

## **Exhibit 2036**

UNITED STATES PATENT AND TRADEMARK OFFICE

---

BEFORE THE PATENT TRIAL AND APPEAL BOARD

---

SHENZHEN RONGLIDA TECHNOLOGY CO. LTD.

Petitioner,

v.

PATHWAY IP LLC

Patent Owner.

---

U.S. Patent No. 7,841,729

Case No. IPR2025-01231

---

Declaration of Eric Bretschneider, Ph.D.

# I. Introduction

1. My name is Eric Bretschneider.

2. I have been retained as an expert by counsel for Pathway IP LLC in connection with Patent Owner's Preliminary Response in *inter partes* review proceeding, Case No. IPR2025-01231 (herein, the "'231 Proceeding"), to provide my expert opinions concerning the validity of the claims of U.S. Patent 7,841,729.

3. I am being compensated at \$500 for my time. My compensation is in no way contingent on the content of my testimony or the outcome of these or any other proceedings relating to the '729 patent. I have no other financial interest in this proceeding.

4. I have reviewed the IPR petition filed by Petitioner SHENZHEN RONGLIDA TECHNOLOGY CO. LTD. d/b/a ShutterLight in the '231 Proceeding, and I have reviewed the documents associated with this IPR petition. The documents I have reviewed include the prior art references cited in the IPR petition and the declaration of Morgan Pattison filed by Petitioner in support of its IPR petition.

5. It is my opinion that Petitioner has not shown that any of claims 1-13 of the '729 Patent is unpatentable, including for being obvious to a person of ordinary skill in the art ("POSITA").

## II. Qualifications and experience

6. A copy of my curriculum vitae (CV) is attached as **Appendix A**. As set forth more fully in my CV, I have at least 30 years of experience in lighting and LED design, engineering, and device and product design. I obtained a Ph.D. from the University of Florida in the field of Chemical Engineering. I am a named inventor on 69 patents related to the LED and lighting industry, and I have reviewed, evaluated, and analyzed hundreds of additional patents related to this industry.

7. Over the past 30 years, I have gained substantial experience within the LED and lighting industry, including a comprehensive background on a full range of LED production and lighting technologies, including Metal-Organic Chemical Vapor Deposition (“MOCVD”) hardware/process, fabrication, LED chip and package testing and reliability, optical design, thermal management, driver design, color conversion, and SSL fixture/lamp design, integration, reliability and manufacturing.

8. Throughout the course of my career, I have designed and developed dozens of LED chips and LED packages. I have also designed and transitioned into production over 150 different LED-based lighting products ranging from

replacement bulbs to integrated fixtures and luminaires. Notably, I developed the first half dozen LED light bulbs to achieve Energy Star Certification.

9. I have served as an expert in proceedings before Federal Courts, the International Trade Commission, and the Patent Trial and Appeal Board. I have also served as an expert in proceedings before courts in Asia, Australia, Europe, and South America.

10. I have authored or coauthored over a dozen publications related to LED technology.

11. I am and have been a member of several professional societies related to the LED and lighting industry, including the Illuminating Engineering Society (IES), the Optical Society of America (OSA), the Society for Optics and Photonics Technology (SPIE), the Society for Information Display (SID), and the Materials Research Society (MRS). In 2006, I became a member of the Test Procedures Committee within IES, which was when it first began developing standards related to lighting products. I have also served as the chair of the Solid-State Lighting subcommittee, which focused solely on standards related to LEDs. I am also a founding member of the IES Science Advisory Panel, which has oversight over all testing and technical committees and work groups within the IES. I have also led several work groups in developing and improving standards

related to solid-state lighting and testing procedures used for both traditional and solid-state lighting components, modules and fixtures.

12. I have been an invited speaker at numerous conferences, international meetings, and academic institutions. In recent years, my talks almost always involve LED technology and applications.

13. I have received several awards and recognitions for my work related to the LED and lighting industry, including for the development of the first six LED light bulbs to achieve Energy Star Certification.

14. I am currently the Chief Technology Officer at EB Designs & Technology. As Chief Technology Officer, I am responsible for, among other things, the design of solid-state lighting technologies and fixtures, new test development, reverse engineering of competitive products, and reliability testing for clients ranging from startups to Fortune 100 companies.

15. Between 2016 and 2023, I served as the Chief Technology Officer for QuarkStar. QuarkStar is a technology development company that has developed a portfolio of over 150 patents related to various solid state lighting technologies. In that role, I lead the development and refinement of technologies and manufacturing methods, negotiate license agreements, and provide technical support to licensees.

16. Between 1998 and 2023, I served as a member of the University of Florida Department of Chemical Engineering Advisory Board. For eight years of those years, I served as the Chair of the Advisory Board. I have also been a Conference Chair for LED Measurement and Standards.

17. Prior to the position with EB Designs & Technology, I served as the Director of Engineering at HeathCo, LLC. In that capacity, I was responsible for advanced technology/product development related to solid-state lighting, including LED lighting, sensors, notifications, and control products. I ensured that products met all requirements for big box retailers, including light output, distribution pattern, motion sensing, dimming, safety and control integration.

18. Prior to the position with HeathCo, LLC, I was positioned at Elec-Tech International Co., Ltd., a multi-billion-dollar solid-state lighting startup company headquartered in mainland China. There, I held the concurrent positions of Chief Engineer at ETi Lighting Research Institute and VP of Research and Development at ETi Solid State Lighting. In this capacity, my responsibilities included developing all technology and product roadmaps for markets in North America, China, Europe, and Japan. I trained and led a staff of over 100 engineers, technicians, and designers in the methods and procedures for designing solid-state lighting products. This included determining proper light sources for desired spectral content, testing LED package reliability, designing strategies for thermal

management of lamps and fixtures that utilized LED light sources, optical design, control integration, and electrical drive circuits. I also had technical responsibility for LED die design, package design, and light engine design for products intended for the domestic Chinese market as well as markets in Japan, North America, and Europe.

19. Between 2008 and 2011, I was positioned at Lighting Science Group Corp., first as a product development manager, and then as VP of Research. My responsibilities included developing advanced LED lighting models for LED product development and production control. Further, my responsibilities also included thermal management design/analysis and optical design of LED lighting components and fixtures as well as testing/benchmarking internal and external products, and development of test and reliability procedures and equipment. Finally, I was also responsible for destructive testing and reverse engineering efforts as well as intellectual property review.

20. Between 2004 and 2008, I was positioned at Toyoda Gosei North America, where I was a sales manager and the sole technical support for Toyoda Gosei LED dies and packages in the Western Hemisphere. My responsibilities included managing and developing LED die and package sales accounts in North America and Europe. In my role as technical support for the Western Hemisphere, I provided knowledge and experience necessary for customers to use LED dies

and packages. Regarding LED dies, this included aiding and supporting customers with optical design and thermal-management design of LED packages as well as phosphor conversion materials and techniques. For LED packages, my responsibilities included testing protocols, reliability evaluation, as well as thermal-management analysis, design and testing as well as optical design of LED light engines and fixtures.

21. Between 2003 and 2004, I served as Director of Solid-State Lighting Engineering at Beeman Lighting, and my responsibilities included optical design, thermal-management design, and color control of LED light engines and fixtures.

22. Between 1998 and 2003, I was positioned at Uniroyal Optoelectronics, where I was Team Leader for the Epitaxial Growth and Materials Characterization areas. I later held the position of Director of Intellectual Property, University Relations and Government contracts. Between 1999 and 2003, I also had a concurrent assignment as a Senior Epi Scientist. Throughout these roles, I supported all sales efforts for LED die and package sales. I had primary responsibility for thermal-management design and analysis as well as optical design of LED dies and packages. A part of my responsibility in supporting sales of LED dies and packages included thermal-management design and analysis as well as optical design of packages for LED die customers and thermal-management modeling and optical modeling of LED modules and fixtures for

LED package customers, and that work included analysis and consideration of all modes of heat dissipation including conduction, convection, and radiation. My interactions with customers and potential customers included design work on several projects that would still be considered technically challenging today. These included exterior lighting for the U.S. Navy DDX (Stealth Destroyer) program, a lighting module for the U.S. Air Force for use on the XSS-11 satellite, an implantable light source for the Paul Allen Foundation, and linear chip on board (COB) lighting modules for the passenger cabin of the Boeing 737. I also worked on an internal project that developed a liquid based cooling system for LEDs that could dissipate more than 20 Watts of heat per square millimeter which is an order of magnitude greater heat flux than what is generated by current state of the art LEDs. Further, working with a sister company known as Norlux, I helped design the "Hex," which was one of the first COB LED products released that incorporated from 40 to well over 100 LED chips operating with an electrical power input of 1 to 5 watts. I was also responsible for reverse engineering and destructive testing of internal and competitive products.

23. Between 1996 and 1998, I worked at Emcore Corporation as a Process Engineer. There, I was responsible for qualifying MOCVD capital equipment for production and manufacturing process development for epitaxial structures. Some

of the processes I developed included both AlInGaP and GaN based LED structures.

24. I have also authored and presented more than 30 publications, presentations, and seminars, and I am a named inventor on 69 issued patents and over 25 pending patent applications.

25. I earned a Ph.D. in Chemical Engineering from the University of Florida in 1997. My graduate work focused on the development of solid-state lighting devices and device structures, including novel silicon based visible LEDs, sulfide based TFELD structures and zinc selenide blue LEDs. As a graduate student, I was involved in the generation of L-I (light vs current) and L-V (light vs voltage) curves which were standard part of characterizing light emitting structures such as LEDs and TFELD structures and provided useful information for dimming devices.

26. In 1989, I worked for Shell Oil Corporation in Norco, LA. I was tasked with modeling heat exchanger performance that used convective heat dissipation for the crude oil distillation column to identify cost saving opportunities. I developed an improved model for determining the operating efficiency of heat exchange units that determined the economic impact on different operating conditions. The model was designed to be compatible with all major operating units on site and resulted in cost savings of over \$20 million/year at the Norco

Facility. My work was quickly adopted throughout the entire corporation and resulted in sustained annual cost savings of over \$500 million/year.

27. I am the current chair of the Life and Projection subcommittee of the IES Test Procedures Committee. This group developed the internationally accepted standards related to testing and reliability standards for lighting products.

28. Based on my education and experience explained above and as set forth in my curriculum vitae, I believe that I am an expert in the field of lighting. I have a detailed understanding of the state of the art of the '729 Patent during the relevant period, as well as significant experience with and a substantial understanding of how a person of skill in the art at that time would understand the technical issues in this case.

### **III. Materials Considered**

29. In the course of conducting my analysis and forming my opinions, I have reviewed materials including those listed below:

- i. U.S. Patent No. 7,841,729 (Ex 1001);
- ii. Prosecution history for Application 12/011090 (Ex. 1003);
- iii. U.S. Patent Application Publication No. 2007/0046626 to Cheng (“Cheng”) (Ex. 1005);
- iv. U.S. Patent No. 2,682,603 (“Dine”) (Ex 1006);

- v. U.S. Patent Application Publication No. 2006/0007666 to Cook (“Cook”) (Ex 1007);
- vi. U.S. Patent No. 6,799,861 (“Naghi”) (Ex 1008);
- vii. Japanese Patent Publication No. 1999-066930 to Masayuki (“Masayuki”) (Ex 1009) and certified translation thereof (Ex. 1010);
- viii. Chinese Utility Model Patent No. CN 2235130 Y to Luo (“Luo”) (Ex. 1012) and certified translation thereof (Ex. 1013);
- ix. U.S. Patent Application Publication No. 2007/0115672 to Nelson (“Nelson”) (Ex. 1014);
- x. U.S. Patent Application Publication No. 2007/0139515 to Du Breuil (“Du Breuil”) (Ex 1015); and
- xi. Declaration of Morgan Pattison, Ph.D. (Ex. 1017).

