U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Solid-State Lighting Patents Resulting from DOE-Funded Projects

As of March 2023, 256 solid-state lighting (SSL) patents have been awarded to research projects funded by the U.S. Department of Energy (DOE). Since December 2000, when DOE began funding SSL research projects, a total of 483 patent applications have been submitted, ranging from large businesses (150) and small businesses (171) to universities (148) and national laboratories (14).

DOE tracks three types of patent applications. A brief overview and the symbol used to identify each application type follows:

NP **U.S. Nonprovisional Patents:** the standard U.S. patent application. Nonprovisional applications are examined by a patent examiner and may be issued as a patent if all requirements for patentability are met.[1]

P **U.S. Provisional Patents:** a lower-cost patent application filing option in the United States used to establish an early effective filing date in a later-filed nonprovisional patent application. An applicant who files a provisional application must file a corresponding nonprovisional application for patent during the 12-month pendency period in order to benefit.[2]

PCT **International Patents:** an international patent application under the Patent Cooperation Treaty (PCT), by which applicants can simultaneously seek protection for intellectual property in 148 countries, including the United States.[3]

Each patent application has a unique application number used to track progress until a patent is awarded. Patent application titles may not be unique, and often we see the same title for multiple patent applications. For this reason, duplicate titles may be listed in the table below, but each instance corresponds to a unique patent application. Provisional patents are only tracked until the nonprovisional patent is filed, at which point they are superseded to avoid double counting. If a nonprovisional U.S. patent and an international patent are linked (i.e., one is a continuation of the other), the title is listed once but designated with both NP and PCT. In instances where the patent information is protected, the patent may be listed by application type, but no title is provided.

Primary Research Organization	**Titles of Patent Applications** (nonprovisional patents granted shown in bold) NP = U.S. Nonprovisional P = U.S. Provisional PCT = International	
Acuity Brands Lighting	• **Cassette for Holding a Planar Light Source with a Thermally Isolated Driver Board**NP • **Power Line Communication System and Auto-Addressing Protocol**NP	• **Power Line Communication System and Auto-Addressing Protocol**NP
Agiltron	• **Optoelectronic Device with Nanoparticle Embedded Hole Injection/Transport Layer**NP	• One provisional patent application filedP
Applied Materials, Inc.	• **Method and Apparatus for Inducing Turbulent Flow of a Processing Chamber Cleaning Gas**NP • **Methods for Improved Growth of Group III Nitride Buffer Layers**NP, PCT	• **Methods for Improved Growth of Group III Nitride Semiconductors**NP • **Multiple Complementary Gas Distribution Assemblies**NP

1 For more information on nonprovisional patents, see: https://www.uspto.gov/patents-getting-started/patent-basics/types-patent-applications/nonprovisional-utility-patent#heading-1

2 For more information on provisional patents, see: https://www.uspto.gov/patents-getting-started/patent-basics/types-patent-applications/provisional-application-patent

3 For more information on PCT and international patents, see: https://www.wipo.int/pct/en/or https://www.uspto.gov/sites/default/files/patents/process/file/efs/guidance/indexing-pct-new-appl.pdf

