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Editorial

Quantum Dots and Nanoparticles in Light Emitting Diodes, Displays, and Optoelectronic Devices

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Quantum dots (QDs) and nanoparticles (NPs) have been widely studied in the past decades. Researchers and scientists have made a great effort to research and develop QDs and NPs for optoelectronic, sensing, and catalytic applications. Nowadays, QDs/NPs are gradually stepping into our life and they are being considered in new-generation products such as light emitting diodes (LEDs) with high color rendering index (CRI), displays with ultra-wide color gamut, high performance biosensors, and environmentally friendly cleaning devices. However, there are still existing difficulties and problem which need to be overcome and solved such as scalable synthetic process, better carrier transport, stability and reliability, and environmental compatibility for QD and NP nanomaterials.

The articles in this special issue include studies of microstructure characterization, carrier behaviors, application of white LEDs, biological sensing, and catalytic hydrodechlorination for QDs and NPs. For QDs used in light emission applications, synthesis of high-quality core/shell QDs with optimized composition and structure is the key to improve the emission efficiency and stability of QDs in lighting application. The paper entitled "The Core/Shell Structure of CdSe/ZnS Quantum Dots Characterized by X-Ray Absorption Fine Spectroscopy" by H. Wei et al. reports a single-step injection-free scalable synthetic method for core/shell CdSe/ZnS QDs and investigates them by X-ray absorption fine spectroscopy. The authors found that wurtzite CdSe is the main core structure with a Cd-Se bond length of 2.3 Å without phase shift and thought that different emission wavelengths are only due to the crystal size in their single-step injection-free synthesis, which could generate organic sulfur ligand-capped CdSe/ZnS QDs with the nearly ideal core/shell structure.

In many applications such as electroluminescence, core/shell CdSe/CdS QDs are considered to be a promising material. The carrier behavior of the QDs plays an important role in the luminescent application. In the paper entitled "Direct Determination of Spatial Localization of Carriers in CdSe-CdS Quantum Dots" published by Y. Zhao et al., they report a simple and direct I-V measurement method to determine the localized holes and delocalized electrons in core/shell CdSe/CdS QDs by evaluating the CdSe/CdS QDs-P3HT nanofibers and CdSe/CdS QDs-ZnO nanorods nanocomposites.

High CRI lighting or wide-gamut display lighting is the current focused topic for luminescent QDs. However, the reabsorption loss among different sized quantum dots (QDs) is a critical issue for those QD based white LEDs. In the paper

entitled "High Luminescence White LEDs Prepared with 2D Island-Pattern of Quantum Dots Dispersed Photopolymer Films", H.-G. Hong et al. fabricated a new film structure of 2D island-patterns consisting of separate green and red QDs dispersed photopolymer patterns in a zigzag form. From experimental and simulation analyses, they confirmed that the QD LED has better optical efficiency by employing the QD film with the 2D island-patterns due to the reduced reabsorption loss and obtained a promising white QD LED with efficiency of 62.2 lm/W and CRI of 83.

Development of rapid label-free biological detectors for bacteria or tumors is one of the most important subjects in human health in biomedical research. In the paper entitled "Core-Shell Structure of Gold Nanoparticles with Inositol Hexaphosphate Nanohybrids for Label-Free and Rapid Detection by SERS Nanotechnology", A. H. H. Mevold et al. reported a novel Au NPs/inositol hexaphosphate (IP_6) nanohybrid with great stability and Raman enhancement. This new nanohybrid detector was prepared by binding Au NPs to IP_6 through modified Frens method for surface-enhanced Raman scattering (SERS) detection.

In the manufacturing process of industrial materials and products involving QDs or NPs, toxic compounds such as aryl halides may be involved that cause environmental hazards. Scientists have spent much effort in order to solve the problem by catalytic hydrodechlorination (HDC) treatment for those chlorinated compounds. The paper entitled "Catalytic Hydrodechlorination of Trichlorobenzenes with $Pd(Phen)Cl_2$ as Catalyst Precursor" by G. Zhang et al. investigates catalytic hydrodechlorination (HDC) of trichlorobenzenes by an organometallic compound $Pd(Phen)Cl_2$ as a catalyst precursor. They found that $Pd(Phen)Cl_2$ could smoothly promote the HDC reactions of several TCBs to occur under the special conditions and different dechlorination products were detected.

The editors hope that the issue would draw attention to the importance of current development and speed the implementation of the QDs/NPs in the market that help improve the environment and quality of human life. We also hope it would attract more attention of scientists and researchers to develop QDs/NPs and solve the current difficulties and problem in light emitting diodes, displays, optoelectronic devices, and potential environmental problem.

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