## **IV. My understanding of relevant legal principles**

30. I am not a lawyer, and I will not provide legal opinions. Although I am not a lawyer, I have been advised certain legal standards are to be applied by technical experts in forming opinions regarding the meaning and validity of patent claims.

31. I understand that a patent claim is invalid if it is anticipated or obvious in view of the prior art, and that a claim can be unpatentable even if all of the requirements of the claim cannot be found in a single prior art reference. I further understand that invalidity of a claim requires that the claim be anticipated or obvious from the perspective of a person of ordinary skill in the art at the time the invention was made.

32. I have been informed that a patent claim is invalid if it would have been obvious to a person of ordinary skill in the art. In analyzing the obviousness of a claim, I understand the following factors may be taken into account: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims; (3) the level of ordinary skill in the art; and (4) any so called “secondary considerations” of nonobviousness if they are present.

33. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references. I understand that to prove that prior art or a combination of prior art renders a patent obvious, it is necessary to:

- 1) Identify the particular references that, singly or in combination, make the patent obvious;
- 2) Specifically identify which elements of the patent claim appear in each of the asserted references; and
- 3) Explain why a person of ordinary skill in the art would have combined the references, and how they would have done so, to create the inventions claimed in the patent.

34. I further understand that exemplary rationales that may support a conclusion of obviousness include:

- Combining prior art elements according to known methods to yield predictable results;
- Simple substitution of known element for another to obtain predictable results;
- Use of known technique(s) to improve similar devices (methods or products) in the same way;
- Applying a known technique to a known device (method or product) ready for improvement to yield predictable results;
- “Obvious to try” – choosing from a finite number of identified, predictable solutions with a reasonable expectation of success;
- Known work in one field of endeavor may prompt variations of the work for use in either the same field or a different field based on design incentives or other market forces if the variations are predictable to a person of ordinary skill in the art; and
- Some teaching, suggestion, or motivation in the prior art that would have led a person of ordinary skill in the art to modify the prior art reference or to combine the prior art reference teachings to arrive at the claimed invention.

35. I have been informed that, in considering obviousness, hindsight reasoning derived from the patent-at-issue may not be used.

## **V. State of the art at the time of the '729 Patent**

36. Dr. Pattison notes: “A POSITA would understand that all types of cameras (*e.g.*, analog and digital, photo and video) generally involve the same lighting considerations and that it is important to provide light that evenly illuminates the target subject or object to minimize reflected glare and shadows.” (Ex. 1017, at para. 35).

37. I disagree with Petitioner that a POSITA would understand all types of cameras. I further and completely disagree with Petitioner “that all types of cameras (*e.g.*, analog and digital, photo and video) generally involve the same lighting considerations.” (Ex. 1017, at para 35).

38. As to whether a POSITA would understand all types of cameras, the '729 Patent claims priority to a provisional patent application filed on January 26, 2007. By this date, film photography was an obsolete art. It is noted that Kodak, the world's largest manufacturer of traditional (chemical) film ceased production in 2004 due to declining demand and the rise of digital photography.

39. Further, the title of the '729 Patent is "Webcam Illuminator Device" which clearly and unambiguously identifies the relevant field of art as digital video. Additionally, the '729 Patent also clearly describes "This invention relates to an illuminator device. More particularly, this invention relates to an illuminator device for a web camera (hereinafter 'webcam') that illuminates the face of a person who is viewed using a webcam." ['729 Patent, 1:7-13]. Film based photographic methods are utterly incompatible with webcam applications as any images require significant time and chemical processing to develop images (negatives) and then print viewable images. A POSITA clearly understands that the relevant field is motion capture and more specifically electronic or digital video photography.

40. Additionally, "all types of cameras (*e.g.*, analog and digital, photo and video) generally DO NOT involve the same lighting considerations." There are fundamental differences in the method of image capture for film-based photography and digital photography, and these fundamental differences substantially affect lighting considerations.

41. Film photography utilizes multiple layers of light sensitive chemicals and dyes to capture an image. Light striking the film results in chemical reactions that can be used to create images. Crucially, the images captured by film-based photography are negative images. The colors and light/dark areas of the image are

reversed from the actual scene photographed. The resulting negative image must be photographed again to reverse the colors and light/dark areas to create a normal looking image. The chemicals and dyes used in the process affect how colors are captured and also determine the sensitivity of the film to light.

42. Film-based photography also captures an entire image simultaneously across the entire surface of the film. All portions are exposed and developed at the same time.

43. In contrast, digital photography relies on an array or matrix of electronic light sensors or pixels to capture an image. The read out of information from the matrix of sensors occurs sequentially. This means that the exact time a pixel records a portion of an image varies depending on where the pixel is located in the matrix.

44. Digital photography does not rely on chemical reactions and instead relies on direct conversion of light to an electronic signal. No chemical processing or developing is required.

45. An additional difference between film-based photography and digital photography is that color filters are used over sensors so that each pixel collects intensity information for a limited range of wavelengths of light.

46. The very nature of digital photography and in particular, the way information is read out from a pixel array means that digital photography is

subject to artifacts known as rolling shutter artifacts. The term rolling shutter comes from the fact that the sequential readout of pixels is equivalent to a shutter rolling across (exposing) different parts of a frame at different times. Examples of rolling shutter artifacts include curved images of objects in motion or a series of light and dark bands if the light source illuminating a scene is not constant during the entire read out process.

47. To the extent a POSITA understood film cameras, the POSITA understood that due to the differing technical requirements, a light suitable for film photography may not be suitable or even usable for digital photography or digital videography, and vice versa. For example, the POSITA would consider the “actinic light” of Dine (Dine, 1:8-18) is for film photography and is unsuitable for use in digital photography or digital videography. Petitioner’s lack of appreciation for the suitability (and unsuitability) of different lights for different applications infects and dooms its invalidity analysis.

## **VI. Person of ordinary skill in the art**

48. In my opinion, a person of ordinary skill in the art of the ’729 Patent would have at least: (a) a bachelor’s degree in electrical engineering, optical engineering, or a related field; (b) two years of practical experience in designing and developing lighting systems, particularly those integrated with electronic

devices such as webcams or computer monitors; and (c) knowledge of user-interface considerations for consumer electronics. Additional experience can substitute for education and vice versa.

## **VII. Claim Construction**

49. The Petition includes the claim constructions respectively proposed by Patent Owner and Petitioner in the associated litigation. (IPR Petition, p. 52; pp. 14-17). I understand a *Markman* order has not issued.

50. I agree with Patent Owner's proposed constructions.

51. I agree with Petitioner that the Board need not formally construe any claim terms in order to adjudicate this Petition. In my opinion, Petitioner has not shown invalidity of the claims under any reasonable construction of the claims.

## **VIII. Cited Prior Art**

### **A. Naghi**

52. Naghi teaches a method of illuminating one or more objects associated with a laptop computer. "An aspect of the invention involves a method of illuminating one or more objects associated with a laptop computer comprising the steps of attaching a light to a support surface of the laptop computer and

illuminating one or more objects associated with the laptop computer with at least one LED of the light.” [Naghi 1:45-51]

53. Naghi notes many benefits of using LEDs as light sources including low power draw [Naghi 3:21-23] and small size. [Naghi 3:23-32] Naghi also notes that the small size of LEDs allows a low profile light that is unobtrusive. “The wide-angle LED broadly casts light across the entire page 112 or adjacent pages 112 of the reading publication 116, while at the same time allowing the reading light 100 to rise a short distance above the page 112, resulting in a low-profile reading light 100. The low profile of the reading light 100 reduces the obstructive effect the light 100 may present to a user reading the publication 116 and reduces torque bending on pliable pages 112 or a cover 108.” [Naghi 3:40-47]

54. While Naghi contemplates use with a camera integrated into a computer, Naghi clearly and unambiguously teaches that the camera is integrated into the display of the computer. [ref Fig. 11]

55. Naghi also teaches the use of white LEDs due to their ability to emit the full spectrum of visible light which results in vibrant, true colors, and is more comfortable to the user’s eyes. “A white light LED is further preferred because it emits the full spectrum of visible light, unlike conventional light bulbs used in prior art reading lights, resulting in more vibrant, vivid and true colors. The

resulting light from a white light LED is also more comfortable to a reader's eyes than the light from conventional light bulbs.’ [Naghi 3:47-53]

## **B. Dine**

56. Dine teaches use of a high-voltage flash lamp for film photography. Indeed, it is noted that the priority date of Dine, August 9, 1952 is decades before the first digital video camera.

57. The light source of Dine is a flash lamp which is an actinic light source. “Among the principal objects of the present invention is the provision of an exceedingly compact and light-weight lighting accessory for cameras which is characterized by the use of an electric discharge lamp in the form of a circular tube adapted for attachment in close relation to and concentrically about the camera lens to produce an intense flash of actinic light by which the subject to be photographed may be uniformly illuminated virtually free of any shadow.” [Dine 1:8-18] A POSITA understands actinic light sources to contain significant amounts of blue light.

58. Dine’s flash lamp creates light by a high voltage electrical discharge through an ionizable gas such as xenon or krypton. “[I]t will be observed that the lighting unit as constructed in accordance with and embodying the principles of the present invention essentially comprises a gaseous discharge tube 10 of glass

or quartz, within which is sealed a suitably ionizable gas, such as xenon, krypton or the like,” [Dine 2:4-10]

59. Dine teaches that a high voltage spark source is used to trigger the flash of light from the lamp. “Suitably fixed in the rectangular part 18 of the tube enclosure is a supporting plate 23 of electrically insulating material, upon which are mounted the lead-in wires 14 and 14a to the tube electrodes and the lead-in conductor 24 to a spark coil 25 of conventional type having a secondary winding S suitably connected to a high-voltage spark trigger or trip wire electrode 26, the free end of which is wrapped around the tube 10 as shown. It will be noted that only one end of the trip wire electrode 26 is connected to the spark coil secondary winding and that the trip wire electrode is itself capacity coupled to the electrode of the gaseous tube to complete the circuit for producing the requisite high-voltage triggering spark.” [Dine 2:48-3:9]

60. Dine’s light source creates a single intense pulse of light. “When the unit is thus mounted directly upon the camera, and is energized through operation of the flash gun in synchronization with actuation of the camera shutter, a brilliant flash of actinic light, produced in full circle about the camera lens” [Dine 3:71-4:2]

61. A POSITA understands that Dine’s flash lamp emits light as a consequence of current passing through an ionized gas. This is a description of a

plasma discharge and while brief represents a very high energy density and subsequently high heat generation.

62. Even if Dine's flash lamp could be modified to produce a flash of a suitable duration for electronic image capture, it would still need to be modified to produce a continuous sequence of flashes that were synchronized with the frame rate of a digital camera for use with video capture. By itself this would require large amounts of electrical power and result in generation of significant amounts of heat.

63. A POSITA would also be aware that using such a flash lamp for video capture would amount to positioning a person directly in front of a strobe and would be at best distracting and disorienting.

## **C. Nelson**

64. Nelson teaches a low light level illumination device. "The present invention is generally directed to portable illuminating devices. More particularly, aspects of the invention pertain to low light illuminators including book lights."  
[Nelson 0001]

65. Nelson's illuminator is specifically designed and intended for low light environments. "Certain portable illuminators can be affixed to objects thereby eliminating the need for the user to hold the light in order to use the light emitted.