Primary Research Organization	**Titles of Patent Applications** (nonprovisional patents granted shown in bold) NP = U.S. Nonprovisional P = U.S. Provisional PCT = International	
Arizona State University	• **Iridium Complexes Demonstrating Broadband Emission Through Controlled Geometric Distortion and Applications Thereof**[NP] • **Metal-Assisted Delayed Fluorescent Emitters Employing Benzo-Imidazo-Phenanthridine and Their Analogues**[NP] • **Metal-Assisted Delayed Fluorescent Emitters Employing Benzo-Imidazo-Phenanthridine and Analogues**[NP] • **Metal Compounds and Methods and Uses Thereof**[NP, PCT] • **Non-Platinum Metal Complexes for Excimer Based Single Dopant White Organic Light Emitting Diodes**[NP] • **Organic Light Emitting Diode with Split Emissive Layer**[NP] • **Thermally Assisted Delayed Fluorescent Materials with Triad-Type Materials of Substituted Heteroaryls**[NP] • **Thermally Assisted Delayed Fluorescent Materials with Triad-Type Materials of Substituted Heteroaryls**[NP] • Efficient and Stable Near-Infrared OLED Employing Metal Complex Aggregates as Host Materials[NP] • Functional Materials Based on Stable Chemical Structure[NP] • Hole-Blocking Materials for Organic Light Emitting Diodes[NP, PCT]	• Metal-Assisted Delayed Fluorescent Emitters Employing Benzo-Imidazo-Phenanthridine and Their Analogues[NP] • Metal-Assisted Delayed Fluorescent Emitters Employing Pyrido-Pyrrlol-Acridine and Analogues[NP, PCT] • Metal Assisted Delayed Fluorescent Emitters for Organic Light-Emitting Diodes[NP] • Non-Planar Blue Phosphorescent Emitters Based on Functionalized Imidazolyl Group[NP] • Non-Platinum Metal Complexes for Excimer Based Single Dopant White Organic Light Emitting Diodes[NP, PCT] • **OLED with Multi-Emissive Material Layer**[NP] • Phosphorescent Excimers with Preferred Molecular Orientation as Monochromic Emitter for Display and Lighting Applications[PCT] • Single-Doped White OLED with Extraction Layer Doped with Down-Conversion Red Emitters[NP, PCT] • **Substituted Heteroaryls as Thermally Assisted Delayed Fluorescent Materials**[NP] • Two nonprovisional patent applications filed[NP] • One provisional patent application filed[P] • Two patent applications filed
Arkema, Inc.	• **Chemical Vapor Deposition Using N,O Polydentate Ligand Complexes of Metals**[NP, PCT]	· OLED Substrate Consisting of Transparent Conductive Oxide (TCO) and Anti-Iridescent Undercoat[NP, PCT]
Atom	• Single-Walled Carbon Nanotube Films and Method and Apparatus for Fabricating Thereof[NP, PCT]	
Carnegie Mellon University	• **Composite Compositions and Modification of Inorganic Particles for Use in Composite Compositions**[NP, PCT]	
Cree, Inc.	• **Expandable LED Array Interconnect**[NP] • **Extraction Film for Optical Waveguide and Method of Producing Same**[NP] • **High Reflectivity Mirrors and Method for Making Same**[NP, PCT] • **LED Lamp Incorporating Remote Phosphor with Heat Dissipation Features**[NP] • **LED Lamp or Bulb with Remote Phosphor and Diffuser Configuration with Enhanced Scattering Properties**[NP] • **LED Package Element with Internal Meniscus for Bubble-Free Lens Placement**[NP] • **LED Structure with Enhanced Mirror Reflectivity**[NP, PCT] • **Light Emitting Diode with High Aspect Ratio Submicron Roughness for Light Extraction and Methods of Forming**[NP] • **Light Emitting Diode with High Aspect Ratio Submicron Roughness for Light Extraction and Methods of Forming**[NP]	• **Light Emitting Diode with Porous SiC Substrate and Method for Fabricating**[NP, PCT] • **Recipient Luminophoric Mediums Having Narrow Spectrum Luminescent Materials and Related Semiconductor Light Emitting Devices and Methods**[NP] • **Solid State Lighting Component**[NP] • **Solid State Lighting Component**[NP] • **Solid State Lighting Component**[NP] • **Solid State Lighting Component**[NP] • **Solid State Lighting Component**[NP] • **Ultra-Thin Ohmic Contacts for P-Type Nitride Light Emitting Devices**[NP] • **Ultra-Thin Ohmic Contacts for P-Type Nitride Light Emitting Devices**[NP] • Ultra-Thin Ohmic Contacts for P-Type Nitride Light Emitting Devices and Methods of Forming[PCT]
Crystal IS, Inc.	• **Growth of Large Aluminum Nitride Single Crystals with Thermal-Gradient Control**[NP, PCT]	
Dow Corning	• One provisional patent application filed[P]	• Three patent applications filed
Eastman Kodak	• **Device Containing Non-Blinking Quantum Dots**[NP, PCT] • **Device Containing Non-Blinking Quantum Dots**[NP] • **Doped Nanoparticle-Based Semiconductor Junction**[NP, PCT] • **Ex-Situ Doped Semiconductor Transport Layer**[NP, PCT] • **Light-Emitting Nanocomposite Particles**[NP]	• **Method of Making Highly-Confined Semiconductor Nanocrystals**[NP] • Highly Confined Semiconductor Nanocrystals[NP, PCT] • Making Colloidal Ternary Nanocrystals[NP, PCT]

