VCSEL arrays for parallel optical interconnects,” Proceedings of the SPIE - The International Society for Optical Engineering, vol. 2683, pp. 81-91, Feb. 1996.
 50. **Lebby, M.**; Gaw, C.A.; Jiang, W.; Kiely, P.A.; Shieh, C.L.; Claisse, P.R.; Ramdani, J.; Hartman, D.H.; Schwartz, D.B.; Chun, C.K.Y.; Foley, B.M., “Parallel optical interconnects using VCSELs,” Proceedings. IEEE/Cornell Conference on Advanced Concepts in High Speed Semiconductor Devices and Circuits, pp. 348-56, Aug. 1995.
 51. Schwartz, D.B.; Chun, C.K.Y.; Foley, B.M.; Hartman, D.H.; **Lebby, M.**; Lee, H.C.; Chan Long Shieh; Shun Meen Kuo; Shook, S.G.; Webb, B., “A low cost, high performance optical interconnect,” (May 1995),
http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=514410.
 52. Kiely, P.A.; Taylor, G.W.; Isabelle, A.; **Lebby, M.S.**; Tell, B.; Brown-Goebeler, K.F.; Chang, T.-Y., “An n-channel BICFET in the InGaAs/InAlGaAs/InAlAs material system,” IEEE Electron Device Letters, vol. 10, no. 7, pp. 304-6, July 1989.
 53. **Lebby, M.S.**; Kiely, P.A.; Taylor, G.W., “Reactive ion etching (RIE) and magnetron ion etching (MIE) combinations for opto-electronic integrated circuit (OEIC) processing,” Proceedings of the SPIE - The International Society for Optical Engineering, vol. 1037, pp.88-96, Nov. 1988.
 54. Taylor, G.W.; Crawford, D.L.; Kiely, P.A.; Cooke, P.; Sargood, S.; Isabelle, A.; Chang, T.Y.; Tell, B.; **Lebby, M.S.**; Brown-Goebeler, K.; Simmons, J.G., “An inversion channel technology for opto-electronic integration,” Proceedings of the SPIE - The International Society for Optical Engineering, vol. 994 , pp. 251-7, 1989.
 55. Taylor, G.W.; Kiely, P.A.; Isabelle, A.; Crawford, D.L.; **Lebby, M.S.**; Chang, T.-Y.; Tell, B.; Goebeler, K.B.; Simmons, J.G., “An n-channel BICFET in the GaAs/AlGaAs material system,” IEEE Electron Device Letters, vol. 10, no. 2, pp. 88-90, Feb. 1989.
 56. G. W. Taylor, **M. S. Lebby**, T. Y. Chang, R. P. Gnall, N. Sauer, B. Tell, and J. G. Simmons, “ Very High Transconductance HFET”, *IEEE International Electron Devices Conference and Proceedings*, LA, Dec 1988.
 57. Crawford, D.L.; Taylor, G.W.; Kiely, P.A.; Cooke, P.; Isabelle, A.; Chang, T.Y.; Tell, B.; **Lebby, M.S.**; Brown-Goebeler, K.; Simmons, J.G., “An inversion channel technology for opto-electronic integration,” Fourteenth European Conference on Optical Communication, No. 292, vol. 1, pp. 211-14, Sept. 1988.
 58. Taylor, G.W.; **Lebby, M.S.**; Kiely, P.A.; Cooke, P.; Isabelle, A.; Chang, T.Y.; Tell, B.; Crawford, D.L.; Brown-Goebeler, K.; Simmons, J.G., “Performance and advantages of BICFETs versus HBTs,” Proceedings of the 1988 Bipolar Circuits and Technology Meeting, pp. 41-5, Sept. 1988.
 59. Taylor, G.W.; Crawford, D.L.; Kiely, P.A.; Sargood, S.K.; Cooke, P.; Isabelle, A.; Chang, T.Y.; Tell, B.; **Lebby, M.S.**; Brown-Goebeler, K.; Simmons, J.G.,

- “GaAs/AlGaAs inversion channel devices for an integrated opto-electronic technology,” IEEE Transactions on Electron Devices, vol. 35, no. 12, pp. 2446, June 1988.
60. **Lebby, M.S.**; Taylor, G.W.; Izabelle, A.; Tell, B.; Brown-Goebeler, K.; Chang, T.-Y.; Simmons, J.G., “A p-channel BICFET in the InGaAs/InAlAs material system,” IEEE Electron Device Letters, vol. 9, no. 6, pp. 278-80, June 1988.
61. Taylor, G.W.; **Lebby, M.S.**; Izabelle, A.; Tell, B.; Brown-Goebeler, K.; Chang, T.-Y.; Simmons, J.G., “Demonstration of a p-channel GaAs/AlGaAs BICFET,” IEEE Electron Device Letters, vol. 9, no.2, pp.84-6, Feb. 1988.
62. Taylor, Geoffrey; **Lebby, M S**; Izabelle, A; Tell, B; Brown-Goebeler, K., “Demonstration of a p-channel GaAs/AlGaAs BICFET (Bipolar Inversion- Channel),” IEEE Electron Device Letters, vol. 9, pp. 84-86, Feb. 1988.
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.
64. Taylor, G.W.; **Lebby, M.S.**; Chang, T.Y.; Gnall, R.N.; Sauer, N.; Tell, B.; Simmons, J.G., “GaAs/AlGaAs inversion channel devices for an integrated opto-electronic technology,” Electronics Letters, vol. 23, no. 2, pp. 77-9, Jan. 1987.
65. Taylor, G.W.; **Lebby, M.S.**; Chang, T.Y.; Gnall, R.N.; Sauer, N.; Tell, B.; Tennant, D.M.; Simmons, J.G., “A new heterostructure FET,” International Electron Devices Meeting 1986. Technical Digest, pp. 817-21, Dec. 1986.

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
 - d. <http://www.edt.brad.ac.uk/home/>
- 3) <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1486581> 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 $L_g = 2/\mu m$ 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"
 - d. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4257306>
- 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
 - c. http://www.electrochem.org/meetings/biannual/past_meetings_list.htm

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"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=2048>
- 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"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8871>
- 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"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=716&tag=1>
- 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) <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=93560> 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"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=51041>
- 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.
 - c. http://spie.org/x648.html?product_id=951018

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"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=29660&tag=1>
- 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"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=32438&tag=1>
- 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
- d. http://spie.org/x648.html?product_id=960136

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
 - c. http://www.researchgate.net/publication/235184814_A_Compendium_of_Position_Papers_from_the_Workshop_on_Architectures_for_Free_Space_Digital_Optical_Computing_Held_in_Vail_Colorado_on_28-30_January_1991

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"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=482526>
- 11) Book: Research in VCSEL devices - Annual technical review 1995
 - 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
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=864750>
- 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"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=571604>
- 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"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=533892>
- 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"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=517404>
- 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
 - c. <http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=1015866>
- 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
 - d. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=533892>
- 21) Invited talk and abstract: Ridge Waveguide and Planar VCSEL Device Reliability
- a. Sep 1996
 - b. European Laser Workshop, Oslo, 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
 - c. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=579434>
- 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
 - b. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=610586>
- 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
- c. <http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=918720>
- 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
 - c. <http://www.deepdyve.com/lp/spie/parallel-interconnect-for-a-novel-system-approach-to-short-distance-RFreDaEJjb>
- 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 1997
 - c. http://www.researchgate.net/publication/3700010_Vertical_cavity_surface_emitting_laser_packaging_with_auto_powercontrol
- 30) Course (peer reviewed): "Optoelectronic devices and packaging"
 - a. May 1997
 - b. IEEE ECTC
 - c. <http://www.ectc.net>
- 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
 - c. [http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=606195&contentType=Conference+Publications&sortType%3Dasc_p_Sequence%26filter%3DAND\(p_IS_Number%3A13278\)](http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=606195&contentType=Conference+Publications&sortType%3Dasc_p_Sequence%26filter%3DAND(p_IS_Number%3A13278))
- 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 its 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 tomorrow's 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
 - d. <http://www.ewh.ieee.org/soc/cpmt/ast98/lebbby-01.ppt>
- 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 photopatternable 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: 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 µm have been achieved
 - c. Proceedings of the 1998 48th Electronic Components and Technology Conference
 - d. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=678838&contentType=Conference+Publications>
- 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
 - c. <http://www.opticsinfobase.org/abstract.cfm?URI=IPR-1998-IWD1>
- 37) Paper: Automatic power control of a VCSEL using an angled lid TO56 package
- a. May 1998
 - b. 1998 Proceedings. 48th Electronic Components and Technology Conference