An example of portable illuminator may be a book light. Book lights often have a clip for clipping on a book and a light extending from the clip. The light may typically be positioned when manipulated by a user. Portable illuminators such as book lights are normally used in low light environments.” [Nelson 0002]

66. Nelson further teaches a light source that not only provides low light levels, but is also unobtrusive.” While, the location of light source housing 115 within the clamp 120 may alter the illumination emitted due to components of the clamp 120 obstructing some of the light emitted when compared to the non-nested position depicted in FIGS. 1A-1C, varied or reduced illumination enables the illumination device to serve as an especially unobtrusive illumination device when positioned in the described second position. Since the illuminating device 100 may be utilized in numerous environments, such as a reading light for travelers, the unobtrusive lighting aspects when in the second position are desirable so as to prevent offending other travelers.”[Nelson 0052] “Further, when in an ON state, light will be transmitted through the sides of the transparent/translucent section 111 to provide a lower lighting condition which may be beneficial to serve as an especially unobtrusive illumination device when positioned in the described nested position.” [Nelson 0057]

67. Notably absent from the teachings and specification of Nelson is even the remotest suggestion of use with a camera. Indeed, for the reasons discussed

above, a POSITA would understand that Nelson implicitly teaches away from use with a camera as such an application would result in an *obtrusive* light source.

#### **D. Luo**

68. Luo teaches a type of flash lamp for conventional film photography. “This utility model discloses a shadowless flash, which consists of a power supply unit and a ring flash. The axis of the ring flash is aligned with the axis of the camera lens, thereby solving the problem commonly found in traditional flash photography where shadows are cast on the film, and as a result, producing more aesthetically pleasing photographs.” [Luo Summary]

69. Luo’s flash unit is described as connecting to the flash socket of a camera and is friction fit around the lens of the camera. “A power supply and charging unit is inserted into the flash socket above the camera. A wire connects the ring flash to the power supply unit. The ring flash is friction fitted onto the camera lens after the lens cap is removed, such that the axis of the ring flash coincides with the axis of the camera lens.” [Luo at 2]

#### **E. Cheng**

70. Cheng teaches a digital presenter which is analogous to a conventional overhead projector. “Digital presenter is an image acquiring device composed of

a camera and at least a support frame. The digital presenter is used to display what the camera has taken by using an external image output device such as a multimedia projector, a rear projector television, a general television and a liquid crystal display (LCD) monitor.”[Cheng 0002] “In the video conference, the digital presenter is used to display information, data, pictures or even an object grabbed at hand which is associated with the conference.” [Cheng 0002]

71. Cheng’s digital presenter includes a base with an attached camera and lamp. “The digital presenter according to the preferred embodiment of the present invention is schematically shown therein. The digital presenter comprises a base 11, a support arm 12, an image acquiring device 13, a to-be-display object 15, a lamp 14 and an image output device 16. In the embodiment, the support device 12 is a flexible support arm 12, the image acquiring device 13 is a charge-coupled device (CCD) 13, and the to-be-displayed object 15 is a book 15 and photographed by the image acquiring device 13. The lamp 14 is connected to the base 11 and used to facilitate an acquirement of the image of the book 15.” [Cheng 0015]

72. Importantly, Cheng’s camera (image acquiring device) and lamp are on separate support arms. [ref Fig. 1] and Cheng’s lamp only provides supplemental light to aid image acquisition when ambient light is insufficient. “When acquiring image, the lamp 14 may be turned on to take a clear image of the book 15 in

prevention of poor image acquiring due to insufficient ambient light.” [Cheng 0020]

73. It is further noted that Cheng consistently describes that the camera as an image acquiring device [Cheng 0007, 0008, 0015, 0020] and therefore does not contemplate nor suggest use for video purposes.

## **F. Masayuki**

74. Masayuki teaches modifications to fiber optic based light sources and more specifically a method for making light sources with a lower manufacturing cost by reducing the amount of fiber optic used. “To simplify the structure and eliminate the need for complex operations at the time of manufacture, to reduce manufacturing cost by decreasing the quantity of used optic fibers, and to obtain a ring-shaped uniform diffused illumination.” [Masayuki Abstract]

75. Importantly, it is noted that Masayuki’s light source is not ring shaped – the ring shape of Masayuki is the fiber optic element. “This Light Emitter 43 is formed by routing the light radiating ends of the optic fibers into a ring shape within ring-shaped Casing 45 (which is formed with ring-shaped Light Passage Slit 44) so as to face Passage Slit 44. In this way, the light irradiated from the light source will pass through Fiber Bundle 41 and be emitted in a ring shape from Light Emitter 43;”

## **G. Du Breuil**

76. Du Breuil teaches a video system that can compensate for low light levels. “A video system and method of operation are described that compensate for low-light conditions. The video system includes a light source that adjusts.” [Du Breuil Abstract]

77. Despite this description, Du Breuil’s video system has little need for supplementary light to improve the quality of video. Du Breuil explicitly teaches use of a processor to perform white balancing, color correction, and other image enhancements independent of the actual lighting conditions. “In one exemplary image pick-up device the light is shown upon a CCD or CMOS image sensor. The charges associated with each individual pixel are then sent to analog-to-digital (A/D) converter 325. A/D converter 325 generates digitized pixel data from the analog pixel data received from image pick-up device 320. The digitized pixel data is then forwarded to processor 330. Processor 330 performs operations such as white balancing, color correction or may break the data into luminance and chrominance data. White balancing and color correction are important attributes that can be easily controlled with an integrated light source that can be tuned or adjusted to provide a more pleasing ‘warm’ color balance of the subject.” [Du Breuil 0020]

78. “Processor 330 may derive the brightness (luminance) and color (chrominance) values from the words received from A/D converter 325. The luminance values generated by processor 330 may be transmitted to processor 345 where they are compared to threshold data received from memory 350. Encoder 335 generates a signal in the frequency domain from the data received from processor 330. More specifically, encoder 335 generates transform coefficients for both the luminance and chrominance values received from processor 330. Processor 350 may receive the luminance coefficients and compare those values to the threshold data received from memory 350.” [Du Breuil 0024-0025]

79. Du Breuil explicitly teaches that the video processing system can adjust the gain to compensate for low light levels. “Similarly, if processor 345 instructs light source 355 to decrease the amount of light it outputs, it can also increase the gain of the system via control signals issued to A/D converter 325 or processor 330 on lines 680 and 675. In another implementation, the control signals 675 and 680 may be used to decrease the gain of video processing system 300 after processor 345 has obtained the least amount of light it can from light source 355. Regardless of the mechanism, video processing system 600 can balance the amount of light output by light source 355 with the automatic gain control of the system to provide an optimum image quality.”

80. As powering a light source consumes additional energy, it follows that any efforts to increase the energy efficiency of Du Breuil's device would logically lead to providing no power to the light source and instead utilize the image processor's ability to color compensate and to adjust gain.

81. Additionally, Du Breuil clearly teaches light source positions distant from the camera in order to minimize or eliminate direct light transmission to the camera, which can cause distortion. "In one implementation of video telephone 100, light source 120b is recessed into housing 120a so that it is behind screen 120c and camera 115. By recessing light 120c, light is not projected onto screen 120c so it does not reflect off of the screen and cause the image to be drowned out. This could particularly happen around the edges of screen 120c. In addition, recessed light 120c does not shine light directly into camera 115 distorting the image being captured by camera 115. Clips or a friction fit may be used to mount light source 120b into housing 120a." [Du Breuil 0016]

82. "Light source 220b differs from light source 120b of FIG. 1 in that it includes two discrete light elements that do not circumscribe screen 220c. The two elements of light source 220b are placed parallel to the vertical edges of screen 220c. In alternative arrangement the two light sources could be placed parallel to the horizontal edges of screen 220c. The vertical placement shown in FIG. 2 has the advantage of shining less light into or near camera 215. Light

source 220b may also be recessed into housing 220a so as not to shine light directly into camera 215 or screen 220C.” [Du Breuil 0018]

## **IX. Ground 1A Claim 1 Naghi in view of Dine**

83. In forming his opinions on this combination, Petitioner’s expert Dr. Pattison ignores the significant differences in the technologies and goals of Naghi and Dine. Dr. Pattison also fails to appreciate that the proposed combination requires a POSITA to deliberately ignore the clear and express teachings of both references. Critically, the explicit teachings and goals of Naghi and Dine are contradictory and for that reason alone, a POSITA would not seek to combine the references without reliance on hindsight.

84. To wit, as discussed above, Naghi teaches a small, unobtrusive light. “The low-power draw of the LED is especially advantageous with respect to a reading light because a low power draw allows for a small power source, and, hence, a *small reading light*. A *smaller reading light* means the reading light can be attached to pliable pages and/or a cover without bending the pages/cover. A *smaller reading light* is also less clumsy than a larger reading light.” (emphasis added) [Naghi 3:23-30] Here also, Naghi emphasizes a smaller and less clumsy reading light. Increasing the size of Naghi’s small and unobtrusive reading light

to be consistent with the performance goals of Dine requires a POSITA to dismiss the teachings and benefits of Naghi.

85. Further, Dine's light source is a high voltage flash source. It is large, requires a high voltage to operate, and provides an extremely short duration pulse of light. Dine's light is the antithesis of small and unobtrusive.

86. Moreover, a POSITA would be aware that Naghi's explicit purpose is to provide a constant, low level of illumination which by itself is contradictory to Dine's application which is to provide an exceptionally brief burst of actinic (bluish) light. By itself and simply put, a POSITA would know that Naghi's light source is entirely unsuitable for Dine's application. Similarly, Dine's single high intensity pulse of light would be impossible to use as a reading light.

87. Even if Dine's light were modified to provide repeated flashes of light, it would still be unsuitable for use as Naghi's reading light. Such a light would also be unsuitable for digital photography due to rolling shutter effects described above. A POSITA would have no guarantee or even expectation that Dine's flash lamp would provide illumination for the entire digital image acquisition process. A POSITA would also be aware that even if Dine's light could be used as a strobe light and synced with the frame acquisition rate of an electronic video camera, the stroboscopic nature of light emission would be at best highly distracting and could result in significant glare, discomfort, and eye strain.

88. Dr. Pattison admits “In any general illumination application, light needs to be uniformly delivered to the target to enable visibility by human vision (rather than a camera) with minimal glare and shadows and with good color fidelity.” [Pattison ¶44] Dr. Pattison goes even further to opine that webcam users would be motivated to use flattering lighting. “As described above, webcam users and designers were also motivated by the need for even, flattering lighting (for better on-camera appearance).” [Pattison ¶64] However, his opinion on the combination of Naghi and Dine contradicts this as Dine’s light is explicitly described as actinic (bluish) and would not provide good color fidelity. Indeed, it would lend a bluish hue to skin tones, giving the perception that the user was anemic and perhaps hypoxic or cyanotic (decidedly unhealthy looking and unflattering).

89. Further evidence of Dr. Pattison’s reliance on hindsight is a notable lack of discussion on how a POSITA would combine Naghi and Dine. Dr. Pattison has significant work and experience with LEDs, which are low-voltage, DC powered light sources. Notably lacking in Dr. Pattison’s description of the combination of Naghi and Dine is the fact that Naghi’s low-voltage, DC powered LEDs are utterly incompatible with Dine’s high voltage, single pulse electronics. Indeed, Dr. Pattison opines “Substituting Naghi’s light source (124e) with Dine’s toroidal shaped bulb would have been an obvious substitution of one known illumination means for another, with the expectation of achieving the very uniform lighting

effect that Dine taught using a continuous circular tube – i.e., a toroidal light source. Thus, Dine contributes the toroidal bulb element, and the motivation to use it is that it explicitly solves the known lighting problem identified in the ‘729 patent, as well as in the broader field of imaging technology.” [Pattison ¶63] Dr. Pattison is of the unmistakable opinion that Naghi’s and Dine’s light sources are fungible and can be substituted with no other changes to the equipment.