Primary Research Organization	**Titles of Patent Applications** (nonprovisional patents granted shown in bold) NP = U.S. Nonprovisional P = U.S. Provisional PCT = International	
Eaton Corporation	• **Lighting Fixture**[NP] • **Luminaire with Integrated Lightguide**[NP]	• 3D Printable Lens for Beam Shaping [PCT]
EIE Materials, Inc. (dba Lumenari, Inc.)	• **Phosphor-converted White Light Emitting Diodes Having Narrow-band Green Phosphors**[NP] • **Europium Beta-Diketonate Luminescent Material**[NP, PCT]	• Three provisional patent applications filed[P]
Fairfield Crystal Technology	• **Method and Apparatus for Aluminum Nitride Monocrystal Boule Growth**[NP]	
GE Global Research	• **Blue-Green and Green Phosphors for Lighting Applications**[NP] • **Electrodes Mitigating Effects of Defects in Organic Electronic Devices**[NP] • **Light-Emitting Device with Organic Electroluminescent Material and Photoluminescent Materials**[NP] • **Lighting System with Heat Distribution Face Plate**[NP, PCT] • **Lighting System with Thermal Management System**[NP, PCT] • **Lighting System with Thermal Management System Having Point Contact Synthetic Jets**[NP, PCT] • **Luminaire for Light Extraction from a Flat Light Source**[NP] • **Materials for Optoelectronic Devices**[NP, PCT]	• **Mechanically Flexible Organic Electroluminescent Device with Directional Light Emission**[NP, PCT] • **OLED Area Illumination Source**[NP] • **Organic Electroluminescent Devices and Method for Improving Energy Efficiency and Optical Stability Thereof**[NP] • **Organic Electroluminescent Devices Having Improved Light Extraction**[NP, PCT] • **Series Connected OLED Structure and Fabrication Method**[NP] • Hybrid Electroluminescent Devices[NP] • Eight patent applications filed
GE Lighting Solutions, LLC	• **Novel Green Emitting Phosphors and Blends Thereof** [NP] • **Phosphor Suspended in Silicone, Molded/Formed and Used in a Remote Phosphor Configuration**[NP, PCT]	• One provisional patent application filed[P]
General Electric Company	• **2,5-Linked Polyfluorenes for Optoelectronic Devices**[NP] • **2,5-Linked Polyfluorenes for Optoelectronic Devices**[NP] • **2,5-Linked Polyfluorenes for Optoelectronic Devices**[NP] • **Alkaline and Alkaline Earth Metal Phosphate Halides and Phosphors**[NP] • **Coated Phosphors, Methods of Making Them, and Articles Comprising the Same**[NP, PCT] • **Color Stable Manganese-Doped Phosphors**[NP, PCT] • **Color Stable Manganese-Doped Phosphors**[NP] • **Color Stable Phosphors**[NP, PCT] • **Electronic Devices Comprising Organic Iridium Compositions**[NP] • **Electronic Devices Comprising Organic Iridium Compositions**[NP] • **Electronic Devices Comprising Organic Iridium Compositions**[NP] • **Emissive Polymeric Materials for Optoelectronic Devices**[NP] • **Functionalized Polyfluorenes for Use in Optoelectronic Devices**[NP] • **Ketopyrroles Useful as Ligands in Organic Iridium Compositions**[NP]	• **Kimzeyite Garnet Phosphors**[NP] • **Lighting System with Thermal Management System**[NP] • **Lighting System with Thermal Management System**[NP] • **Lighting System with Thermal Management System**[NP] • **Lighting System with Thermal Management System**[NP] • **Lighting System with Thermal Management System Having Point Contact Synthetic Jets**[NP] • **Lighting System with Thermal Management System Having Point Contact Synthetic Jets**[NP] • **Method for Preparing Polymeric Organic Iridium Compositions**[NP] • **Method of Making Organic Light Emitting Devices**[NP] • **OLED Devices with Internal Outcoupling**[NP] • **Organic Iridium Compositions and Their Use in Electronic Devices**[NP] • **Organic Iridium Compositions and Their Use in Electronic Devices**[NP] • **Organic Iridium Compositions and Their Use in Electronic Devices**[NP] • **Phosphors for LED Lamps**[NP] • Alkaline Earth Borate Phosphors[NP]
Georgia Tech Research Corporation	• One patent application filed	
Glint Photonics, Inc.	• Method for Producing Optical Article with Anti-Reflective Surface, and Optical Article with Anti-Reflective Surface [NP, PCT]	• One provisional patent application filed[P] • One patent application filed
Global OLED Technology, LLC	• **Electroluminescent Device Having Improved Light Output**[NP]	

