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## Licensing Opportunities

- Exclusive
- Non-exclusive
- Research Sponsorship
- Product Development Partnerships (PDP)

Lehigh Case # **122406-01**

## *Light Emitting Diodes using SiO<sub>2</sub> / Polystyrene Microlens Arrays for Enhanced Light Extraction Efficiency*

### Overview

The invention is regarding a new method to achieve high-efficiency III-Nitride light emitting diodes (LEDs) emitting in the visible regime (covering from 420 nm up to 650 nm), with applications for solid state lightings, display, biochemical sensing, and water purification applications.

Specifically, the invention is related to a novel method to increase the light extraction efficiency of optoelectronic emitters by utilizing a SiO<sub>2</sub> / polystyrene (PS) microlens array deposited on the surface on the light emission area. The implementation of SiO<sub>2</sub> / PS microspheres leads to a low-cost and straight-forward approach to form microlens arrays on the emission surface of emitters for improving light extraction efficiency, without using costly electron-beam lithography process. The diameter of the microspheres can be controlled accurately, resulting in good control and repeatability in the microlens structure and optical properties. The deposition of 2D close-packed SiO<sub>2</sub> / PS colloidal crystal is also practical and straight forward, as compared to electron-beam lithography or complex wafer fabrication techniques. As the SiO<sub>2</sub> microspheres are deposited as the final step on the top emission area of the optoelectronic emitters, this approach avoids any degradation on the electrical characteristics of the optoelectronic emitters.

The utilization of this novel invention allows one to realize light emitting diodes with significantly enhanced light extraction efficiency, using a straight forward and low-cost method.

### Applications and Advantages

- General Illumination Light Sources such as Fluorescent and Incandescent Lamps
- Solid State Display Applications (i.e. Traffic Lights, Signage, etc)
- Efficient Liquid Crystal Display (LCD) Backlight
- Emerging Technology of High-Definition and True-Color Television Using LEDs-based Pixels (ie. Sony Qualia).
- Entertainment Lighting effects and luminaries for theatres, studios, nightclubs, entertainments, restaurants and other high-visibility venues.
- Durable low voltage Landscape Lighting for city, park, or residential.
- Portable Lighting (i.e. Flashlights).
- High brightness, low power LEDs for interior and exterior automotive lighting with small footprints that offer improvement in safety, durability, and design.

### Status and Intellectual Property

A Patent Cooperation Treaty (PCT) has been filed.

### Lehigh ExpertNet

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