- c. <http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=678694&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel4%2F5582%2F14953%2F00678694.pdf%3Farnumber%3D678694>
- 38) Paper: O/e-MCM packaging with new, patternable dielectric and optical materials
 - a. May 1998
 - b. Electronic Components & Technology Conference, 1998. 48th IEEE
 - c. <http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=678929&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel4%2F5582%2F14953%2F00678929.pdf%3Farnumber%3D678929>
- 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-patternable 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 µm have been achieved
 - c. 1998 Proceedings. 48th Electronic Components and Technology Conference
 - d. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=678838&contentType=Conference+Publications>
- 40) Course (peer reviewed): "Optoelectronic devices and packaging: VCSEL technology"
 - a. May 1998
 - b. IEEE ECTC
 - c. <http://www.ectc.net>
- 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
 - d. <http://www.ectc.net>
- 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.
 - c. http://spie.org/x648.html?product_id=318648
- 46) Paper: VCSEL devices and packaging
- a. Dec 1998
 - b. Proceedings of SPIE, ISSN 0277-786X, 05/2003, Volume 3289, Issue 1
 - c. <http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=935769>

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
 - c. <http://www.ectc.net>

2000

- 49) Invited Panel Session: Opto Electronic Integrated Circuits - More IC than OE?
- 5th Mar 2000
 - "The panel session focused on optical integration for communications. Other panel members included Brendan Hyland CEO of Kymata amongst others.
 - OSA Executive Forum: Photonics and Telecommunications: the tidal wave of the new millennium
 - <http://www.laserfocusworld.com/articles/2000/02/osa-executive-forum-at-ofc-2000.html>
- 50) Course: Optoelectronics Components and Modules for Datacom and Telecom
- May 2000
 - 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.
 - Proceedings 50th Electronics Components and Technology Conference May 2000
 - <http://www.thierry-lequeu.fr/data/Ectc/ECTC2000/ECTC2000.pdf>
- 51) Invited Presentation and Abstract: An investor's perspective on optical interconnects
- 24th May 2000
 - The talk discusses the investor's perspective on optical interconnects from Intel Capital.
 - IEEE: Workshop on interconnections within high-speed digital systems
 - <http://www.oi-ieee.org/>
- 52) Invited Presentation: Optoelectronic Integration for Metro DWDM: Intel's perspective...
- 3rd Sep 2000
 - As part of the ECOC conference in Munich Germany, this workshop invited 9 speakers to discuss the future of optical networking in metropolitan environments.
 - Electronicast Europe
 - <http://www.electronicastconsultants.com>
- 53) Keynote Presentation: Optoelectronics Integration for Metro DWDM, Intel's Perspective
- 9th Oct 2000
 - Electronicast Corporations: Optical communications start-up and emerging companies conference
 - <http://www.electronicastconsultants.com>
- 54) Panel Session: Semiconductors to Optics
- 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
- d. <http://www.thefreelibrary.com/Endwave+Founder+and+EVP+To+Speak+at+JP+Morgan+Communications...-a067529552>

2001

- 55) Paper: Optical components and their role in optical networks
 - a. 2001
 - b. Electronic Components and Technology Conference, 2001. Proceedings., 51st
 - c. http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=927765&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxppls%2Fabs_all.jsp%3Farnumber%3D927765
- 56) Invited Presentation: "Starting a company and hitting the ground running"
 - a. 7th Feb 2001
 - b. Storm Ventures limited partner meeting
 - c. <http://www.stormventures.com>
- 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
 - c. <http://www.photonics.com/Article.aspx?AID=8916>
- 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
 - c. <http://www.compoundsemiconductor.net/csc/features-details.php?cat=features&id=11719>

2002

- 61) Book chapter: "Optical sources: Light-emitting diodes and laser technology"
- Published 2002
 - "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.
 - Academic Press (1998, 2002); ISBN: 0-12-207892-6; Handbook of Fiber Optic Data Communication By Casimer DeCusatis
 - http://books.google.com/books?id=Rlb6lKknl8IC&printsec=frontcover&source=gb_s_ge_summary_r&cad=0#v=onepage&q&f=false
- 62) Book chapter: "Semiconductor laser and light emitting diode fabrication"
- Published 2002
 - "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.
 - Academic Press: Editor DeCusatis: Fiber Optic Data Communication: Technological Advances and Trends (February 2002, ISBN: 0-12-207892-6)
 - <http://books.google.com/books?id=Rlb6lKknl8IC&lpg=PP1&pg=PP1#v=onepage&q&f=false>
- 63) Keynote speech: "Business and Technical Perspectives for Optical Networking"
- 14th Jul 2002
 - PhoPack 2002 Stanford University
 - http://www.accessmylibrary.com/coms2/summary_0286-25792277_ITMhttp://books.google.com/books/about/LEOS_88.html?id=LUS0cQAAAJ
- 64) Interview Optcon (Japan), "Ignis Optics: Small is beautiful"
- 15th Aug 2002
 - Overview of Ignis Optics strategy for fiber optic transceivers with innovative optoelectronic devices and packaging (in Japanese).
 - Optcon volume 8, no 161, pp50-51
 - <http://magissuelist.nichigai.co.jp/detail?id=0000000098732>
- 65) Panel Session: An adventure into venture capital - lessons from silicon valley
- 12th Sep 2002
 - 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
- c. <http://www.electronicastconsultants.com/>

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.
- c. <http://www.compoundsemiconductor.net>

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
- d. <http://www.oida.org/home/publications/oida-publication-report-library/>

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
- d. <http://www.compoundsemiconductor.net>

70) Short Article: President's Letter to OIDA Membership

- a. Nov 2005

- b. OIDA Newsletter, quarterly from 2005-2009
 - c. http://www.wsr-ods.com/files/oidanews_0408.pdf
- 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
 - c. <http://opticscenter.uncc.edu/node/275>

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 [http://www.oida.org/home/publications/oida_publication_report_library/100_gb_ethernet_the_next_challenge_for_communi\(1\)/](http://www.oida.org/home/publications/oida_publication_report_library/100_gb_ethernet_the_next_challenge_for_communi(1)/)
 - c.
- 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 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
 - e. http://www.oida.org/home/publications/oida_publication_report_library/the_challenge_for_indium_phosphide_photonic_develo/
- 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
 - e. http://www.oida.org/home/publications/oida_publication_report_library/nitride_led_and_laser_technology_and_its_impact_on/
 - f.
- 75) Invited Article: A New Model for the Optoelectronic Indium-based Semiconductor Industry
- a. May 2006
 - b. OSA: Optics and Photonics News
 - c. <http://www.osa-opn.org/Content/ViewFile.aspx?id=10456>
- 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
 - d. http://www.oida.org/home/publications/oida_publication_report_library/2006_global_optoelectronics_industry_market_report/
- 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
 - e. http://www.oida.org/home/publications/oida_publication_report_library/high_power_diode_laser_sources_and_their_impact_on/
- 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.