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Heraeus Materials Technology LLC	• One provisional patent application filed[P]	
InnoSys, Inc.	• Solid State Luminaire Lighting System[NP]	• One nonprovisional patent application filed[NP]
Innotec, Corp.	• Illumination Assembly Including Thermal Energy Management[NP, PCT]	
International Technology Exchange	• One patent application filed	
Kebotix, Inc.	• One provisional patent application filed[P]	• One patent application filed
KLA-Tencor	• **Scattered Light Separation**[NP] • **Substrate Inspection**[NP, PCT] • **High Throughput Hot Testing Method and System for High Brightness Light Emitting Diodes**[NP, PCT]	• **High Throughput Hot Testing Method and System for High Brightness Light Emitting Diodes**[NP] • Solid State Light Production Using Flexible Grouping of LEDs[NP, PCT]
Lawrence Berkeley National Laboratory	• **Carbon Nanotube Polymer Composition and Devices**[NP]	• **Organic Light Emitting Diodes with Structured Electrodes**[NP]
Lehigh University	• **Abbreviated Epitaxial Growth Mode (AGM) Method for Reducing Cost and Improving Quality of LEDs and Lasers**[NP] • **Gallium Nitride-Based Device and Method**[NP] • **Nitride Based Quantum Well Light-emitting Devices Having Improved Current Injection Efficiency**[NP] • **Semiconductor Light-emitting Devices Having Concave Microstructures Providing Improved Light Extraction Efficiency and Method for Producing Same**[NP]	• **Staggered Composition Quantum Well Method and Device**[NP, PCT] • **Staggered Composition Quantum Well Method and Device**[NP] • **Surface Plasmon Dispersion Engineering via Double-metallic AU/AG Layers for Nitride Light-emitting Diodes**[NP]
Light Prescriptions Innovators	• **Optical Device for LED-Based Lamp**[NP, PCT] • **Optical Devices**[NP] • **Optical Manifold**[NP] • **Optical Manifold for Light-Emitting Diodes**[NP, PCT]	• **Optical Manifold for Light-Emitting Diodes**[NP] • **Wide Band Dichroic-Filter Design for LED-Phosphor Beam Combining**[NP] • Three patent applications filed
Lightscape Materials Inc.	• **Carbonitride Based Phosphors and Light Emitting Devices Using the Same**[NP, PCT] • **Carbonitride Based Phosphors and Light Emitting Devices Using the Same**[NP] • **Halogenated Oxycarbidonitride Phosphor and Devices Using Same**[NP] • **Oxycarbidonitride Based Phosphors and LED Lighting Devices**[NP]	• **Oxycarbonitride Phosphors and Light Emitting Devices Using the Same**[NP, PCT] • **Oxycarbonitride Phosphors and Light Emitting Devices Using the Same**[NP] • **Oxycarbonitride Phosphors and Light Emitting Devices Using the Same**[NP] • **Silicon Carbidonitride Based Phosphors and Lighting Devices Using the Same**[NP, PCT]

