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Rare-earth-element free luminescent materials for warm white LEDs

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White light-emitting diodes (WLEDs) have gained considerable attention owing to its great potential in energy saving. Nevertheless, current available methods for WLEDs are mostly based on environmentally hostile and expensive rare-earth-element (REE) doped phosphors. REE mining, refining and disposal would cause a tremendous harm to the environment. Therefore, we explore environmental benign fluorescence materials for warm-WLEDs. We integrate ZnO and ZnS: Mn semiconductor nanoparticles with polymeric material poly (9,9-di-n- hexylfluorenyl-2,7-diyl). The resultant nanocomposites can be endowed with three different photon-emitting mechanisms corresponding to blue, green and orange emissions, respectively. Consequently, white light can be generated from the nanocomposites upon UV-LED excitations and exhibits widely tunable color temperatures, ranging from 2100 K to above 6000 K. The light emission from the nanocomposites can have very low color temperature, similar to candle light, which is good for human health. A warm-white light emission with 90% high quantum efficiency has been demonstrated under the commercial UV-LED excitation. We also successfully develop innovative II-VI nanoparticles without quantum-confinement effect to emit fluorescence light under 450 nm-LED excitation. Because the photo-physical behavior is not restricted by quantum confinement, the nanoparticles can exhibit a strong absorption at 453 nm, which well matches the wavelength of commercial blue-LEDs (450-460 nm). Also, the ZnSe: Mn nanoparticles can efficiently convert blue light (440-460 nm) to orange light (580 nm). The proposed REE-free nanotechnology-based materials not only achieve the eco-friendly purpose, but also provide a promising solution to conquer the health issues involved in current blue-YAG-LED lighting.

Biography

Ching-Fuh Lin is a Fellow of IEEE, a Fellow of SPIE, and Member of Asia-Pacific Academy of Materials. He obtained his MS and PhD degrees in electrical engineering from Cornell University, Ithaca, NY, in 1989 and 1993, respectively. He is now the Director of Innovative Photonics Advanced Research Center (i-PARC) and a joint distinguished Professor in the Graduate Institute of Photonics and Optoelectronics, Graduate Institute of Electronics Engineering, and Department of Electrical Engineering at National Taiwan University, Taipei, R.O.C. He has published over 160 journal papers and 460 conference papers, and holds more than 60 patents.

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