- d. OIDA
- e. http://www.oida.org/home/publications/oida_publication_report_library/biophotonic_sensors_and_smart_fiber_optic_sensor_n/

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
- e. http://www.oida.org/home/publications/oida_publication_report_library/wide_area_surveillance/

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
- d. <http://www.biophot.caltech.edu/optofluidics/>

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
- c. <http://opticscenter.uncc.edu/node/268>

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
- e. http://www.oida.org/home/publications/oida_publication_report_library/artificial_vision_systems/

- 83) Keynote address: Global perspectives in optoelectronics and photonics
- 6th Dec 2006
 - Photonics 21: European Union's 7th Framework Program Key Photonics Platform
 - http://www.photonics21.org/downloads/download_presentations.php

2007

- 84) Workshop: Micropackaging for the Next Generation of Optical and Electrical Components
- 2007
 - Workshop chairman and editor of the report:
 - 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.
 - OIDA
 - http://www.oida.org/home/publications/oida_publication_report_library/micropackaging_for_the_next_generation_of_optical/
- 85) Workshop: Silicon Photonics: Challenges and Future, 2007
- 2007
 - Workshop chairman and editor of the report:
 - 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.
 - OIDA
 - http://www.oida.org/home/publications/oida_publication_report_library/silicon_photonics_challenges_and_future_2007/
- 86) Workshop: Photonic Sensors Roadmapping Report, 2007
- 2007
 - Workshop chairman and editor of the report:
 - 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
 - e. http://www.oida.org/home/publications/oida_publication_report_library/photonic_sensors_roadmapping_report_2007/
- 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)
 - e. <http://adsabs.harvard.edu/abs/2007SPIE.6619E...2H>
- 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
 - d. <http://www.cpmt.org/scv/meetings/cpmt0701.html>
- 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
 - c. <http://www.epixnet.org/index.php?id=393>
- 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
 - e. http://www.oida.org/home/publications/oida_publication_report_library/100_gb_ethernet_the_next_challenge_for_communicati/
- 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
 - d. http://www.oida.org/home/publications/oida_publication_report_library/2007_global_optoelectronics_industry_market_report/
- 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
 - d. <http://www.thefreelibrary.com/Growing+at+light+speed%3a+after+a+false+start%2c+OE+is+fast+becoming+a...-a0168812805>
- 94) Keynote/special invited talk: "10 Grand Challenges in Photonics"
- a. 31st Oct 2007
 - b. Sixth annual symposium UNCC Optoelectronics Center
 - c. <http://opticscenter.uncc.edu/node/265>

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 3) The implications of offshore manufacturing on both the U.S. defense and commercial market sectors within the different fields of optoelectronics.

- d. OIDA
 - e. http://www.oida.org/home/publications/oida_publication_report_library/perspectives_on_the_optoelectronics_industry_manuf/
- 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
 - d. http://www.oida.org/home/publications/oida_publication_report_library/perspectives_on_the_optoelectronics_industry_innov/
- 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
 - e. http://www.oida.org/home/publications/oida_publication_report_library/perspectives_on_the_optoelectronics_industry_2008/
- 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
 - e. http://www.oida.org/home/publications/oida_publication_report_library/future_optical_communication_systems_2008/
- 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
- d. <http://books.google.com/books?hl=en&lr=&id=wXV9tffoGeYC&oi=fnd&pg=PR9&dq=michael+lebbby&ots=cYEwXIHMDC&sig=KlCtj2ZDgbOYEhnqKdHiMo6SdzA#v=onepage&q=michael%20lebbby&f=false>

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
 - e. http://www.oida.org/home/publications/oida_publication_report_library/green_photonics_the_role_of_optoelectronics_in_a_s/
- 101) Conference: Optimism: "Powering the green revolution through photonics"
 - a. 4th Jan 2009
 - b. "Co-chairman of Optimism conference with Pennwell.
 - c. OIDA and Pennwell (Laser Focus World)
 - d. <http://www.laserfocusworld.com/articles/print/volume-45/issue-4/world-news/conference-preview-optimism-to-emphasize-lsquoogreenrsquo-growth.html>
- 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
 - d. http://ec.europa.eu/information_society/events/cf/ee09/item-display.cfm?id=2174
- 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
 - e. http://www.uscc.gov/hearings/2009hearings/written_testimonies/09_03_24_wrts/09_03_24_lebby_statement.pdf
- 104) Report: Photonics industry-university collaborations (PICs)
- a. 1st Jun 2009
 - b. OIDA Final Technical Report
 - c. <http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA502737>
- 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
 - d. <http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=5270369&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F2220%2F5270368%2F05270369.pdf%3Farnumber%3D5270369>
- 106) Paper: Photonic Intgeration: what is the Holy Grail?
- a. 14th Oct 2009
 - b. Compound Semiconductor
 - c. <http://compoundsemiconductor.net/csc/features-details.php?id=40435>
- 107) Keynote talk: Global optoelectronics and green photonics trends
- a. 28th Oct 2009
 - b. UNCC 8th Annual Symposium: Optoelectronics Center

- c. <http://opticscenter.uncc.edu/node/255>
- 108) Keynote talk and abstract: Is this the rise of green photonics?
 - a. Dec 2009
 - b. ICFO (Institut de Ciencies Fotoniques) Barcelona, Spain
 - c. <http://www.icfo.es/images/news/ICFO%20CLP%20DAY%20Program.pdf>
- 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
 - d. http://www.oida.org/home/publications/oida_publication_report_library/2009_global_optoelectronics_industry_market_report/
- 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
 - d. <http://www.youtube.com/watch?v=t8EB-1-1irY>
- 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)
 - d. <http://onlinelibrary.wiley.com/doi/10.1002/047134608X.W2106/abstract>

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
 - d. http://www.oida.org/home/publications/oida_publication_report_library/fabrication_challenges_and_opportunities_in_photon/
- 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
 - d. <http://iee.ucsb.edu/node/1024>
- 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
 - d. <http://www.clocate.com/conference/3rd-Annual-Green-Photonics-Forum-OIDA-Green-2010/4045/>
- 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
 - c. <http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=5643407&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F5623516%2F5643317%2F05643407.pdf%3Farnumber%3D5643407>

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)
 - c. <http://ecst.ecsdl.org/content/41/3/161>
- 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. <http://www.photonics.com/Webinar.aspx?WebinarID=7>
- 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
 - c. <http://honet.uncc.edu/archive/honet11/speakers.htm>

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)
 - c. <http://jss.ecsdl.org/content/1/2/N24.full.pdf+html>
- 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)
 - c. <http://onlinelibrary.wiley.com/doi/10.1002/pssc.201200255/abstract>
- 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)
 - c. <http://onlinelibrary.wiley.com/doi/10.1002/pssc.201100393/abstract>
- 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
- e. <http://onlinelibrary.wiley.com/doi/10.1002/pssc.201100393/abstract>
- 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
 - d. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=6118290&contentType=Journals+%26+Magazines>
- 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
 - c. http://proceedings.aip.org/resource/2/apcpcs/1477/1/36_1?bypassSSO=1
- 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
 - c. http://scholar.googleusercontent.com/scholar?q=cache:l3-oHWxNDzwJ:scholar.google.com/+%22michael+lebbby%22&hl=en&as_sdt=1,5&as_ylo=2013&as_vis=1
- 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
 - c. <http://ma.ecsdl.org/content/MA2012-02/30/2538.short>