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Lucent Optics, Inc.	• **Edge-Lit LED Lighting Fixture**NP • **Illumination Systems Employing Thin and Flexible Waveguides with Enhanced Light Coupling**NP • **Light Emitting Sheet**NP • **Light Emitting Sheet**NP • **Light Emitting Sheet**NP • **LED Lighting Sheet with Surface Pattern**NP • **Light Emitting Sheet with Surface Pattern**NP • **Light Emitting Sheet with Surface Pattern**NP • **Light Emitting Sheet with Surface Pattern**NP • **Light Emitting Sheet with Surface Pattern**NP • **Light Emitting Sheet with Surface Pattern**NP • **Light Emitting Sheet with Surface Pattern**NP • **Light Guide**NP • **Light Guide**NP • **Backlight Unit for LCD Displays Employing Side-Emitting LEDs and Optical Waveguides**NP • Wide-Area Lighting Fixture with Segmented EmissionNP • **Suspended Lighting Fixtures Employing Shaped Light Guide Illumination Devices**NP • **Suspended Lighting Fixture Employing Shaped Light Guide Illumination Devices**NP	• **Light Guide Illumination Systems with Enhanced Light Coupling**NP • **Method of Making Illumination Systems Employing Thin and Flexible Waveguides with Enhanced Light Coupling**NP • **Light Guide Illumination Systems with Enhanced Light Coupling**NP • **Light Guide Illumination Systems with Enhanced Light Coupling**NP • Method of Making Light Guide Illumination Systems with Enhanced Light CouplingNP • **Shaped Light Guide Illumination Devices**NP • **Solid-State Lighting Fixture**NP • **Solid-State Lighting Fixture**NP • **Wide-area Solid-state Illumination Devices and Systems**NP • **Wide-area Solid-state Illumination Devices and Systems**NP • **Face-Lit Waveguide Illumination Systems**NP • **Lighting Fixture for Direct and Indirect Lighting with Patterned Light Emitting Area**NP • One patent application filed
Lumileds, LLC (formerly Philips Lumileds Lighting, LLC)	• **Dimming LED Circuit Augmenting DC/DC Controller Integrated Circuit**NP • **Hybrid Chip-on-board LED Module with Patterned Encapsulation**NP, PCT • **LED Module with High Index Lens**NP • **Printed Circuit Board for Integrated LED Driver**NP	• **Printed Circuit Board for Integrated LED Driver**NP • **Zener Diode Protection Network in Submount for LEDs Connected in Series**NP • Molded Lens Incorporating a Window ElementNP • One nonprovisional patent application filedNP • One provisional patent application filedP • One patent application filed
Lumisyn, LLC	• Method of Making Colloidal Semiconductor NanocrystalsPCT • Shell Structures for Colloidal Semiconductor NanocrystalsNP, PCT	• Shell and Core Structures for Colloidal Semiconductor NanocrystalsNP
Maxdem Incorporated	• **Polymer Matrix Electroluminescent Materials and Devices**NP, PCT	
MoJo Labs Inc.	• **Wand Gesture**NP	
Moser Baer India Ltd.	• **Method of Manufacturing Organic Lighting Device**NP	
Nanosys	• **Nanocrystal Doped Matrices**NP, PCT	
National Renewable Energy Laboratory	• **High Bandgap III-V Alloys for High Efficiency Optoelectronics**NP, PCT • **Lattice-Mismatched GaInP LED Devices and Methods of Fabricating Same**NP	• **Solid State Lighting Devices and Methods with Rotary Cooling Structures**NP • Strain Balanced Direct Bandgap Aluminum Indium Phosphate Quantum Wells for Light Emitting DiodesNP
North Carolina State University	• One provisional patent application filedP	
Ohio State University	• **Photonics Materials**NP, PCT	• One provisional patent application filedP
OLEDWorks, LLC	• **Method for Mask-Free OLED Deposition and Manufacture**NP, PCT • **Solder Hermetic Sealing for OLEDS**NP	• Spectrally Tunable Stacked OLEDNP • Two provisional patent applications filedP

