THE APPLICATIONS OF QUANTUM CONTROL TECHNOLOGIES IN LEDS FOR LIGHTING

Yiping Cui, Advanced Photonics Center, Southeast University, China

Solid state lighting has received considerable interest due to advantages of low energy-consuming, long lifetime, and more environmental-friendly. As a typical kind of solid state light source, light emitting diodes (LED) devices have become an important industry product as a new generation of light source. Nowadays, most of white LED products are obtained by excitation of fluorescent powders (for instance yellow YAG:Ce fluorescent powders) via a blue LED. Although this type of white LED devices can satisfy the requirement of normal lighting, the color rending index (CRI) of the devices is hard to exceed 80. The relatively short lifetime of fluorescent powders is also a problem to restrict the lifetime of white LED devices.

Quantum Dots (QDs) are nano-sized particles of the compounds of II-IV or III-V group elements with diameters between 1~10nm. Because of Quantum Confine effect, the emission spectrum of QDs is tunable in a broad range by changing the size of the nanoparticles. Besides, QDs have continuous absorption band, narrow emission band, and good optical stability. These optical properties make QDs as the potential luminescent materials for high quality lighting devices.

There are two major technique strategies for using QDs in the lighting devices. One is Electroluminescence. A typical example is preparing organic/QDs lighting devices by doping colloidal QDs into organic materials. The other is to use QDs as nanophosphors excited by blue or ultraviolet LED tube core. In order to improve the CRI of the devices, the fluorescent materials can be sole QDs or a mixture of red QDs and yellow YAG fluorescent powders.

This talk will present the fundamental description of Quantum Control Technologies for nanoscale luminescent materials and discuss recent development of QD-LEDs. Some important issues about QDs luminescence including temperature-sensitive self-absorption and luminescence efficiency, doped QDs, color saturation behaviors of QDs, and design and fabrication of nontoxic QDs will be discussed. The research works about QD-LEDs in Advanced Photonics Center, Southeast University, will be introduced as well.