2013

- 127) Paper: Epitaxial 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
- c. <http://ecst.ecsdl.org/content/50/4/47.short>
- 128) Article: OPTICAL MATERIALS: 'On-silicon' engineered substrates speed photonic device development
 - a. 1st Apr 2013
 - b. Laser Focus World
 - c. <http://www.laserfocusworld.com/articles/print/volume-49/issue-04/features/optical-materials---on-silicon--engineered-substrates-speed-phot.html>
- 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
 - d. <http://www.ecoc2013.org/sc2.html>
- 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)
 - c. <http://jss.ecsdl.org/content/1/5/P246.full>
- 131) Growth of GaN by MOCVD on rare earth oxide on Si(111)
 - a. 31st Oct 2013
 - b. ECS Transactions, 58, 455 (2013)
 - c. <http://ecst.ecsdl.org/content/58/4/455.short>
- 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
 - d. <http://www.euroinvestor.com/news/2013/12/10/iqe-plc-capital-markets-day/12617916>
- 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
 - d. http://www.orc.soton.ac.uk/UKSP_presents.html
- 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)
 - d. <http://epic-assoc.com/contact-us/?at=94>
- 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)?
 - d. <http://epic-assoc.com/contact-us/?at=94>

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
 - c. <http://www.cpmpt.org/scv/meetings/cpmpt1401.html>
- 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
 - e. <http://www.phoxtrot.eu/1st-optical-interconnect-in-data-centers-symposium/>
- 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
 - c. <http://cs-international.net/agenda.php>
- 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
 - d. <http://www.hollandinthevalley.com/panel-discussion-on-the-future-of-integrated-photonics/>
- 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
 - c. <http://www.astro.cardiff.ac.uk/research/cmp/events/resources/Sioeprogramme14final.pdf>
- 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
 - c. <http://www.glyndwr.ac.uk/en/AboutGlyndwrUniversity/Newsandmediacentre/Newsarchive/PressReleases2014/UniWeek/>
- 142) Invited Talk/Panel session: EPIC technology workshop on Photonic Integrated Circuits (PIC) packaging standardization
- a. 18th Jun 2014
 - b. EPIC
 - c. <http://epic-assoc.com/contact-us/?at=94>
- 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
 - e. <http://www.sciencedirect.com/science/article/pii/S0022024812009487>
- 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)
 - d. http://www.wof.org.uk/home.php?page_id=4&event_id=317
- 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
- d. <http://www.photonics21.org/download/Events/DraftagendaPhotonicsPilotLineworkshop-Website.pdf>

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 California'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)
 - e. <http://www.isi.edu/news/story/531784>
- 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
 - e. <http://www.epic-assoc.com/epic-workshop-on-photonic-integrated-circuits/>
- 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
 - c. <http://www.ita15.net/keynote-speaker/>

- 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
 - d. <http://www.phiconference.com/photonics/building-big-business-with-the-next-generation-integrated-circuits/>
- 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
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/916-ict-28-2015.html>
- 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
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/916-ict-28-2015.html>
- 152) Keynote talk and abstract: "PIC the next generation IC..."
 - a. 23rd Sep 2015
 - b. Photonic Integration Conference, organized by Jakajima, Netherlands
 - c. <http://www.phiconference.com/program/>
- 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
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/916-ict-28-2015.html>
- 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
 - c. <http://webcache.googleusercontent.com/search?q=cache:Qb68vjzhV5IJ:www.ecocexhibition.com/visitorhome/marketfocus2015/cfs+&cd=1&hl=en&ct=clnk&gl=us&client=safari>

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
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5094-ict-29-2016.html>
- 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
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5094-ict-29-2016.html>
 - d. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5094-ict-29-2016.html>
- 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
 - c. <http://lightwavelogic.com/company-updates/>
- 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
- c. <http://www.ecocexhibition.com/marketfocus>
- 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
 - d. <http://www.ecocexhibition.com/interviews2016>
- 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
 - b. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5094-ict-29-2016.html>
- 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.
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5094-ict-29-2016.html>

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 Leefink about photonics ecosystem and startups. Photonics highlights (Michael Lebby)
 - c. Consulate General San Francisco, The Kingdom of Netherlands
 - d. <https://ez.atavist.com/emerging-technologies-summit>
- 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.
 - c. <http://www.photondelta.eu>

- 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
 - d. <https://www.iaf.fraunhofer.de/en/research/research-areas/semiconductor-lasers/mirphab.html>
- 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
 - d. <http://pi-scale.eu>
- 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
 - d. <http://www.fabiodisconzi.com/open-h2020/projects/206352/index.html>
- 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
 - d. <http://www.lightwavelogic.com>
- 171) Chairman: PIC (Photonic Integrated Circuits) International Conference, Brussels, Belgium
 - a. 7th Mar 2017
 - b. "Photonic Integrated Circuits International
 - c. CS International
 - d. <http://www.picinternational.net>
- 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
 - d. <http://www.photondelta.eu>
- 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
 - d. <http://www.pix4life.eu>
- 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"
 - c. <http://www.xilinx.com>
- 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)
 - d. <http://www.lightwavelogic.com/presentations>
- 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
 - d. <https://worldtechnologymappingforum.org/the-programme>
- 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)
 - d. <https://worldtechnologymappingforum.org/the-programme>
- 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
 - c. <https://vimeo.com/317216466>
- 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
- d. <http://www.picinternational.net>
- 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
- d. <http://www.picinternational.net>
- 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
 - d. <http://www.picinternational.net>
- 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
 - d. <http://www.picinternational.net>
- 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
 - c. <https://vimeo.com/275376937>
- 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.
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 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.
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 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.
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 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.
- d. <https://www.photondelta.eu>
- 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.
 - d. <https://www.photondelta.eu>
- 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 PISCAL
 - a. 18th Sept 2018
 - b. European Commission, Brussels
 - c. PISCAL 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
 - d. <http://www.picinternational.net>
- 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
 - d. <http://www.picinternational.net>
- 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
 - d. <http://www.picinternational.net>
- 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
 - d. <http://www.picinternational.net>
- 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:
<https://drive.google.com/file/d/1wh8irF8rmi9bU6VeGKAHFqVURyUcytdX/view?usp=sharing>
- 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.
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 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.
 - d. <https://www.photondelta.eu>
- 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.
 - d. <https://www.photondelta.eu>

- 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.
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 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) (www.springinvestorsummit.com)
- 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)
 - c. <https://www.youtube.com/watch?v=Mn4oICQpVTQ>
- 220) Invited video 'Lightwave Logic advancing its silicon photonic prototypes' by Proactive, (<https://www.proactiveinvestors.com>) NY
 - a. 2nd April 2019
 - b. Proactive video (Wall St) series:
<https://www.youtube.com/watch?v=3B0oGXvyogA>
 - 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.
 - d. <http://www.inside-h2020.eu>
- 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
 - c. https://www.youtube.com/watch?v=e_V4TeTSwaM
- 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
 - c. <https://vimeo.com/341952732>
- 224) Reviewer (European Commission) for pilot line PISCALE

- a. 11th Sept 2019
- b. European Commission, Brussels
- c. PISCAL 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.
 - d. <https://spie.org/profile/michael.lebby-4009?SSO=1>
- 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 at: : <https://www.ecocexhibition.com/visit/market-focus/>
- 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:
https://drive.google.com/file/d/1xfisLKe6QIykCAIMjOZ0XdIR-Ht_O7zZ/view?usp=sharing
 - 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 (<https://onlinesummit.angel-tech.net/breakout/pic-international>)
 - 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 at <https://onlinesummit.angel-tech.net/breakout/pic-international>
 - 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.
 - c. <https://www.epic-assoc.com/24hours/> and video on Youtube at: <https://www.youtube.com/watch?v=aiUSlfxPlz0> starting at 46:00
- 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 [https://www.photonics.com/Articles/Electro-Optic Polymers Improve Speed and Power/p5/vol180/i1193/a65902](https://www.photonics.com/Articles/Electro-Optic_Polymers_Improve_Speed_and_Power/p5/vol180/i1193/a65902)
- 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: <https://www.ecocexhibition.com/visit/market-focus/>
- 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
 - b. PIC International Conference, (https://picmagazine.net/article/112351/AngelTech_Virtual_2_-_The_Sequel_Proves_A_Hit_Success) and (<https://onlinesummit.angel-tech.net>)
- 243) 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 (<https://www.youtube.com/watch?v=tHh-z724D2g>) and also at EPIC: <https://www.epic-assoc.com/epic-online-technology-meeting-on-datacenter-interconnects-in-cooperation-with-cobo-and-ea/>