Primary Research Organization	**Titles of Patent Applications** (nonprovisional patents granted shown in bold) NP = U.S. Nonprovisional P = U.S. Provisional PCT = International	
OSRAM Opto Semiconductors	• **Device Structure for OLED Light Device Having Multi Element Light Extraction and Luminescence Conversion Layer**[NP] • **Electroluminescent Apparatus Having a Structured Luminescence Conversion Layer**[NP] • **Integrated Fuses for OLED Lighting Device**[NP] • **Light Source Comprising a Common Substrate, a First LED Device and a Second LED Device**[NP] • **Novel Method to Generate High Efficient Devices, which Emit High Quality Light for Illumination**[NP]	• **OLED Lighting Devices Having Multi Element Light Extraction and Luminescence Conversion Layer**[NP] • **Organic Electrophosphorescence Device Having Interfacial Layers**[NP] • **Polymer and Small Molecule Based Hybrid Light Source**[NP] • **Structured Luminescence Conversion Layer**[NP] • **Using Prismatic Microstructured Films for Image Blending in OLEDS**[NP] • OLEDs with Phosphors[NP] • One provisional patent application filed[P]
Osram Sylvania Inc.	• **Ceiling Mounted Luminaire**[NP] • **Driver Circuit for Solid State Light Sources**[NP] • **Interior Frame for Solid State Light Source Luminaire**[NP] • **Lamp with a Truncated Reflector Cup**[NP] • **LED Lamp**[NP] • **Solid State Light Source Driver Establishing Buck or Boost Operation**[NP]	• **Thermal Trim for a Luminaire**[NP, PCT] • **Thermal Trim for a Luminaire**[NP] • Apparatus Incorporating an Optically Transmitting Circuit Board[NP, PCT] • Arrangement of Solid State Light Sources and Lamp Using Same[NP, PCT] • One patent application filed
Pacific Northwest National Laboratory	• **OLED Devices**[NP] • Organic Materials with Phosphine Sulphide Moieties Having Tunable Electric and Electroluminescent Properties[NP, PCT]	• Organic Materials with Tunable Electric and Electroluminescent Properties[NP, PCT]
Palo Alto Research Center Incorporated	• One nonprovisional patent application filed[NP]	
Philips Electronics North America	• One provisional patent application filed[P]	• Three patent applications filed
Philips Lighting North America Corporation	• **Integrated LED-based Luminaire for General Lighting**[NP] • **Integrated LED-based Luminaire for General Lighting**[NP] • **LED Lamp Color Control System and Method**[NP] • **LED Lamp Power Management System and Method**[NP]	• **Methods and Apparatus for Controlling Respective Load Currents of Multiple Series-connected Loads**[NP] • **LED Module with High Index Lens**[NP] • One provisional patent application filed[P]
PhosphorTech Corporation	• **Light Emitting Device Having Selenium-Based Fluorescent Phosphor**[NP] • **Light Emitting Device Having Silicate Fluorescent Phosphor**[NP, PCT] • **Light Emitting Device Having Sulfoselenide Fluorescent Phosphor**[NP, PCT]	• **Light Emitting Device Having Thio-Selenide Fluorescent Phosphor**[NP] • **Phosphor Sheets**[NP]
Pixelligent Technologies LLC	• **Nanocomposite Formulations for Optical Applications**[NP] • Nanocomposite Formulations for Optical Applications[PCT] • Nanocomposite Formulations for Optical Applications[PCT]	• Nanocomposite Formulations for Optical Applications[PCT] • One provisional patent application filed[P] • One patent application filed
PPG Industries Inc.	• **Organic Light Emitting Diode with Light Extracting Layer**[NP]	
Princeton University	• **Process for Fabricating a Porous Film in a Scattering Layer**[NP]	• **Organic Light-emitting Device with a Phosphor-sensitized Fluorescent Emission Layer**[NP]
Purdue University	• Metalized Silicon Substrate for Indium Gallium Nitride Light-Emitting Diode[NP, PCT]	• Process for Fabricating III-Nitride Based Nanopyramid LEDs Directly on a Metalized Silicon Substrate[NP]
Rensselaer Polytechnic Institute	• **High Efficiency Light Source Using Solid-state Emitter and Down-conversion Material**[NP] • Free-Standing Mounted Light Emitting Diodes for General Lighting[NP]	• Method of Fabricating an Ohmic Contact to N-Type Gallium Nitride[NP] • Three provisional patent applications filed[P]