90. The honest expectation of a POSITA attempting to substitute Naghi’s light source for Dine’s toroidal shaped bulb which would result in applying a high-voltage pulse to a light source designed for low-voltage continuous current is absolute and complete destruction of the light source.

91. Additional evidence of Dr. Pattison’s reliance on hindsight is his lack of explanation as to how or why a POSITA would install a large, obtrusive light source around Naghi’s camera which is explicitly shown as being embedded in the display of a laptop. Ignoring all other factors raised above, any effort to surround Naghi’s camera with Dine’s light source would necessarily obfuscate portions of the laptop display and render it largely unreadable. Moreover, adding Dine’s high-voltage, large, and obtrusive light source to Naghi’s laptop embodiment (Fig. 11) would dramatically increase the size and weight of the clamshell of the laptop computer.

92. During my career, I spent years working with laptop manufacturers including Apple, Dell, and HP and can attest that the primary design objectives for laptop clamshells are to make them as thin as possible and to minimize the bezel (area around the display) width. Dr. Pattison's combination of Naghi and Dine would increase the thickness, weight, and bezel size of the clamshell, and thus violate specific design objectives for laptop computer clamshells. It would also render significant portions of the actual display unusable.

## **X. Ground 2 Nelson and Luo**

93. As discussed above, a POSITA would understand that Nelson's clear directive of creating an unobtrusive light source is contradictory to use as a camera illuminator. Modifying the embodiments of Nelson to serve as a camera (of any type) illuminator would require increasing the size and light output, thus resulting in an obtrusive light source.

94. Further, it is reiterated that Nelson neither suggests, nor implies use of any embodiment with a camera of any type.

95. Additionally, it is noted that Luo's light source is a flash for a camera and more specifically a flash for a film (analog) camera. "Conventional *flash units* are typically mounted above the camera body. Since the axis of the *flash* is angled relative to the axis of the camera lens, this often results in shadow

formation on the *film*, thereby compromising the overall aesthetic quality of the photograph. “(emphasis added) [Luo p1] “The objective of the utility model is to provide a *flash device* in which the axis of the *flash* aligns with the axis of the camera lens, thereby eliminating shadows on the *film*.” (emphasis added) [Luo p1] For the reasons discussed above, a POSITA would understand a camera flash to be a highly obtrusive light source and for that reason alone understand that Nelson and Luo have contradictory design intents and goals and therefore cannot be combined without extraordinary motivation. Dr. Pattison’s motivations are prefaced with a reading of claim elements and are therefore necessarily understand to be based on hindsight.

96. Further, as described above, camera flash units (e.g., Luo) are powered by high-voltage pulses, a drive method which is incompatible with low-voltage, DC driven LED devices (e.g., Nelson). Dr. Pattison fails to address this critical issue and instead opines that a POSITA would merely substitute one light source for another with no additional modifications. “A POSITA would have been motivated to improve Nelson’s portable illuminating device by incorporating Luo’s integrated toroidal lamp tube and conforming circular reflector system.” [Pattison ¶88] Dr. Pattison’s reasoning and directions are clear and explicit, namely that a POSITA would merely incorporate Luo’s integrated toroidal lamp tube in Nelson’s illuminating device. However, a POSITA would understand that

Nelson's illuminating device is based on LED light sources [Nelson 0009, 0021, 0023, 0050, 0064] and would therefore provide low-voltage direct current to Luo's flash lamp. Such a power supply would be inadequate to power a flash lamp and therefore a POSITA would understand that the predictable outcome of Dr. Pattison's proposed combination is failure.

## **XI. Ground 3 Cheng and Masayuki**

97. It is first noted that Dr. Pattison fails to quote or support his opinion that Cheng teaches or suggests "an illuminator device that illuminates one or more users in front of a web camera". [Pattison ¶109] Dr. Pattison cites a single paragraph from Cheng to support this opinion, which I reproduce below in its entirety.

98. "Referring to FIG. 1, the digital presenter according to the preferred embodiment of the present invention is schematically shown therein. The digital presenter comprises a base 11, a support arm 12, an image acquiring device 13, a to-be-display object 15, a lamp 14 and an image output device 16. In the embodiment, the support device 12 is a flexible support arm 12, the image acquiring device 13 is a charge-coupled device (CCD) 13, and the to-be-displayed object 15 is a book 15 and photographed by the image acquiring device 13. The lamp 14 is connected to the base 11 and used to facilitate an acquirement of the

image of the book 15.” [Cheng 0015] The passage is not couched in complex technical terms and can easily be interpreted.

99. The teachings of Cheng relied upon by Dr. Pattison are clear. Cheng teaches that display object 15 is in fact a book. The use of a lower case “b” for book clearly informs a POSITA that “book” refers to a common noun and is not a proper noun or more specifically the given or family name of a presenter.

100. More to the point, a POSITA understands that Cheng is an electronic version of an overhead projector that allows digital images to be transmitted as opposed to merely projecting an image of a slide of object placed on the projector. Thus Dr. Pattison opinion appears to be consistent with the user of a prior art overhead projector placing their head under the projector. This is neither taught nor suggested by Cheng.

101. Dr. Pattison admits that Masayuki teaches installation of the light around the camera lens. “Masayuki teaches that the illumination device that can be installed around the lens of a camera to project uniform light from the periphery of the lens onto the photographic subject.” [Pattison ¶111] In doing so, Dr. Pattison necessarily admits that Masayuki’s light is in a fixed position relative to the camera. Dr. Pattison never addresses this fatal flaw in his logic to combine Cheng and Masayuki and opines that because Cheng’s lamp is positionable

relative to the camera, the combination of Cheng and Masayuki would also result in a lamp that is positionable relative to the camera. [Pattison ¶¶119-120]

102. Additionally, as described above, a POSITA understands that the embodiments of Cheng transmit single images and not video.

103. Dr. Pattison further opines “At least driven by the need to address technical problems such as insufficient illumination and eliminating shadows in photography, a POSITA would have been motivated to improve Cheng’s digital presenter by incorporating Masayuki’s more advanced and integrated and larger angular sized lighting system, with its integrated toroidal bulb and conforming circular reflector, to increase the angular size of the light source. Masayuki’s system directly addresses the goal of providing uniform, diffused, ring-shaped illumination, which is superior for many imaging tasks compared to a generic light source.” [Pattison ¶115]

104. This opinion is predicated on Cheng inadequately lighting the object which understood to be flat (e.g., book-like). “In using the digital presenter, the book 15 is first placed under the CCD 13, and the flexible support arm 12 and the CCD 13 are each adjusted to a proper position. Since the flexible Support arm 12 may be curved at any angle within the strength range, the CCD 13 may be adjusted to a desired position and angle. As such, the digital presenter provides better convenience, compared with the conventional digital presenter.” [Cheng 0018]

105. More specifically, Cheng explicitly states that the light source allows a clear image of the book to be recorded. “Next, the CCD 13 acquires an image of the book 15 and then transmits the image to the image output device 16. The image output device 16 may be one of a television, a projector and a desktop computer monitor. Then, the image of the book 15 may be displayed on the image output device 16. When acquiring image, the lamp 14 may be turned on to take a clear image of the book 15 in prevention of poor image acquiring due to insufficient ambient light.” [Cheng 0020] Thus a POSITA understands that Cheng’s light source is more than adequate to the task and no modifications are required.

106. Dr. Pattison also appeared to ignore standard technology developments over time. Specifically, the priority date of Cheng is December 28, 2005 and the priority date of Masayuki is August 11, 1997. It thus appears that Dr. Pattison is opining that in the approximately eight years between Masayuki and Cheng that lighting technology got worse and that the LEDs of Cheng performed worse than the fiber coupled light source of Masayuki. Thus, without support or justification, Dr. Pattison’s opinion is that in 2005, a POSITA would look to an older, out-dated technology to improve a newly developed technology. This however would necessitate that Cheng was inferior and inadequate and therefore never would have been considered by a POSITA. Dr. Pattison’s silence on this issue is particularly noteworthy.

107. It is further noted that in his arguments for Ground 1B, Dr. Pattison opined that a POSITA would be motivated to combine Cheng's base in place of Naghi's clamp (with Naghi's small and unobtrusive light) to enable Naghi's lamp to be stably mounted on a flat surface. In contrast, here Dr. Pattison argues that a POSITA would be motivated to *increase* the size of Cheng's light source by replacing it with Masayuki's larger light source which would reduce the stability of Cheng. Following Dr. Pattison's own arguments and reasoning, it is clear that a POSITA would not be motivated to combine Cheng and Masayuki.

## **XII. Ground 4 Du Breuil/Du Breuil and Dine**

108. Dr. Pattison admits that Du Breuil does not teach lights surrounding the camera, but opines "I believe that even if it is considered that these bulbs do not surround the webcam, then it would have been obvious to a POSITA to rearrange the bulbs in a manner to achieve a surrounding light effect to optimize the image, whether that includes rearranging the bulbs or to reposition the bulbs to achieve a desired effect of diffused light that minimizes shadows. It is well within the ordinary knowledge of a POSITA to arrange bulbs in a manner to produce the desired illumination effect and to optimize the quality of the image." [Pattison ¶140]

109. Dr. Pattison further opines that a bulb could easily be shaped to surround Du Breuil's camera and that such a configuration would have been obvious in consideration of the prior art.

110. However, Dr. Pattison's opinion is fatally flawed as he fails to acknowledge or consider Du Breuil's warnings about issues that would result from light sources being located adjacent to the camera. More specifically, as discussed above Du Breuil teaches away from locating light sources adjacent to the camera in order to minimize or eliminate direct light transmission to the camera, which can cause distortion. "In one implementation of video telephone 100, light source 120b is recessed into housing 120a so that it is behind screen 120c and camera 115. By recessing light 120c, light is not projected onto screen 120c so it does not reflect off of the screen and cause the image to be drowned out. This could particularly happen around the edges of screen 120c. In addition, recessed light 120c does not shine light directly into camera 115 distorting the image being captured by camera 115. Clips or a friction fit may be used to mount light source 120b into housing 120a." [Du Breuil 0016]

111. "Light source 220b differs from light source 120b of FIG. 1 in that it includes two discrete light elements that do not circumscribe screen 220c. The two elements of light source 220b are placed parallel to the vertical edges of screen 220c. In alternative arrangement the two light sources could be placed

parallel to the horizontal edges of screen 220c. The vertical placement shown in FIG. 2 has the advantage of shining less light into or near camera 215. Light source 220b may also be recessed into housing 220a so as not to shine light directly into camera 215 or screen 220C.” [Du Breuil 0018]

112. Therefore, a POSITA starting with Du Breuil would not have found such a configuration obvious regardless of teachings of the prior art. In particular, a POSITA considering Du Breuil and Dine would have been highly motivated not to use the high intensity flash source of Dine as even distant locations could still have resulted in significant amounts of light shining into or near Du Breuil’s camera.

113. It is also noted that while Dr. Pattison opines that Dine teaches use of a toroidal bulb in close relation to and concentrically about the camera lens [Pattison ¶142] he neglects to consider that Dine’s toroidal bulb is a high-voltage flash lamp and would be incompatible with the LED light sources of Du Breuil.

114. In sum, Petitioner has not demonstrated unpatentability of any independent claim of the ’729 Patent. Petitioner has not demonstrated unpatentability of any dependent claim of the ’729 Patent at least for this reason.

I attest under penalty of perjury that the foregoing is true and correct.

Date: October 20, 2025

Signature: 

Eric Bretschneider, Ph.D.