- 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 <https://photonicsplus.com> 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 <https://photonicsplus.com> and also at <https://www.lightwavelogic.com/presentation/video-presentation-commercializing-polymer-modulators/>
 - c. Hosted by EPIC
- 247) Invited Webinar and panelist: Roth Capital Partners (<https://www.roth.com/Page/Corporate-Access-Past-Conferences>)
 - 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., (https://www.lightwavelogic.com/wp-content/uploads/sites/319/2021/03/WP_IPSR-Roadmap-Decoded.pdf)
 - 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,
(https://picmagazine.net/article/112351/AngelTech_Virtual_2_-_The_Sequel_Proves_A_Hit_Success) and (<https://onlinesummit.angel-tech.net>)
 - 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
(<https://www.youtube.com/watch?v=tHh-z724D2g>) 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 (<https://www.oppenheimer.com/events/2021/6th-annual-emerging-growth-conference.aspx>)
 - 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”
- 27th May 2021
 - Presentation can be found at: <https://www.lightwavelogic.com/presentation/2021-asm-business-update-por-lightwave-logic-ceo-dr-michael-lebby/>
 - 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...”
- 2nd June 2021
 - Agenda at: <https://brainporteindhoven.com/en/events/launch-photonics-integration-techology-center> and presentation at: <https://www.lightwavelogic.com/presentation/photonic-integration-technology-center-keynote/>
 - 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”
- 10th June 2021
 - Presentation at: <https://api.mziq.com/mzfilemanager/v2/d/307dbc8b-e212-48ba-9968-8cef3f6b5188/8c054319-48a6-bd6b-2a0c-66e56f5f489f?origin=2>
 - 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
- 15th June 2021
 - Market Focus Exhibition for ECOC 2021,
 - Hosted by ECOC exhibition: <https://www.ecocexhibition.com/visit/market-focus/>
- 258) Invited speaker at HC Wainwright non-deal roadshow (virtual)
- 3rd and 4th August 2021
 - Presentation of “Lightwave Logic investor presentation”
 - Hosted by HC Wainwright Investment Bank
- 259) Invited speaker at Q3 Investor Summit (virtual)
- 17th and 18th August 2021
 - Presentation of “Lightwave Logic investor presentation” and link: <https://drive.google.com/file/d/1mH0bCzOd8UxtvN6FeR50KIP7moFsFhjJ/view?usp=sharing>
 - Hosted by Investor Summit (<https://investorsummitgroup.com>)
- 260) Invited speaker and video recording at HC Wainwright conference (virtual)
- 13-15th September 2021
 - 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:
<https://www.nasdaq.com/videos/lightwave-logic-inc.-rings-the-nasdaq-stock-market-opening-bell>
- 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>
 - a. <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;
<https://tdameritradenetwork.com/video/rB4A-HvPH-2Be9Hw1tYC0w>
- 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 at: : <https://www.ecocexhibition.com/visit/market-focus/>
- 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 <https://www.youtube.com/watch?v=VrFeSwqnWAK>
 - a. 13th September 2021
 - b. Market Focus Exhibition for ECOC 2021,
 - c. Hosted by ECOC exhibition: <https://www.ecocexhibition.com/visit/market-focus/with-video-at>
- 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,
<https://www.ecocexhibition.com/visit/market-focus/market-focus-2021-session-details/>
- 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:
<https://www.ecocexhibition.com/visit/ecoc-exhibition-industry-awards/>
 - 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.
 - d. <https://medphab.eu>
- 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 infrared wavelength modules and technologies based on quantum cascade lasers, MIR detectors, Antimonide based compound semiconductors and their associated packaging.
 - d. <https://www.iaf.fraunhofer.de/en/research/research-areas/semiconductor-lasers/mirphab.html>
- 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.
- d. <https://www.inpulse.jepix.eu>
- 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: https://www.meetmax.com/sched/event_76871/conference_home.html
 - d. <https://www.youtube.com/watch?v=JEvSV8qYGMA>
- 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: <https://www.bizpod.net>
- 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: https://www.meetmax.com/sched/event_76871/conference_home.html
 - d. <https://www.youtube.com/watch?v=JEvSV8qYGMA> and https://me21.mysequire.com/recording?session_id=d354f581-6ab6-47d9-99de-d642c1c25d87
- 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: <https://ladenburg21.mysequire.com>
 - d. Presentation can be found at: <https://ladenburg21.mysequire.com>
- 277) Invited video: Chairmans introduction to the 5th PIC International Conference, www.picinternational.net,
 - 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, , www.picinternational.net,

- 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, , www.picinternational.net,
 - 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, www.picinternational.net
 - 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, www.picinternational.net
 - 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, www.picinternational.net 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 (<http://arnaarteconomics.com/dagvandetips2020/>) investor conference (<https://vimeo.com/653240070>) 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 with youtube recording: <https://www.youtube.com/watch?v=kS-7FVTNE2Y>
 - b. Presentation can be found at: <https://www.youtube.com/watch?v=kS-7FVTNE2Y> and the Spencer Israel show/background at <https://www.linkedin.com/in/spencer-israel-44b02b31/> and <https://www.benzinga.com/author/spencer-israel>

2022

- 285) Invited Live TV interview: Benzinga (Spencer Israel show).
- TV interview on 11th Feb 2022 with youtube recording:
<https://www.youtube.com/watch?v=jFiB9P3voUk>
 - Presentation can be found at: <https://www.youtube.com/watch?v=jFiB9P3voUk> and the Spencer Israel show/background at <https://www.linkedin.com/in/spencer-israel-44b02b31/> and <https://www.benzinga.com/author/spencer-israel>
- 286) Invited Webinar and panelist: Roth Capital Partners at the 34th Annual Roth Dana Point Conference, (<https://www.roth.com/Page/Corporate-Access-Past-Conferences>) with Lightwave Logic investor presentation and meetings.
- 13-15th March 2022
 - 34th Annual Roth Deer Valley Conference (invite only)
 - 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 (<https://www.digitaljournal.com>), and interviewer; Dr. Tim Sandle.
- Digital Journal interview and publication on 1st April 2022 in the Digital Journal.
 - Article and interview can be found at: <https://www.digitaljournal.com/tech-science/qa-electro-optic-polymers-herald-a-new-age-of-ultra-fast-communication/article>
- 288) Invited Article entitled: “Electro-optic polymers allow faster, more efficient data transmission.” With Broadband Communities (<https://www.bbcmag.com>)
- Published in Broadband Communities 13th April 2022.
 - Article can be found at:
https://www.bbcmag.com/pub/doc/BBC_Mar22_webFINAL.pdf
- 289) Invited video: Chairmans introduction to the 6th PIC International Conference, www.picinternational.net, recorded on 10th May 2022.
- 8th May 2022 to be published in May 2022 for the conference being held on 27-29th June 2022
 - Conference hosted by Angel events.
 - Sheraton Airport Hotel, Brussels, Belgium.
- 290) Invited speaker at Oppenheimer 7th Annual Emerging Growth Conference (virtual)
- 10th May 2022
 - Presentation of “Lightwave Logic investor presentation”
 - Hosted by Oppenheimer Investment Bank:
https://www.meetmax.com/sched/event_80933/conference_invlogin.html?event_id=80933&username=LWLG&confirmation_number=MVRJ8BYW865 and
<https://www.oppenheimer.com/events/2022/7th-annual-emerging-growth-conference.aspx>

