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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 implements 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_{70} lifetimes >80,000 hours at T_a=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 2nd 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 2nd 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. Makanoeich, 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.

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, 16th 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 OMCVD ZnS on $BaTa_2O_5$ 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 12th 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 21st 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 8th 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).