# Appendix A

**Skills Summary**

- Successful Management and Team building with personnel at levels ranging from Sr. Scientists and Engineers to Technicians/Operators. Maximum Department size >100; Budget >\$25 million/yr.
- Strong New Product Development background; over 100 new SSL products taken from concept to manufacturing, including regulatory, Energy Star certification and DLC certification.
- Excellent communication skills sales and sale support experience as evidenced by development of new 8+ figure accounts for LED die, packages and applications. Proven ability to match customer demands/needs/desires with existing products.
- Comprehensive technical background in the full range of semiconductor and LED production technologies including MOCVD hardware/process, fabrication, LED chip/package test/reliability, optical design, thermal management, color conversion, SSL fixture/lamp design/integration and reliability.
- Direct Design and Development experience of LEDs (structures, die, packages) and SSL fixtures/components using TracePro and SolidWorks.
- Extensive experience in development of industry test and measurement standards.

**Employment****CTO; EB Designs & Technology Flower Mound, TX  
2014 –**

- Design and development of innovative solid-state lighting technology and designs, with a primary focus on optical design, thermal design and production/assembly technologies.
- Manage technology roadmap and draft IP disclosures/patent filings.
- Provide technical support and conduct research/technology development for clients in the field of solid-state lighting. This work additionally includes serving as an expert witness.
- Developed the first method able to predict chromaticity shift of LED products over time. Method is being used as the basis for a new industry standard: IES TM-35-19 "Projecting Long-Term Chromaticity Coordinate Shift of LED Packages, Arrays and Modules."
- Developed the method for interpolating between drive currents for flux maintenance lifetime for LED based products that is being implemented in IES TM-21-19 "Projecting Long Term Lumen, Photon and Radiant Flux Maintenance of LED Light Sources."

**CTO; QuarkStar, LLC Las Vegas, NV  
2016 – 2023**

- Manage technology roadmap and draft IP disclosures/patent filings.
- Developed technology to stabilize color shift over time of LED lighting products.
- Negotiated first IP licensing technology with a major European lighting company. Technology was used to develop a premium downlight product line.
- Managed transition from R&D to manufacturing. Products provided the majority of artificial lighting for a \$500 million expansion at the Museum of Fine Art Houston.
- Developed technology and oversaw product design for L-Prize concept phase. Resulting design was one of four winners at this stage of the L-Prize competition.

**Director of Engineering; HeathCo, LLC Bowling Green, KY  
2013 – 2014**

- Managed Engineering Department Staff (11 domestic, 14 international); Responsibilities included preparation and administration of the department budget (\$3.5 million annual). The department was charged with developed advanced technology/products related to: Solid State Lighting, Sensors, Notifications and Control Products and included regulatory/certifications for UL, FCC, Energy Star and DLC.
- Developed technology, IP and product roadmaps for all three business units (Lighting, Sensors, Notifications). Provided solid state lighting technology support for The Chamberlain Group.
- Additional responsibilities included establishing career development paths and training goals for all members of the department.
- Key accomplishments:

- Led team for product recall issue dating back to 2006. Reduced recall scope (# units) by >80% and financial exposure by >85% through detailed investigation and analysis of production records and analysis of excess and obsolete inventory.
- Completed review for entire product portfolio to comply with new cUL bi-lingual language requirements. Project required warning requirement changes to physical components (tooling), warning labels, documents and packaging on >400 products.

**Elec Tech International Zhuhai, Guangdong Province, P.R. China**

**Chief Engineer ETi Lighting Research Institute**

**VP Research & Development ETi Solid State Lighting**

**2011 – 2013**

- Managed Engineering and R&D staff for newly formed vertically integrated LED company (107 Engineering, Scientists, Designers); responsibilities included preparation and administration of the department budget (>\$25 million annual)
- Worked directly with President and CEO of the company to develop IP and product roadmaps for all LED based lighting products/projects for markets in the US, Europe, Japan and China.
- Trained engineering staff on semiconductor growth/fabrication technologies, and semiconductor layer materials characterization techniques
- Key accomplishments:
  - Developed capability for fast turn functional prototypes (<2 weeks from concept to operating units). This was an improvement over the prior process that required 6+ weeks for a working prototype. Prior to this the company lost ~50% of all opportunities that required functional prototypes.
  - Supported product development and production ramps that enabled the company to increase sales from ~\$10 million to >\$40 million in one year.
  - Developed proprietary linear lamp technology capable of >1000 lumens/ft with a wall plug efficacy >100 lm/W, CRI>80 and L70>50,000 hrs (Ta = 25°C). Technology allows the same base units to be installed in fixtures as a replacement tube or used as individual luminaires with transverse spacing criteria ranging from 1.6 – 2.9.

**Lighting Science Group Corporation Satellite Beach, FL**

**2010 - 2011 VP of Research**

- Assembled and managed research and development teams for projects related to solid state lighting.
- Direct responsibility for design/development of customized photometric and radiometric characterization equipment.
- Direct responsibility for modeling and determining product and component lifetimes based on optical, thermal, mechanical and electrical analysis with respect to intended operating environments.
- Served as company representative on industry standards committees related to SSL technology (LM79, LM80, TM21, etc.)
- Key accomplishments:
  - Developed advanced LED models for product development and production control; including advanced color control schemes for multi-color applications. Methods capable of predicting average chromaticity to within a combined  $\Delta xy \leq 0.002$ ; production variation < 2 step MacAdam ellipse.
  - Developed and characterized wavelength conversion materials, methods and technology. Work included development of optics and materials for L-Prize entry.

**2008 – 2010 Product Development Manager**

- Tasked with developing Solid State Lighting products including: optical, mechanical and thermal design, design and process FMEA, oversight of initial production, development of quality system documents and requirements for internal production and out-sourced components. Projects ranged from individual efforts to team of 10+ employees
- Served as the primary technical resource for all OEM customers.
- Managed group responsible for all product certifications and standards requirements including UL, FCC, CE, Energy Star and DLC as well as IES lighting requirements for outdoor products.
- Responsible for development, calibration and maintenance of photometric equipment in development and production areas.
- Key accomplishments:
  - Completed fast track development and launch of OEM SSL acorn retrofit product (<5 months). Product exceeded all customer requirements including: lumen output, efficacy, thermal resistance and size. Developed second generation product with >100% increase in light output with now cost increase.

- Completed design of Streetlight family (4 products) in 4 month time span. Products achieved >90 lumens/Watt efficacy at thermal stability with projected L<sub>70</sub> lifetimes >80,000 hours at T<sub>a</sub>=40°C (continuous).
- Development replacement lamp family line (6 primary lamp types, 100+ variations). Product family included the first replacement LED lamps to achieve Energy Star certification. Product variations developed for LSG brand name and 3 OEM customers. Altogether the family accounted for >50% of the Energy Star certified LED lamps as of December 2011.

#### **2004 - 2008 Toyoda Gosei North America Troy, MI**

##### **Sales Manager**

- Primary responsibility for developing new and managing existing LED die and package customers for the Eastern region of North America. This required extensive communications with existing and potential customers to determine best fit products for their applications/requirements.
- Additional responsibility for search for and identifying new market opportunities for existing or newly developed products.
- Served as the primary technical resource for all customers in North/South America and Europe; provide engineering support for customers developing LED packages and LED lighting products.
- Pioneered introduction of LEDs into large format display applications.
- Key accomplishments:
  - Secured two new 8 figure accounts in a new market niche. These customers designated as the only two priority customers for Toyoda Gosei world-wide. Sales ramped from \$0 to >\$100 million/yr in less than 18 months.
  - Secured sole supplier status for LED backlights in Apple - 9.9" (iPad), 15.4", 17" and 22" displays. This was the culmination of an 18 month campaign with the Apple Display group to find the best fit product for their requirement and to train Apple personnel on potential technical barriers/issues with their application.
  - Addressed Microsoft concerns about blue light hazards related to development of a next generation optical mouse. After three months, I was able to conclusively show to Microsoft that it would be impossible for 14mil die products to present a photo-biological hazard under both IEC 62471 and IEC 60825.
  - Awarded business for all passenger lighting on the B787 Dreamliner. This award was made by Diehl which controls all lighting for Boeing, Airbus and Embraer and was achieved within 4 months of first contact with Diehl. At the time of first contact Diehl had no knowledge of Toyoda Gosei and had been working with 4 LED companies for over 12 months on the project.

#### **2003 – 2004 Beeman Lighting Sarasota, FL**

##### **Director of Solid-State Lighting Engineering**

- Tasked with leading development of solid-state lighting systems and materials with primary focus on chip on board applications and devices. Product lines included RGB landscape lighting and minimal environmental impact fixtures and novel display/artwork fixtures.
- Managed all IP issues (competitor analysis, IP roadmap, patentability analysis).
- Worked with existing and potential customers to ensure new products meet or exceed requirements and expectations.
- Key accomplishment
  - Developed RGB LED based landscape light with minimal environmental impact. This was accomplished by establishing a research project with FAU and included studies that conclusively showed the products had no impact on the behavior of sea turtle hatchlings.

#### **2003 University of South Florida Tampa, FL**

##### **Intellectual Property Manager**

- Managed IP portfolio of over 100 active patents and applications for University faculty/staff. Key portfolio items included: anti-cancer bioactive compounds, dendrimer synthesis and application technology, and spectral analysis of biological materials (blood analysis, surface and soluble protein analysis).
- Tasked with enhancing University reputation and revenue through negotiation of licensing agreements for IP
- Key accomplishments:

- Negotiated license agreement for evaluation of new anti-cancer compounds derived from cold water tunicates.
- Assembled team that included 3 corporate and 2 academic partners for the DARPA SUVOS program. This task was completed in one month and the resulting proposal was ranked 2<sup>nd</sup> overall out of a field of 34 entries and was noted by the reviewers as the only proposal to address each and every portion of the RFP.

#### **1998 – 2003 Uniroyal Optoelectronics Tampa, FL**

##### **Director of Intellectual Property, University Relations & Government Contracts (2001 – 2003)**

- Concurrent assignment as Sr. Epi Scientist.
- Tasked with establishing IP roadmap and track patent landscape related to MOCVD growth, chip/package design and applications for LED technology.
- Reviewed all production and R&D activities to identify potential IP. This included drafting initial disclosures and working with external counsel for patent filings and responses to office actions. Activities with external counsel further included development of opinions of non-infringement.
- Oversight and management of a \$3.4 million multi-campus research program.
- Monitor and track RFP notices for externally funded research related to the company's core technology development roadmap.
- Key accomplishments:
  - Developed opinions of non-infringement with external counsel for 10 LED patents that had been the subject of numerous infringement suits against Tier 1 LED companies.
  - Assembled team that included 3 corporate and 2 academic partners for the DARPA SUVOS program. This task was completed in one month and the resulting proposal was ranked 2<sup>nd</sup> overall out of a field of 34 entries and was noted by the reviewers as the only proposal to address each and every portion of the RFP.

##### **Team Leader, Epitaxial Materials & Characterization (1999 – 2001)**

- Concurrent assignment as Sr. Epi Scientist.
- Oversaw start up and qualification of Epitaxial Growth & Characterization areas; role included training of Sr. Scientists, Engineers and Technicians for both areas in theory, application, process and maintenance procedures.
- Managed Epitaxial Growth & Characterization areas for production of InGaN and AlInGaP LED wafers. This included preparation and administration of the department budget (~\$25 million annual) as well as setting department performance goals (total good wafers, wafer yield, performance improvements and unit production costs).
- Coordinate inventory levels with purchasing department to minimize value of inventory necessary to support production plan. Additionally, negotiated key raw material specifications and prices.
- Served as Sr. member of Quality Team responsible for ISO9001 certification. Certification was achieved within a 12 month time span.
- Key accomplishments:
  - Completed process qualifications for all MOCVD systems within 3 months of CapEx delivery and established initial production yields 15% higher than the benchmark process transferred to UOE.
  - Managed departmental expansion and quality system efforts that allowed >250% increase in production capacity.
- Managed start up and qualification of Epitaxial Growth & Characterization areas; role included training of Engineers and technicians for both areas in theory, application, process and maintenance procedures.