- 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 <https://medium.com/authority-magazine>
 - 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 can be found at: <https://www.lightwavelogic.com/presentation/2021-asm-business-update-por-lightwave-logic-ceo-dr-michael-lebby/> and stream-video at: https://viaavid.webcasts.com/starthere.jsp?ei=1544482&tp_key=3c8d96d340
 - 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 can be found at: <https://me21.mysequire.com/>
 - 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 (<https://ldinv12.sequireevents.com>)
 - a. 7th June 2022
 - b. Presentation at : <https://me21.mysequire.com/>
 - c. 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 can be found at: <https://photonicsmanufacturing.org/how-get-involved>
 - c. and <https://www.eventbrite.com/e/2022-spring-ipsr-i-roadmap-meeting-tickets-323380047427>
 - d. 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.
- 10th June 2022, election to the CEC (https://www.optica.org/en-us/about/leadership_and_volunteers/councils/councils/)
 - CEC listing: https://www.optica.org/en-us/about/leadership_and_volunteers/councils/councils/#Industry
 - Optica (Optical Society of America – previous name)
- 298) Reviewer: European Commission HORIZON-CL4-2022-DIGITAL-EMERGING-01-38 (CSA): International cooperation in semiconductors
- 8th June 2022
 - 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.
 - CSA: <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 299) Reviewer: European Commission HORIZON-CL4-2022-DIGITAL-EMERGING-01-03: Advanced multi-sensing systems.
- 10th June 2022
 - European Commission: Reviewing submitted technical photonics proposals for Horizon 2022 evaluation calls and rate proposals to EU guidelines.
 - RIA: <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 300) Invited live interview with Dan Loney, Wharton Business Daily Radio Station
- 15th June 2022
 - Wharton Business Daily live radio interview. Subject: Lightwave Logic business and technology plans for growth: <https://twitter.com/whartonbizdaily?lang=en>
 - Location: virtual recording at Lightwave Logic, Englewood, CO.
- 301) Invited speaker at Diamond Equity Research Emerging Growth Invitational Conference (virtual)
- 17th June 2022
 - Presentation of “Lightwave Logic investor presentation”
 - Hosted by Diamond Equity Research Bank: <https://www.diamondequityresearch.com/conferences/> at 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)
- 17th June 2022
 - Market Focus Exhibition, technical sessions and awards for ECOC 2022,
 - Hosted by ECOC exhibition: <https://www.ecocexhibition.com/ecoc-exhibition-2022/> 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”
- 23rd June 2022
 - Interview on the radical innovation needed for the internet and optical networking, hosted by <https://microcapdaily.com/microcapdaily-interviews-dr-michael-lebby-ceo-of-lightwave-logic-inc-nasdaq-lwlg-on-radical-innovation-needed-to-keep-the-internet-growing-2/>
 - Interview with Boe Rimes, Microcap Daily
- 304) Session chairman: 7th PIC International conference, www.picinternational.net
- 28-29th June 2022
 - Conference hosted by Angel events together with CS International and SSI International.
 - Sheraton Airport Hotel, Brussels, Belgium.
- 305) Invited Panelist: For the panel entitled, “Optica Industry Panel: Hybrid Integration” of 6th PIC International conference, www.picinternational.net
- 28-29th June 2022
 - Conference hosted by Angel events together with CS International, and SSI International.
 - 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, www.picinternational.net in the day 2 session, “Optimizing the PIC architecture”
- 28-29th June 2022
 - Conference hosted by Angel events together with CS International, and SSI International.
 - Sheraton Airport Hotel, Brussels, Belgium.
- 307) Invited speaker: “Status of Lightwave Logic and electro-optic polymers” at the Cleydael Golf Club, Antwerp, Belgium (www.cleydael.be)
- 30th June 2022
 - Meeting organized by Belgium and Dutch retail investors of Lightwave Logic Inc. (NASDAQ:LWLG)
 - Location: Belgium
- 308) Invited Article for 7th PIC conference entitled, “PIC International proved to be a fantastic success” (<https://angel-tech.net/marketing/2022/mailers/post-show/pic/>)
- 7th July 2022
 - Conference hosted by Angel events together with CS International, and SSI International.
 - 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:
https://www.youtube.com/watch?v=TyKY9R8WT_U
- b. Video interview can be found at: <https://www.benzinga.com/markets/emerging-markets/22/07/28231018/lightwave-logic-the-company-with-a-proprietary-solution-to-make-transmitting-data-faster> and the Zunaïd Suleman show/background at <https://www.benzinga.com/events/speakers/zunaïd-suleman/>
- c. Location: Virtually recorded in Washington DC
- 310) Invited Live TV interview with SNN network show Planet MicroCap Podcast and host Robert Kraft: <https://www.youtube.com/watch?v=zCD-hTKtkLg>
 - a. 22nd July 2022
 - b. Hosted by SNN and Robert Kraft, and video interview can be found at: <https://podcasts.apple.com/us/podcast/lightwave-logic-nasdaq-lwlg-designing-modulators-that/id1024217659?i=1000574742796>
 - 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: “[Efficient Data Transmission \(Audio\)](#).”
 - a. 9th August 2022
 - b. Hosted by Paul Sweeney and Matt Miller at Bloomberg Market Radio show <https://www.bloombergradio.com/shows/bloomberg-markets-am/>
 - 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 and can be found at: <https://vimeo.com/tbdmediagroup/review/742996199/8dc9821c7a>. with interview at 3:00-50.
 - a. 10th August 2022
 - b. Hosted and videoed by TBD Media hub on [Bloomberg.com](https://www.bloomberg.com)
 - 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.” With link to website: <https://epic-assoc.com/events/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: <https://epic-assoc.com>
 - 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 (www.cleydael.be)
- 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” and link to website: <https://journey.ct.events/hub/660eb381-b261-4d25-afae-35b654ed04c1> and <https://hcwco.com>
- a. 12 and 13th September 2022 (talk on 13th September 2022)
 - b. Meeting organized by HC Wainwright Investment Banking (<https://hcwco.com>)
 - c. Location: Lotte Palace Hotel, New York City, NY
- 319) Invited interview: Interviewed by Greg Bryan at Telegeography (<https://www2.telegeography.com>) Podcast which can be found at: <https://telegeography.podbean.com/> as well as <https://blog.telegeography.com/simply-illuminating-considering-the-future-of-optical-transport>
- 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 : <https://epic-assoc.com/events/epic-meeting-on-cmos-compatible-integrated-photonics-at-imec/>
- 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: <https://www.pingzine.com/featured-article/the-radical-innovation-of-a-new-polymer-internet/>
- 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 at : <https://www.ecocexhibition.com/visit/market-focus/>
- 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 <https://youtu.be/X8iQoB4vqaA>
 - a. 20th September 2022
 - b. Market Focus Exhibition for ECOC 2022,
 - c. Hosted by ECOC exhibition: <https://www.ecocexhibition.com/visit/market-focus/>
- 324) Invited talk and abstract: “Utilizing foundries to scale hybrid electro-optic polymer modulators” with Dr. John Zyskind, VP Engineering, Lightwave Logic Inc: <https://www.ecocexhibition.com/visit/market-focus/components-ics-pics-fiber/>
 - a. 19th September 2022
 - b. Market Focus Session, PIC components
<https://www.ecocexhibition.com/visit/market-focus/market-focus-timetable-2022/>
 - 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) <https://www.ecocexhibition.com/visit/ecoc-exhibition-industry-awards/> :
 - 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 and can be found at: <https://youtu.be/nRd3dYCozUM>
 - a. 21st September 2022
 - b. Market Focus Session, PIC components
<https://www.ecocexhibition.com/visit/market-focus/market-focus-timetable-2022/>
 - 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.
- 21st September 2022
 - ECOC Rump session
 - 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.
- 22nd September 2022
 - ECOC Post Deadline session 1; 13:42 to 13:54pm
https://www.optica.org/events/topical_meetings/ecoc/schedule/?day=Thursday#Th3B.2
 - 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*.
- 22nd September 2022
 - ECOC Post Deadline session 1; 14:18 to 14:30pm
https://www.optica.org/events/topical_meetings/ecoc/schedule/?day=Thursday#Th3B.5
 - 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” and can be found at https://us02web.zoom.us/webinar/register/WN_2aoRT-XPSZiCFd1cLkVrXA and <https://finance.yahoo.com/news/diamond-equity-research-host-spotlight-113000297.html>
- 4th October 2022 (10:20-10:50am East coast time)
 - Diamond Equity Research’s Spotlight Emerging Growth Invitational Virtual Investor Conference, conferences@diamondequityresearch.com
 - Recorded 30th September 2022 virtually at LWLG.
- 331) Invited interview: Interviewed by Cory Johnson at The Drill Down podcast (<https://twitter.com/drilldownpod?lang=en>) Podcast which can be found at: <https://www.iheart.com/podcast/269-the-drill-down-81530167/> as well as <https://twitter.com/DrillDownPod/status/1449964020522360836>
- 7th October 2022
 - Published by The Drill Down Podcast and Cory Johnson on 17th October 2022
 - Virtual interview
- 332) Invited oral presentation: LD Micro Main Event XV conference with presentation entitled, “Lightwave Logic Update”
- 25th October 2022