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Research Triangle Institute	• **Color Tunable Lighting Devices and Methods for Tuning Color Output of Lighting Devices**[NP] • **Reflective Nanofiber Lighting Devices**[NP, PCT] • **Photoluminescent Nanofiber Composites, Methods and Fabrication, and Related Lighting Devices**[NP]	• Lighting Devices with Color-Tuning Materials and Methods for Tuning Color Output of Lighting Devices[NP, PCT] • Long-Pass Optical Filter Made from Nanofibers[NP, PCT] • Stimulated Lighting Devices[PCT]
Sandia National Laboratories	• **Cantilever Epitaxial Process**[NP]	• **Nanowire-Templated Lateral Epitaxial Growth of Non-Polar Group III Nitrides**[NP]
SC Solutions, Inc.	• One patent application filed	
Sinmat, Inc.	• **High Light Extraction Efficiency Solid State Light Sources**[NP]	• Chemical Mechanical Fabrication for Forming Tilted Surface Features[NP]
Soraa, Inc.	• **Process for Large-Scale Ammonothermal Manufacturing of Semipolar Gallium Nitride Boules**[NP] • **Process for Large-Scale Ammonothermal Manufacturing of Gallium Nitride Boules**[NP]	• Process for Large-Scale Ammonothermal Manufacturing of Gallium Nitride Boules[NP] • One nonprovisional patent application filed[NP]
State University of New York, Buffalo	• **Colloidal Nanocrystals and Method of Making**[NP]	• One provisional patent application filed[P]
Universal Display Corporation	• **Binuclear Compounds**[NP, PCT] • **General Bus Line Design Rules for Large-Area OLED Lighting**[NP] • **Intermediate Connector for Stacked Organic Light Emitting Devices**[NP] • **Light Extraction Blocks for Thin Form Factor OLED Lighting with Improved Power Efficacy**[NP] • **Novel Host Compounds for Red Phosphorescent OLEDs**[NP] • **Organic Light Emitting Device Architecture for Reducing the Number of Organic Materials**[NP]	• **Organic Light Emitting Device Structure for Obtaining Chromaticity Stability**[NP] • **Organic Light Emitting Device Structure for Obtaining Chromaticity Stability**[NP] • **Organic Light Emitting Device with Conducting Cover**[NP, PCT] • **Organic Light-Emitting Devices for Illumination**[NP, PCT] • **White Phosphorescent Organic Light Emitting Devices**[NP] • Stacked OLEDs with a Reflective Conductive Layer[NP] • Organic Light Emitting Device Architecture[PCT]
University of California, San Diego	• **Rare-Earth Activated Aluminum Nitride Powders and Method of Making**[NP, PCT]	• One provisional patent application filed[P] • One patent application filed
University of California, Santa Barbara	• **Enhancing Performance Characteristics of Organic Semiconducting Films by Improved Solution Processing**[NP] • **Horizontal Emitting, Vertical Emitting, Beam Shaped, Distributed Feedback (DFB) Lasers by Growth over a Patterned Substrate**[NP, PCT] • **Nanowire-Polymer Composite Electrodes**[NP] • **Plasmon Assisted Enhancement of Organic Optoelectronic Devices**[NP, PCT] • **Single or Multi-Color High Efficiency Light Emitting Diode (LED) by Growth over a Patterned Substrate**[NP, PCT]	• Light Emitting Devices with Embedded Void-Gap Structures through Bonding of Structured Materials on Active Devices[NP] • Optoelectronic Devices with Embedded Void Structures[NP] • Selective Dry Etching of N-Face (Al,In,Ga)N Heterostructures[NP] • Semiconductor Micro-Cavity Light Emitting Diode[NP, PCT] • Silicone Encapsulants for Light Emitting Diodes[NP] • Methods of Hole Injection in Indium Aluminum Gallium Nitride Light-Emitting Diodes[PCT] • One provisional patent application filed[P] • Two patent applications filed
University of Florida	• **Inkjet Printing of Microlenses for Photonic Applications**[NP] • **Stable and All Solution Processable Quantum Dot Light-Emitting Diodes**[NP]	• **Top-emission Organic Light-emitting Devices with Microlens Arrays**[NP]