##### **Sr. Epi Scientist (1999 – 2003)**

- Primary responsibility for MOCVD hardware and process modifications necessary to support performance improvements, yield enhancements and cost reductions.
- Served as primary technology liaison with customers and investors. Provided support to customers on package and fixture design and integration.
- Tasked with technical oversight of all photometric/radiometric characterization.
- Responsible for LED chip and package optical/thermal design including wavelength conversion materials. Developed LED package solutions for small format, full color backlight applications.
- Key accomplishments:
  - Resolved gold corrosion issue in Fab area. Also eliminated transparent contact failure mechanism. Combined efforts increased fabrication yield by >30%.

- Modified hardware and epitaxial growth process to increase throughput of Epitaxial Growth & Characterization areas by 80% (9 hour to 5 hour cycle time), while cutting unit cost by >30%. Also reduced surface and interfacial roughness by a factor of >3x while improving thickness uniformity from 4% to <2%, using DOE methods. Designed additional hardware modifications that further increased throughput by another 20%.
- Developed new test methods to verify performance of LED structures prior to Fabrication. Methods allowed verification of optical power to within 15% and wavelength within 2 nm prior to beginning of fabrication.

#### **Staff Engineer (1998 – 1999)**

- Designed/specified Epitaxial Growth & Characterization areas. This responsibility included specification and selection of all CapEx equipment for the Epitaxial Growth and Characterization areas and managing the construction, CapEx equipment installation and start up.
- Additional responsibilities included determining initial product cost and throughput based on installed CapEx tool base.
- Key accomplishments:
  - Implemented and validated new ammonia delivery system that allowed multiple MOCVD systems to draw from the same cylinder and eliminated downtime for cylinder changes. Implemented new exhaust management process for arsine/phosphine waste stream, extending maintenance interval by >300%.
  - Developed zero assumption cost and throughput models for LED facility. Cost estimate for 18 months post-start up proved accurate to within 10% of actual costs.

#### **1996 – 1998 Emcore Corporation Somerset, NJ**

##### **Process Engineer**

- Responsible for installation, materials demonstration and production process qualification and transition into manufacturing of MOCVD systems in an ISO9000 manufacturing environment (6 systems in 18 months).
- Tasked with identifying cost reduction and throughput/yield enhancements for epitaxial growth processes.
- Member of internal Quality System audit team.
- Key accomplishments:
  - Developed MOCVD Tool Qualification Procedure for benchmarking and qualifying all MOCVD systems installed for internal corporate use as well as at customer locations world-wide.
  - Completed Manufacturing Readiness Review for AlGaAs/Ge solar cell process in ~25% of standard time. Resulted in 3 year, \$15 million supply contract for company.
  - Scaled up and transferred of InSb magneto resistor process to a higher throughput system (single wafer D-180 to five wafer E-300). Increased wafer yield by from 65% to >95%.
  - Developed industry's first comprehensive cost and throughput model for epitaxial growth processes. The model typically allowed cost reductions of 10-20% and throughput increases of >10%.

#### **1990 AT&T Bell Labs**

**Holmdel, NJ**

##### **Visiting Researcher**

- Designed and built custom MOCVD/Mass spec system. System allowed tracking of precursor molecules, reaction intermediates and products over 12+ orders of magnitude of concentration.
- Implemented program to evaluate novel precursors for use in growth and doping of III-V and II-VI compound semiconductors. Data used to determine reaction and decomposition mechanisms for metal-organic sources. Successfully identified grow conditions for novel carbon doping source (norbornadiene) for III-V materials.

#### **1989 Shell Oil Norco, LA**

##### **Process Engineer**

- Developed and implemented new system for determining optimal time to clean heat exchangers on crude oil distillation column based on global economic metrics of unit and detailed process simulations.
- System exceeded system cost savings target of \$50,000/year by ~3 orders of magnitude. Project resulted in corporate-wide savings of >\$500 million/year. Cumulative corporate savings exceed \$20 billion.

#### **Education**

**Ph.D. in Chemical Engineering**

**University of Florida 1997**

**BSE in Chemical Engineering**

**Tulane University 1989**

- Graduate work focused on development of optoelectronic devices, including novel silicon based visible LEDs and sulfide based TFELD structures.
- Developed the world's first crystalline silicon based visible light LED. Utilized DOE methods to identify process conditions to allow first growth of epitaxial silicon on ZnS epi layers.
- Tested and verified efficacy of novel precursors for p-type doping of ZnSe materials in LED structures.
- Responsible for modification, operation and maintenance of MOCVD system for growth of wide bandgap compound semiconductor materials.
- Trained incoming post docs and graduate students in theory, operation and maintenance of MOCVD systems. Group comprised ~20 students and 6 post docs.

**References Available on request**

## **Curricula Vitae**

### **University of Florida, Department of Chemical Engineering Advisory Board**

Member 1998 – 2023

Chair 2007 – 2009, 2017 – 2023

### **University of Florida, Dean's Advisory Board, College of Engineering**

Member 2007 – 2009, 2017 - 2023

### **Professional Societies:**

- CIE, CIE US National Committee Board of Directors
- CORM – Board of Directors
- SPIE
- Optica (formerly OSA – Optical Society of America)
- SID
- Materials Research Society
- Illuminating Engineering Society (Member of Science Advisory Panel, Member of Executive Board of Test Procedures Committee, Chair of Projection and Reliability Sub-Committee, Member of Light Sources Committee, Secretary of Color Committee)
- American Society of Horticultural Science (ASHS)
- American Society of Agricultural and Biological Engineers (ASABE)

### **Testing and Standards Development:**

- 30+ years experience testing LED components and fixtures
- 18 years experience developing LED testing standards, technical coordinator ANSI/IES LM-86: Measuring Luminous Flux and Color Maintenance of Remote Phosphor components; technical coordinator: ANSI/IES TM-21: Projecting Long-Term Lumen, Photon, and Radiant Flux Maintenance of LED Light Sources; technical coordinator ANSI/IES TM-28: Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaires ; co-technical coordinator ANSI/IES LM-79: Optical and Electrical Measurements of Solid-State Lighting Products
- Developed the modeling method that enabled prediction of color shift of LED based products that is used in ANSI/IES TM-35: Projecting Long-Term Chromaticity Shift of LED Packages, Arrays, and Modules
- Work Group member on over a dozen ANSI/IES Test standards (Test Procedures Committee, Color Committee, Photobiology Committee, Light Sources Committee)

### **Conference Chair**

LED Measurement and Standards, San Diego, CA October 2-3 (2008).

## **Patents (Granted)**

1 US 7,093,956 "Method of Lighting for Protecting Sea Turtles." D. Miller, E. Bretschneider, issued August 22, 2006.

- 2 [US D650,519](#) "Pole for a Street Light Luminaire." F. Maxik, D. Henderson, E. Bretschneider, A. Widjaja, K. Bowen, J. Sundin, E. Peiniger, issued December 13, 2011.
- 3 [US 8,157,413](#) "Light Fixture and Associated LED Board and Monolithic Optic." F. Maxik, Z. Gibler, E. Bretschneider, D. Henderson, A. Widjaja, issued April 17, 2012.
- 4 [US D673,323](#) "Light Fixture." F. Maxik, D. Henderson, E. Bretschneider, A. Widjaja, K. Bowen, J. Sundin, E. Peiniger, issued December 25, 2012.
- 5 [US 8,360,607](#) "Lighting Unit with Heat Dissipating Chimney." E. Bretschneider, Z. Berkowitz, R. Sosnick, L. Pattison, P. Pattison, issued January 29, 2013.
- 6 [US 8,408,725](#) "Remote Wavelength Conversion Device and Associated Methods." F. Maxik, E. Bretschneider, R. Soler, D. Bartine, issued April 2, 2013.
- 7 [US D681,874](#) "Light Fixture." F. Maxik, D. Henderson, E. Bretschneider, A. Widjaja, K. Bowen, J. Sundin, E. Peiniger, issued May 7, 2013.
- 8 [US 8,439,515](#) "Remote Lighting Device and Associated Methods." F. Maxik, R. Soler, D. Bartine, E. Bretschneider, issued May 14, 2013.
- 9 [US 8,465,167](#) "Color Conversion Occlusion and Associated Methods." F. Maxik, E. Bretschneider, R. Soler, D. Bartine, issued June 18, 2013.
- 10 [US 8,491,165](#) "Lighting Unit Having Lighting Strips with Light Emitting Elements and a Remote Luminescent Material." E. Bretschneider, Z. Berkowitz, R. Sosnick, L. Pattison, P. Pattison, issued July 23, 2013.
- 11 [US 8,492,995](#) "Wavelength Sensing Lighting System and Associated Methods." F. Maxik, E. Bretschneider, P. Medelius, D. Bartine, R. Soler, G. Flickinger, issued July 23, 2013.
- 12 [US 8,506,118](#) "Light Fixture and Associated LED Board and Monolithic Optic." F. Maxik, Z. Gibler, E. Bretschneider, D. Henderson, A. Widjaja, issued August 13, 2013.
- 13 [US 8,515,289](#) "Wavelength Sensing Lighting System and Associated Methods for National Security Application." F. Maxik, D. Bartine, P. Medelius, E. Bretschneider, issued August 20, 2013.
- 14 [US 8,547,391](#) "High Efficacy Lighting Signal Converter and Associated Methods." F. Maxik, R. Soler, D. Bartine, R. Zhou, V. Bastien, M. Regan, E. Grove, E. Bretschneider, issued October 1, 2013.
- 15 [US 8,616,715](#) "Remote Light Wavelength Conversion Device and Associated Methods." F. Maxik, E. Bretschneider, P. Medelius, D. Bartine, R. Soler, G. Flickinger, issued December 31, 2013.
- 16 [TWI 428,542](#) "Lighting Unit Having Lighting Strips with Light Emitting Elements and a Remote Luminescent Material." E. Bretschneider, Z. Berkowitz, R. Sosnick, L. Pattison, P. Pattison, issued March 1, 2014.
- 17 [US 8,680,457](#) "Motion Detection System and Associated Methods Having at Least One LED of a Second Set of LEDs to Vary Its Voltage." F. Maxik, issued March 25, 2014.
- 18 [US 8,686,641](#) "Tunable LED Lamp for Producing Biologically Adjusted Light." F. Maxik, D. Bartine, R. Soler, E. Grove, E. Bretschneider, issued April 1, 2014.
- 19 [US 8,684,566](#) "Light Emitting Unit With Indirect Light Source." E. Bretschneider, Z. Berkowitz, R. Sosnick, L. Pattison, M. Pattison, issued April 1, 2014.