- b. Oral presentation details can be found at:
https://www.meetmax.com/sched/event_86249/conference_home.html as well as
https://www.meetmax.com/sched/event_86249/conference_presentations.html?bank_access=0&event_id=86249
- 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:
<https://www.photonics.com/Advertise/MarketingBlog.aspx?AID=68312>
 - c. Hosted by Photonics Spectra (www.photonics.com)
- 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. (https://www.optica.org/en-us/about/leadership_and_volunteers/councils/councils/)
 - a. 1st November 2022,
 - b. CEC listing: https://www.optica.org/en-us/about/leadership_and_volunteers/councils/councils/#Industry
 - c. Optica (Optical Society of America – previous name)
- 337) Invited interview with Laser Focus editor Peter Fretty, Editor in Chief of [LASER FOCUS WORLD](http://www.laserfocusworld.com), 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 at: <https://www.laserfocusworld.com> and the magazine at: <https://www.laserfocusworld.com/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. <https://www.picsummiteurope.com/program/>
 - 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. <https://www.picsummiteurope.com/program/>
 - 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. <https://www.picsummiteurope.com/program/>
 - c. Located at the TU/e Eindhoven University, Netherlands.
- 341) Invited talk: IEEE IPC (Integrated Photonics Conference) <https://ieee-ipc.org/industry-day/> as part of the conference <https://ieee-ipc.org> 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) <https://ieee-ipc.org>
 - c. Located at the Hyatt Regency, Vancouver, BC, Canada.
- 342) Invited talk and panelist: IEEE IPC (Integrated Photonics Conference) <https://ieee-ipc.org/industry-day/> as part of the conference <https://ieee-ipc.org> 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) <https://ieee-ipc.org>
 - 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: <https://ladenburgtech22.sequireevents.com/>
- d. Presentation can be found at: <https://ladenburgtech22.sequireevents.com/>
- 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 (<https://events.photonics.com/Event.aspx?EID=9&OC=EM>)
 - b. Details on the event can be found at: <https://www.photonics.com/Advertise/MarketingBlog.aspx?AID=68312>
 - c. Hosted by Photonics Spectra (www.photonics.com)
- 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 can be found at www.photondelta.com and <https://www.photondelta.com/events/> and <https://www.photondelta.com/events/delta-dialogues-december-2022/>
 - c. Hosted by PhotonDelta www.photondelta.com
- 346) Invited Panelist: Ladenburg Thalmann Virtual Technology Expo conference and presentation can be found at: <https://ladenburgtech22.sequireevents.com/>
 - 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: <https://ladenburgtech22.sequireevents.com/>
- 347) Invited Webinar and panelist: Roth Capital Partners at the 11th Annual Roth Deer Valley Conference, (<https://www.roth.com/Page/Corporate-Access-Past-Conferences>) 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.
 - d. <http://www.inside-h2020.eu>
- 350) Invited speaker and panelist for Laser Focus World Executive Forum (<https://www.laserfocusworld.com/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 can be found at <https://www.laserfocusworld.com/executive-forum> and agenda at <https://www.lfwexecutiveforum.com>
 - 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: <https://community.ionanalytics.com/lightwave-could-acquire-more-assets-ahead-of-commercialization-ceo>
 - 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 at <https://telecomreseller.com/2023/02/14/lightwave-logic-technology-enables-the-existing-fiber-internet-infrastructure-to-perform-3-times-faster-than-current-speeds-podcast/>
 - a. 8th February 2023 (interview) and published 14th February 2023
 - b. Details can be found at: <https://telecomreseller.com/category/channel-daily-news/>
 - 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 (<https://www.bbcmag.com>)
- Published in Broadband Communities 14th February 2023.
 - Article can be found at: https://www.bbcmag.com/pub/doc/BBC_Jan23_BrickWall.pdf
- 354) Interview with AlphaStreet entitled, “Lightwave Logic will license technology to make its polymers ubiquitous: CEO Dr. Michael Lebby” Interview can be found at <https://news.alphastreet.com/lightwave-logic-will-license-technology-to-make-its-polymers-ubiquitous-ceo-dr-michael-lebby/>
- 6th March 2023 (interview) and published 10th March 2023
 - Details can be found at: <https://news.alphastreet.com/lightwave-logic-will-license-technology-to-make-its-polymers-ubiquitous-ceo-dr-michael-lebby/>
 - 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 (<https://www.roth.com/Page/Corporate-Access-Past-Conferences>)
- 13th Mar 2023
 - 35th Annual Roth Conference (www.roth.com/oc2023)
 - 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 Interview can be found at: <https://www.laserfocusworld.com/fiber-optics/article/14293915/how-thinking-ahead-shaped-the-fiberoptics-industry>
- 16th March 2023 (interview) and published 17th May 2023
 - Details can be found at: <https://www.laserfocusworld.com>
 - 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: <https://www.idc.com>
 - 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” <https://www.isemag.com/fttx-optical-networks/article/14290981/proactive-powering-problemsolving-with-polymers>
- a. 16th March 2023
 - b. Details can be found at: <https://www.isemag.com>
 - c. ISE has articles on IT solutions and education.
- 359) Invited article and interview (from panel discussion) at Laser Focus World Executive Forum (<https://www.laserfocusworld.com/executive-forum>) in San Francisco with article entitled, “Silicon photonics: Is it witchcraft?” <https://www.laserfocusworld.com/executive-forum/article/14290913/silicon-photonics-is-it-witchcraft>
- a. 17th March 2023
 - b. Details of the event can be found at <https://www.laserfocusworld.com/executive-forum> and agenda at <https://www.lfwexecutiveforum.com>, and article at: <https://www.laserfocusworld.com/executive-forum/article/14290913/silicon-photonics-is-it-witchcraft>, 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, <https://www.expertservices.com/insight/expert-witness-ipr-patents/>
- a. 12th April 2023
 - b. Details can be found at <https://www.expertservices.com>
 - 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 <https://semiengineering.com/transitioning-to-photonics/> entitled, “Transitioning to Photonics”
- a. Interview taken on 4th April 2023 and published online 14th April 2023
 - b. Details can be found at: <https://semiengineering.com/about-us/>
 - 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, www.picinternational.net
- 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, www.picinternational.net 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, www.picinternational.net 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 (www.cleydael.be)
 - 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 <https://semiengineering.com/new-standards-push-co-packaged-optics/> 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 at: <https://semiengineering.com/about-us/>
 - 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 link <https://puertorico.srax.com> with agenda: <https://schedule.puertorico.srax.com>
 - a. Conference on 25th and 26th April 2023 with presentation on 25th April 2023
 - b. Link to website for Sequire event: <https://puertorico.srax.com>
 - 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 found at: https://www.meetmax.com/sched/event_94169/_co-list_cp.html
 - a. 27th April 2023

