Non-Confidential Description - PSU No. 3657
“Low Energy Consumption White LEDs”

Keywords:
- Quantum dots, quantum wells, white LEDs,
- energy efficiency, non-radiative energy transfer

Links:
- Inventor Website
- US Patent 8,835,965

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Fig 1: p-i-n Emitting Diode

Background

White light emitting diode (LED) based solid-state lighting is commanding much attention worldwide for its promise of energy savings compared to incandescent and even compact fluorescent lighting. The energy efficiency, longevity, and material usage in manufacture are all attributes that favor white LED technology, however technical problems persist. The fundamental limitation lies in the multi-step “down conversion” scheme, where energy loss in the process will set the ultimate quantum efficiency of white LEDs below 65%. Colloidal compound quantum dots (QDs) have been introduced through indirect injection to eliminate energy losses associated with the down conversion scheme. However, there exists a need for quantum dots with varied emission colors coupled to an LED emitter that promotes efficient non-radiative energy transfer to achieve a practical white LED with low energy consumption.

Invention Description

The proposed invention is a quantum well-based p-i-n light emitting diode that includes nanopillars that have an average linear dimension between 50 nanometers and 1 micron. Quantum dot-quantum well coupling is employed to achieve efficient non-radiative transfer while retaining the overlying contact electrode structures with dimensions adjustable to desired thicknesses for improved efficiency. The quantum dot semiconductor nanoparticles contacting the nanopillars through the sidewalls overcomes the physical limitations encountered in the prior art laminar structures to yield a white LED with attractive properties relative to conventional incandescent and fluorescence lighting devices.

Advantages/Applications
- Promotes efficient non-radiative energy transfer
- Low energy consumption white LEDs
- More energy efficient than conventional incandescent and fluorescence lighting devices