- 20 US 8,702,259 "Color Conversion Occlusion and Associated Methods." F. Maxik, E. Bretschneider, R. Soler, D. Bartine, issued April 22, 2014.
- 21 US 8,818,202 "Wavelength Sensing Lighting System and Associated Methods for National Security Applications.": F. Maxik, D. Bartine, P. Medelius, E. Bretschneider, issued August 26, 2014.
- 22 US D715,467 "LED Linear Replacement Lamp Design." E. Bretschneider, Z Berkowitz, R. Sosnick, issued October 14, 2014.
- 23 US 8,866,839 "High Efficacy Lighting Signal Converter and Associated Methods." F. Maxik, R. Soler, D. Bartine, M. Regan, E. Grove, E. Bretschneider, issued October 21, 2014.
- 24 US 8,941,329 "Tunable LED Lamp for Producing Biologically-Adjusted Light." F. Maxik, D. Bartine, R. Soler, E. Grove, E. Bretschneider, issued January 27, 2015.
- 25 US 9,024,536 "Tunable LED Lamp for Producing Biologically-Adjusted Light and Associated Methods." F. Maxik, D. Bartine, R. Soler, E. Grove, E. Bretschneider, issued May 5, 2015.
- 26 US 9,125,275 "Wavelength Sensing Lighting System and Associated Methods." F. Maxik, E. Bretschneider, P. Medelius, D. Bartine, R. Soler, G. Flickinger, issued September 1, 2015.
- 27 US 9,172,199 "Electrical Fixture Connection." T. Birdwell, E. Bretschneider, J. Fitzgibbon, B. Moore, S. Tylicki, issued October 27, 2015.
- 28 US 9,289,574 "Three-channel Tuned LED Lamp for Producing Biologically-Adjusted Light." F. Maxik, D. Bartine, R. Soler, E. Grove, E. Bretschneider, issued March 22, 2016.
- 29 AU 2012346231 "Wavelength Sensing Light System and Associated Methods." F. Maxik, D. Bartine, P. Medelius, E. Bretschneider, issued March 31, 2016.
- 30 CN 104,115,563 "Wavelength Sensing Lighting System and Associated Methods." F. Maxik, E. Bretschneider, P. Medelius, D. Bartine, R. Soler, G. Flickinger, issued April 5, 2016.
- 31 US 8,818,202 "Wavelength Sensing Lighting System and Associated Methods for National Security Applications.": F. Maxik, D. Bartine, P. Medelius, E. Bretschneider, issued August 17, 2017.
- 32 EP 2,788,674 "Tunable LED Lamp for Producing Biologically-Adjusted Light." F. Maxik, D. Bartine, R. Soler, E. Grove, E. Bretschneider issued August 31, 2016.
- 33 US 9,578,710 "Wavelength Sensing Lighting System and Associated Methods." F. Maxik, E. Bretschneider, P. Medelius, D. Bartine, R. Soler, G. Flickinger, issued February 21, 2017.
- 34 US 9,693,414 "LED Lamp for Producing Biologically-Adjusted Light." F. Maxik, D. Bartine, E. Bretschneider, issued June 27, 2017.
- 35 CN 104,114,932 "Adjustable LED Lamp for Producing Biologically Adjusted Light." F. Maxik, D. Bartine, R. Soler, E. Grove, E. Bretschneider issued October 20, 2017.
- 36 CA 2,845,210 "Connexion de Luminaire Electrique." T. Birdwell, E. Bretschneider, J. Fitzgibbon, B. Moore, S. Tylicki, issued October 24, 2017
- 37 EP 2,783,549 "Wavelength Sensing Lighting System and Associated Methods." F. Maxik, D. Bartine, P. Medelius, E. Bretschneider, issued November 21, 2017.
- 38 US 9,839,092 "Wavelength Sensing Lighting System and Associated Methods." F. Maxik, E. Bretschneider, P. Medelius, D. Bartine, R. Soler, G. Flickinger, issued December 5, 2017.

39 DK 2,783,549 "Wave Detection Lighting System and Related Procedures." F. Maxik, D. Bartine, P. Medelius, E. Bretschneider, issued December 11, 2017.

40 US 9,905,976 "Mounting Step Having a Connector to Connect an Electric Fixture to a Junction Box." T. Birdwell, E. Bretschneider, J. Fitzgibbon, B. Moore, S. Tylicki, issued February 27, 2018.

41 JP 6,283,880 "Adjustable LED Lamp for Producing Biologically Adjusted Light." F. Maxik, D. Bartine, R. Soler, E. Grove, E. Bretschneider issued February 28, 2018.

42 US 9,913,341 "LED Lamp for Producing Biologically-Adjusted Light Including a Cyan LED." F. Maxik, D. Bartine, E. Bretschneider, issued March 6, 2018.

43 US 10,054,290 "Movable Barrier Operator Light Distribution." T. Birdwell, E. Bretschneider, J. Fitzgibbon, issued August 21, 2018.

44 US 10,177,287 "Gamut Broadened Displays with Narrow Band Green Phosphors." J. Melman, R. Nordsell, K. Baroudi, Y. Bok Go, E. Bretschneider, A. Thomas, E. Thomas, issued January 8, 2019.

45 US 10,212,781 "Wavelength Sensing Lighting System and Associated Methods." F. Maxik, E. Bretschneider, P. Medelius, D. Bartine, R. Soler, G. Flickinger, issued February 19, 2019.

46 US 10,297,584 "Chip on Board LED Device and Method." S. Makanoich, N. Caldani. E. Bretschneider, issued May 21, 2019.

47 EP 3,139,081 "Tunable LED Lamp for Producing Biologically-Adjusted Light." F. Maxik, D. Bartine, R. Soler, E. Grove, E. Bretschneider issued June 12, 2019.

48 DK 3,139,081 "Accessible Light for Producing Biologically Adjusted Light." F. Maxik, D. Bartine, R. Soler, E. Grove, E. Bretschneider issued July 22, 2019

49 US 10,417,882 "Direction Sensitive Motion Detector Camera." E. Bretschneider, J. Fitzgibbon issued September 17, 2019.

50 US 10,462,874 "Wavelength Sensing Lighting System and Associated Methods." F. Maxik, E. Bretschneider, P. Medelius, D. Bartine, R. Soler, G. Flickinger, issued October 29, 2019.

51 KR 102,074,003 "Wavelength Sensing Light System and Associated Methods." F. Maxik, D. Bartine, P. Medelius, E. Bretschneider issued February 5, 2020.

52 US 10,679,476 "Method of Using a Camera to Detect Direction of Motion." E. Bretschneider, J. Fitzgibbon issued June 9, 2020.

53 CN 107,588,336 "Adjustable LED Lamp for Producing Biologically Adjusted Light." F. Maxik, D. Bartine, R. Soler, E. Grove, E. Bretschneider issued September 8, 2020.

54 US 11,337,282 "Lifetime Color Stabilization of Color-Shifting Artificial Light Sources." E. Bretschneider, L. Lerman, H. P. Stormberg issued May 17, 2022.

55 CA 2,910,093 "Movable Barrier Operator Light Distribution." T. Birdwell, E. Bretschneider, J. Fitzgibbon, issued July 12, 2022.

56 CA 2,856,409 "Wavelength Sensing Light System and Associated Methods." F. Maxik, D. Bartine, P. Medelius, E. Bretschneider issued July 12, 2022.

57 US 11,337,282 "Luminaire with Hollow Optical Systems." E. Bretschneider, L. Lerman, Ferdinand Schinagl issued July 19, 2022.

58 TWI 785,113 "Gamut Broadened Displays with Narrow Band Green Phosphors." J. Melman, R. Nordsell, K. Baroudi, Y. Bok Go, E. Bretschneider, A. Thomas, E. Thomas, issued December 21, 2022.

59 US 11,561,337 "Luminaire Having a Light Guide with Cladding." E. Bretschneider, F. Schinagl issued January 24, 2023.

60 EP 3,590,307 "Lifetime Color Stabilization of Color-Shifting Artificial Light Sources." E. Bretschneider, L. Lerman, H. P. Stormberg issued September 27, 2022.

61 EP 3,861,247 "Luminaire with Hollow Optical Systems." E. Bretschneider, F. Schinagl, L. Lerman, issued December 14, 2022.

62 CN 111,418,075 "Color Gamut Widening Display with Narrow Band Green Phosphor." J. Melman, R. Nordsell, K. Baroudi, Y. Bok Go, E. Bretschneider, A. Thomas, E. Thomas, issued October 13, 2023.

63 JP 7,396,982 "Gamut Broadened Display with Narrowband Green Phosphor." J. Melman, R. Nordsell, K. Baroudi, Y. Bok Go, E. Bretschneider, A. Thomas, E. Thomas, issued December 12, 2023.

64 EP 3,685,449 "Gamut Broadened Displays with Narrow Band Green Phosphors." J. Melman, R. Nordsell, K. Baroudi, Y. Bok Go, E. Bretschneider, A. Thomas, E. Thomas, issued March 27, 2024.

65 US 11,991,801 "Lifetime Color Stabilization of Color-Shifting Artificial Light Sources." E. Bretschneider, L. Lerman, H. P. Stormberg issued May 21, 2024.

66 US 12,085,747 "Luminaire Having a Light Guide with Cladding." E. Bretschneider, F. Schinagl issued September 10, 2024.

67 US 12,085,747 "Luminaire with Luminous Element." E. Bretschneider issued October 29, 2024

68 US 12,135,126 "Luminaire with Hollow Optical Systems." E. Bretschneider, F. Schinagl, L. Lerman, issued November 5, 2024.

69 US 12,362,166 "Cathode-Ray Tube Ultraviolet Light Source." E. Bretschneider, issued July 15, 2025.

70 US 12,455,052 "Luminaire and Lighting Control System." E. Bretschneider, C. Eskow, A. Gladwin, L. Lerman issued October 28, 2025.

### **Patents (Pending)**

>40 US and International Patents pending

### **Publications**

1. "Evaluation of  $Zn\{N[Si(CH_3)_3]_2\}_2$  as a p-Type Dopant in OMVPE Growth of ZnSe" W. S. Rees, D. M. Green, T. J. Anderson, E. Bretschneider, B. Pathangey, C. Park and J. Kim, J. Elec. Mat., vol. 21, pp. 361-366 (1992).
2. "OMVPE Growth of ZnSe Utilizing Zinc Amides as Source Compounds: Relevance to the Production of p-type Material" W. S. Rees, D. M. Green, T. J. Anderson and E. Bretschneider, Wide

Bandgap Semiconductors, eds. T. D. Moustakas, J. I. Pankove and Y. Hamakawa, MRS Pub., vol. 242 (1992).