- b. The conference and expo 2023, was held at Convene Hotel, Park and 41st, New York, New York and can be found at:
https://www.meetmax.com/sched/event_94169/_co-list_cp.html and also at <https://www.ladenburg.com/investment-banking/ladenburg-thalmann-co-inc->
- 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 at www.picinternational.net with newsletters@angelmail.co.uk
 - 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.
- 370) Invited speaker to chair Lightwave Logic Inc’s Annual Shareholder Meeting (ASM) at the Inverness Hilton, Englewood, Colorado.
 - a. 25th May 2023
 - b. Lightwave logic Inc., Denver, Colorado.
 - c. Read script, chair voting procedures for Lightwave Logic Annual shareholder meeting for Lightwave Logic Inc.
- 371) Invited speaker for management/CEO presentation for Lightwave Logic Inc., at the Annual Shareholder Meeting (ASM) at the Inverness Hilton, Englewood, Colorado
 - a. 25th May 2023
 - b. Lightwave logic Inc., Denver, Colorado.
 - c. Annual shareholder meeting for Lightwave Logic Inc., with live presentation with live Q&A from investors.
- 372) Reviewer: European Commission HORIZON-CL4-2022-DIGITAL-EMERGING-Human-01-57 (Digital and emerging technologies for competitiveness and fit for the Green Deal), Horizon IA: Towards next generation of cost-effective multi and hyper spectral remote sensing systems, and applications to health, automotive, and waster sorting.
 - a. 10-26th May 2023
 - b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2023 evaluation calls and rate proposals to EU guidelines.
 - c. IA:<http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 373) Invited keynote speaker at Safecapital investor conference in Ghent with talk entitled, “Commercializing electro-optic polymers” hosted by Brecht Arnaert, Chief Editor www.safecapital.eu with Safecapital Lente meeting, Vander Valk Hotel, Ghent.
 - a. 27th May 2023
 - b. Vander Valk Hotel, Ghent, Belgium
 - c. Safecapital organized a retail investor event with an invite for Lightwave Logic to present and network with investors: <https://tixoom.app/brechtarnaert/ur0v1eff>

- 374) Invited interview with Stephen Hardy of Lightwave Online (www.lightwaveonline.com) with discussion entitled, “Lightwave Logic reaches electro-optic polymer materials commercialization with supply license agreement” and can be found at: https://www.lightwaveonline.com/optical-tech/components/article/14294661/lightwave-logic-reaches-electrooptic-polymer-materials-commercialization-with-supply-license-agreement?utm_source=LW+Friday+5&utm_medium=email&utm_campaign=CPS230602105&o_eid=9764C7112945F2S&rdx.ident%5Bpull%5D=omeda%7C9764C7112945F2S&oly_enc_id=9764C7112945F2S
- Interview conducted on 30th May 2023, and published at www.lightwaveonline.com on 1st June in Stephen Hardy’s Friday 5.
 - Article published at <https://www.lightwaveonline.com>
 - Lightwave online reports on activity in the fiber optics lightwave communications industry at <https://www.lightwaveonline.com>
- 375) Invited Live TV interview: Benzinga (Spencer Israel show).
- TV interview on 9th June 2023 with youtube recording: <https://www.youtube.com/watch?v=jFiB9P3voUk>
 - Presentation can be found at: <https://www.youtube.com/watch?v=jFiB9P3voUk> and the Spencer Israel show/background at <https://www.linkedin.com/in/spencer-israel-44b02b31/> and <https://www.benzinga.com/author/spencer-israel/>
- 376) Project advisor: European Commission HORIZON-CL4-2021-DIGITAL-EMERGING-01-07 LOLIPOP EU project number 101070441
- 21st June 2023
 - European Commission
 - <https://horizon-de-lolipop.eu>
 - LOLIPOP: Lithium NiObate empowered siLIcon nitride Platform for fragmentation free OPERATION in the visible and the NIR. Material technology includes LNOI (lithium niobate on insulator) and TFLN (thin film lithium niobate).
- 377) Contributing author: Heterogeneous Integration Roadmap (2023 edition), Chapter 17 Test Technology which can be found at: https://eps.ieee.org/images/files/HIR_2023/ch17_test.pdf
- 9th August 2023
 - <https://eps.ieee.org/technology/heterogeneous-integration-roadmap.html>
 - Overview of the roadmap: The ITRS Assembly and Packaging Working Group has had many years of history of collaboration with the IEEE Societies in holding workshops and work sessions at IEEE Societies sponsored conferences and events around the world. The basis of this collaboration is the common shared interest in a Technology Roadmap for the IEEE Societies’ membership, conference attendees and participants in the ITRS Technical Working Group work sessions. IEEE Societies Conferences are high profile forums on the latest research and development in Packaging, Interconnect, Test and the materials, processes and equipment supporting this R&D. The Roadmap workshops of the

ITRS had provided an opportunity for the participants to review the directions of these technologies and build a technology Roadmap looking 15 years into the future.

- 378) Invited interview with the publication TWST (The Wall Street Transcript) and Erik Sherman, a reporter at (www.twst.com). The interview entitled “Interview with the Chairperson and CEO: Lightwave Logic Inc. (NASDAQ:LWLG)”
- Interview taken on 42nd August 2023 and published online 17th August 2023
 - Details can be found at: (www.twst.com) and <https://www.twst.com/interview/interview-with-the-chairperson-and-ceo-lightwave-logic-inc-nasdaqlwlg>
 - The Wall Street Transcript is a subscriber-based online and print publication for retail and institutional investors. For more than 50 years, it has published thousands of in-depth interviews with CEOs, industry analysts and professional money managers. The article is about Lightwave Logic and their market positioning for electro-optic polymer modulators in fiber optic communications.
- 379) Invited Live TV interview with Planet MicroCap Podcast and host Robert Kraft <https://planetmicrocapshowcase.com> as Chairman and CEO of Lightwave Logic Inc.
- Recorded 23rd August 2023 and went live at the conference 6th September 2023.
 - Hosted by Robert Kraft with video interview can be found at the website <https://planetmicrocapshowcase.com>
 - Location: Virtually recorded in Washington DC
- 380) Invited presentation entitled, “commercializing electro-optic polymers” with Q&A by host Robert Kraft for Vancouver conference by Planet MicroCap <https://planetmicrocapshowcase.com>
- 23rd August 2023 with presentation conveyed on 6th and 7th September 2023
 - Hosted by Robert Kraft with video Q&A that can be found at the website <https://planetmicrocapshowcase.com> and <https://planetmicrocapshowcase.com/page-1551>
 - Location: Virtually recorded in Washington DC for virtual viewing in Vancouver Canada.
- 381) Invited interview for the Denver Business Journal, reported by Cassidy Ritter. With title of article, “Englewood tech company making the internet faster expands lab to scale commercial arm: The CEO said high speed and low power are the internet’s Achilles heels, but that his company’s technology can address those concerns.”
- 8th September 2023
 - Web link: <https://www.bizjournals.com/denver/news/2023/09/08/lightwave-logic-expands-lab-commercial-arm.html>
 - The Denver Business Journal reports on business activities in the Denver tech center region. <https://www.bizjournals.com/denver/> Interview location at Lightwave Logic Headquarters in Englewood, Colorado.