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University of Michigan	• **Gas Cushion Control of OVJP Print Head Position**[NP, PCT] • **Highly Reliable Stacked White Organic Light Emitting Device**[NP] • **Integrated Window and Light Source**[NP] • **OLED with Improved Light Outcoupling**[NP] • **Organic Electroluminescent Materials and Devices**[NP] • **OLED with Minimal Plasmonic Losses**[NP] • **Ultrabright Fluorescent OLEDs Using Triplet Sinks**[NP, PCT] • Control of Molecular Orientation and Film Crystallinity in Organic Light-Emitting Devices[NP] • **Enhanced OLED Outcoupling by Suppressing Surface Plasmon Modes**[NP] • Enhanced OLED Outcoupling by Suppressing Surface Plasmon Modes[NP] • Flexible Electronic Display Device[NP] • A White Organic Light Emitting Device with Stable Spectrum Employing Transport Barrier Layers[NP] • Optoelectronic Device Including Charge Generation Layer Stack[NP]	• **Hybrid Organic Light Emitting Device**[NP] • Integrated Photovoltaic Window and Light Source[NP] • Integrated Photovoltaic Window and Light Source[NP] • Organic Light Emitting Diode Having a Mixed Blocking Layer[NP] • **Organic Light-Emitting Devices Using a Low Refractive Index Dielectric**[NP] • **A Method of Fabricating a Light Emitting Device Having a Polymer Film with a Specified Surface Roughness**[NP] • **Sub-Electrode Microlens Array for Organic Light Emitting Devices**[NP] • Purcell-Effect-Enhanced Organic Light-Emitting Diodes with Sub-Electrode Microlens Array[NP] • System and Method for Display Patterning[NP] • Ultra-thin Flexible Substrate for Organic Light Emitting Devices with Enhanced Light Extraction Efficiency[NP] • Four provisional patent applications filed[P] • Three patent applications filed
University of North Texas	• **Organic Light-Emitting Diodes from Homoleptic Square Planar Complexes**[NP, PCT]	• Two provisional patent applications filed[P]
University of Southern California	• **Co-deposition Methods for the Fabrication of Organic Optoelectronic Devices**[NP] • **Fluorescent Filtered Electrophosphorescence**[NP, PC] • **Fluorescent Filtered Electrophosphorescence**[NP] • **Luminescent Cyclometallated Iridium (III) Complexes Having Acetylide Ligands**[NP] • **Materials and Architectures for Efficient Harvesting of Singlet and Triplet Excitons for White Light Emitting OLEDs**[NP] • **OLEDs Utilizing Macrocyclic Ligand Systems**[NP] • **OLED with Improved Light Outcoupling**[NP, PC] • **Organic Light Emitting Device Having Multiple Separate Emissive Layers**[NP, PC] • **Organic Vapor Jet Deposition Using an Exhaust**[NP, PC]	• **Phenyl and Fluorenyl Substituted Phenyl Pyrazole Complexes of Ir**[NP] • **Stable Blue Phosphorescent Organic Light Emitting Devices**[NP, PCT] • Low Index Grids (LIG) to Increase Outcoupled Light from Top or Transparent OLED[NP] • Luminescent Compounds with Carbene Ligands[PCT] • OLED with Hybrid Emissive Layer[NP] • Optoelectronic Device Including Charge Generation Layer Stack[NP] • Optoelectronic Device Including Ultrathin Dopant Layers[NP] • Organic Electroluminescent Materials and Devices[NP] • Organic Electroluminescent Materials and Devices[NP] • Stable Blue Phosphorescent Organic Light Emitting Devices[NP] • Four patent applications filed
Vitro	• **Organic Light Emitting Diode with Light Extracting Electrode**[NP] • **Organic Light Emitting Diode with Surface Modification Layer**[NP]	• **Organic Light Emitting Diode with Surface Modification Layer**[NP]
WhiteOptics, LLC	• One patent application filed	
Yale University	• Conductivity Based Selective Etch for GaN Devices and Applications Thereof[PCT]	

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