3. "Characterization of ZnS Layers Grown by MOCVD for Thin Film Electroluminescence (TFEL) Devices" J. E. Yu, K. S. Jones, B. Pathangey, E. Bretschneider, T. J. Anderson, J. Fang, P. H. Holloway, Wide Bandgap Semiconductors, eds. T. D. Moustakas, J. I. Pankove and Y. Hamakawa, MRS Pub., vol. 243 (1992).
4. "A Study of Nucleation of ZnS Thin Layers Grown by Low-Pressure MOCVD for Thin Film Electroluminescence (TFEL) Devices" J. E. Yu, E. Bretschneider, B. Pathangey, T. J. Anderson, J. Fang, P. H. Holloway and K. S. Jones, Mechanisms of Heteroepitaxial Growth, eds. M. F. Chisholm, B. J. Garrison, R. Hull and L. J. Schowalter, MRS Pub., vol. 263 (1992).
5. "MOCVD Growth of Non-Epitaxial and Epitaxial ZnS Thin Films" J. Fang, P. H. Holloway, J. E. Yu, K. S. Jones, B. Pathangey, E. Bretschneider and T. J. Anderson, Appl. Surf. Sci., vols. 70-71, pp. 701-706 (1993).
6. "Temperature and Flow Modulation Doping of Manganese in ZnS Electroluminescent Films by Low Pressure Metalorganic Chemical Vapor Deposition" J. E. Yu, K. S. Jones, P. H. Holloway, B. Pathangey, E. Bretschneider and T. J. Anderson, J. Elec. Mat., vol. 23, pp. 299-305 (1994).
7. "Evidence for Quantum Confinement Effects in MOCVD-Grown Si/ZnS Nanostructures," E. Bretschneider, A. Davydov, J. E. Yu, B. Pathangey, K. S. Jones and T. J. Anderson, submitted to Applied Physics Letter (1994).
8. "Carrier Confinement Effects in Epitaxial Silicon Quantum Wells Prepared by MOCVD," H. P. Maruska, R. Sudharsanan, E. Bretschneider, A. Davydov, J. E. Yu, Z. Huang, B. Pathangey, K. S. Jones and T. J. Anderson, Microcrystalline and Nanocrystalline Semiconductors, eds. R. W. Collins, C. C. Tsai, M. Hirose, F. Koch and L. Brus, MRS Pub., vol. 358 (1994).
9. "Cost of Ownership Issues in Hydrogen Gas Purification," E. Bretschneider, Semiconductor Fabtech, 16<sup>th</sup> ed., pp. 127-30 (2002).
10. "Bi-Chromatic to Polychromatic Photo- Conversion LEDs." W. Kennedy, E. Bretschneider, Proceedings of the SPIE, the International Society for Optical Engineering, vol. 5941, SPIE, Bellingham, WA (2005).
11. "Solid-State Lighting: Where Are We Going, What Are We Doing?" B. Kennedy, E. Bretschneider, Photonics Spectra, vol. 40, pp58-66. (2006).
12. "Efficacy Limits for Solid-State White Light Sources." E. Bretschneider, Photonics Spectra, vol. 47 (2007).
13. "Chasing Rainbows – Does SPD hold the key to future LED Performance?" E. Bretschneider, LEDs Magazine. (2018).
14. "Recommended Method for Determining the Correlated Color Temperature and Distance from the Planckian Locus of a Light Source." K. Smet, M. Royer, D. Baxter, E. Bretschneider, T. Esposito, K. Hauser, W. Luedtke, K. Man, Y. Ohno, Leukos, published online 13 September 2023.
15. "Can Designs and Measurements Based on the Circadian Stimulus Model Stand the Test of Time?" E. Bretschneider, All Things Lighting Association, published online 12 August 2024. (<https://www.allthingslighting.org/can-designs-and-measurements-based-on-the-circadian-stimulus-model-stand-the-test-of-time/>)

16. "Identification of the Blue-Yellow Metameric Locus of the Circadian Stimulus Model" E. Bretschneider, Lighting Research & Technology (2025) in press
17. "Effect of Surface Spectral Reflectance on Predictions of the Circadian Stimulus Model" E. Bretschneider, Leukos, (2025) in press.

### **Presentations and Seminars**

1. "Alternative Group V Precursors for CVD Applications," R. M. Lum\*, J. K. Klingert, D. W. Kisker and E. Bretschneider. Presented at the Fifth International Conference on Metalorganic Vapor Phase Epitaxy and Workshop on MOMBE, CBE, GSMBE and Related Techniques, Aachen, Germany (1990).
2. "Synthesis and Characterization of New Compounds Useful in MOVPE of II-VI Compound Semiconductors," W. S. Rees\*, Jr., D. Green, T. J. Anderson, E. Bretschneider and J. Kim. Presented at the Fifth Biennial Workshop on Organometallic Vapor Phase Epitaxy, Panama City, FL (1991).
3. "Initial Stages Deposition of MOCVD ZnS on BaTa<sub>2</sub>O<sub>5</sub> and Si," E. Bretschneider\*, J. E. Yu, B. Pathangey, T. J. Anderson and K. Jones. Presented at Annual AIChE Meeting, Los Angeles, CA (1991).
4. "Growth and Properties of ZnS Layers for Thin Film Electroluminescence (TFEL) Devices," E. Bretschneider\*, J. E. Yu, J. Fang, B. Pathangey, K. S. Jones, P. H. Holloway and T. J. Anderson. Presented at 21st Ann. Symp. Appl. Vac. Sci. Technol., Clearwater, FL (1992).
5. "MOCVD Growth of Non Epitaxial and Epitaxial ZnS Thin Films," J. Fang, P. H. Holloway\*, J. E. Yu, K. S. Jones, B. Pathangey, E. Bretschneider and T. J. Anderson. Presented at 12<sup>th</sup> Internatl. Vac. Congress, Netherlands (1992).
6. "Microstructure of ZnS Layers Grown by MOCVD for Thin Film Electroluminescent Displays," J. E. Yu, K. S. Jones\*, E. Bretschneider, T. J. Anderson and P. H. Holloway. Presented at the 10th Annual Meeting of the Florida Chapter of Scanning Electron Microscopy Society, Crystal River, FL (1992).
7. "Research in Electroluminescent Thin Film Materials at the University of Florida," J. E. Yu, K. S. Jones, B. Pathangey, T. J. Anderson, E. Bretschneider and P. H. Holloway\*. Presented at Planar Systems Inc, Beaverton, OR (1992).
8. "Microstructure and Properties of MOCVD Grown ZnS Undoped and Doped with Terbium or Manganese," P. H. Holloway\*, J. Fang, J. E. Yu, K. S. Jones, E. Bretschneider, B. Pathangey and T. J. Anderson. Presented at Spring MRS Meeting, San Francisco, CA (1993).
9. "Effects of Substrate Preparation on the Interfacial Abruptness and Composition of ZnS/Si Heterostructures," J. E. Yu, E. Bretschneider, T. J. Anderson\* and K. S. Jones. Presented at Spring MRS Meeting, San Francisco, CA (1993).
10. "Microstructure, Modulation Doping, and Epitaxial Growth of Electroluminescent Films of ZnS," J. E. Yu, J. Fang, K. S. Jones, P. H. Holloway\*, E. Bretschneider, B. Pathangey and T. J. Anderson. Presented at the 40th Nat. Symp. and Topical Conf. of the Amer. Vac. Soc., Orlando, FL (1993).
11. "Blue and Green Light Emitting Phosphors for Thin Film Electroluminescent Displays," J. E. Yu, E. Bretschneider, B. Pathangey, S. Jones, T. Trottier, P. Rack, J. Sebastian, K. S. Jones, T. J. Anderson and P. H. Holloway\*. Presented at Spring MRS Meeting, San Francisco, CA (1994).
12. "Quantum Confinement Effects in Heteroepitaxial Si/ZnS Nanostructures Produced by MOCVD." E. Bretschneider\*, J. E. Yu, Z. Huang, B. Pathangey, K. S. Jones, T. J. Anderson, H. P. Maruska and

- R. Sudharsanan. Presented at the 41st National Symposium of the American Vacuum Society and 3rd International Conference on Nanometer-scale Science and Technology, Denver, CO (1994).
13. "MOCVD Growth of ZnS/Si Quantum Well Structures" E. Bretschneider\*, A. Davydov, C. McCreary, J. E. Yu, L. Wang, K. S. Jones, T. J. Anderson and P. Maruska. Presented at the TMS 7th Biennial Workshop on Organometallic Vapor Phase Epitaxy, Fort Myers, FL (1995).
  14. "MOCVD Growth of ZnS Using Methyl Mercaptan as an Alternate Sulfur Source." C. McCreary\*, A. Davydov, E. Bretschneider and T. J. Anderson. Presented at the AIChE Conference on Electronic and Photonic Materials. Miami, FL (1995).
  15. "ZnS/Si/ZnS Quantum Well Structures for Visible Light Emission." E. Bretschneider\*, C. McCreary, A. Davydov, T. J. Anderson, H. P. Maruska and P. Norris. Presented at the Fall MRS Meeting, Boston, MA (1995).
  16. "MOCVD Growth of Si/ZnS Quantum Well Structures." E. Bretschneider\*, A. Davydov, C. McCreary, T. J. Anderson and H. P. Maruska. Presented at the TMS 8th Biennial Workshop on Organometallic Vapor Phase Epitaxy, Dana Point, CA (1997).
  17. "Cost of Ownership Issues in Hydrogen Purification." E. Bretschneider\*, Presented at CS-MAX 2001, Boston, MA (2001).
  18. "MOCVD Growth of High Brightness Light Emitting Diodes." E. Bretschneider\*, Invited Seminar, Department of Chemical Engineering, Tulane University, March 2002.
  19. "Comparison of CDD and Photodiode Arrays for Measurement of High Brightness Light Emitting Diodes." E. Bretschneider\*, C. Dodds, Presented at CS-MAX 2002, San Jose, CA (2002).
  20. "Angular Variations in Spectroradiometric Characterization of High Brightness Light Emitting Diodes." E. Bretschneider\*, C. Dodds, C. Narfgren, J. Ngafoe, Presented at CS-MAX 2002, San Jose, CA (2002).
  21. "Solid-State Lighting for the 21<sup>st</sup> Century." E. Bretschneider\*, Invited Seminar, Department of Chemical Engineering, University of South Florida, September 2003.
  22. "Bi-Chromatic to Polychromatic Photo-Conversion LEDs." W. Kennedy, E. Bretschneider\*, Presented at Fifth International Conference on Solid-State Lighting, Sand Diego, CA, August 1-4 (2005).
  23. "Introduction to High Brightness LEDs." E. Bretschneider\*, Presented at SID-LEDs in Displays, Costa Mesa, CA (2006).
  24. "High Brightness Side-View LEDs Review." E. Bretschneider\*, Presented at SID-LEDs in Displays, Costa Mesa, CA (2007).
  25. "High Brightness Side-View LEDs: What It Takes to Deliver LEDs Suitable for Mid-Size LCD BLUs in Mass Production." E. Bretschneider\*, Presented at SID-LEDs in Displays, Costa Mesa, CA (2008).
  26. "Color Rendering and Efficacy Limits for Solid State Lighting Technology." E. Bretschneider\*. Presented at SPIE 8<sup>th</sup> International Conference on Solid State Lighting, Los Angeles, CA (2008).
  27. Conference Chair: "LED Measurement and Standards", San Diego, CA October 2-3 (2008).
  28. "Public Lighting Case: New York City", E. Bretschneider\*, E. Peiniger, J. Sundin, Green Lighting 2009, Frankfurt, Germany, March 24-26 (2009).

29. "Honest Metrics for Energy Efficient Lighting", E. Bretschneider, Design Lights Consortium Stakeholders Meeting, Denver, CO August 2-3 (2016).
30. "Models for Predicting Color Point Stability", E. Bretschneider, Strategies in Light, Anaheim, CA February 28 - March 2 (2017).
31. "Models for Predicting LED Color Point Stability" - Invited paper, E. Bretschneider, CORM 2017, Troy, NY, July 31 - August 2 (2017).
32. "Chasing the Rainbow" Strategies in Light, Las Vegas, NV, February 27 – March 1 (2019).
33. "From Back Death to White Light: the LED Revolution that almost didn't happen." (Keynote speaker), Strategies in Light, Las Vegas, NV, February 27 – March 1 (2019).
34. "The Integrated System of Lighting: Paving a New Path to Profitability.", Strategies in Light, San Diego, CA, February 11 – 13 (2020).
35. "The Update of LM-79: Optical and Electrical Measurements of Solid-State Lighting Products.", IES Educational Webinar Series, August 19 (2021).
36. "TM-21-21: Projecting Long-Term Luminous, Photon, and Radiant.", IES Educational Webinar Series, March 10 (2022).
37. "Everything about UVC that you didn't know to ask.", CSA Power Lunch, LightFair 2022, June 22 (2022).
38. "Effect of Surface Spectral Reflectance in the Built Environment on Corneal Spectral Irradiance. CORM/CIE-USNC Joint Annual Conference, November 13 (2024).
39. "A Correlative Comparison of Circadian Lighting Models.", CORM/CIE-USNC Joint Annual Conference, November 14 (2024).