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*Editorial*

# Nanostructured Optoelectronics: Materials and Devices

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The use of nanostructure materials for optoelectronic devices, including light-emitting diodes (LEDs), laser diodes, photodetectors, and solar cells, has recently attracted considerable attention due to their unique geometry. Nanostructures in small dimensions can be perfectly integrated into a variety of technological platforms, offering novel physical and chemical properties for the high performance optoelectronic devices. The exploitation of new nanostructures and their optical and electrical properties is necessary for their emerging practical device applications.

This special issue contains six papers, presenting some recent advances in the theoretical calculation, synthesis, characterization, and application of such novel nanostructures.

Recently, natural dyes have been widely studied as potential sensitizers for dye-sensitized solar cells (DSSCs) due to their cost efficiency, nontoxicity, and complete biodegradation. In "Photoactive Layer of DSSCs Based on Natural Dyes: A Study of Experiment and Theory," Y. Li et al. investigated, both theoretically and experimentally, three natural dyes for DSSCs which were extracted from natural plants, including *Forsythia suspensa*, Herba Violae, and Corn leaf. The authors reported that such natural dyes exhibit wide absorption region which covers almost the whole visible spectrum. The highest photoelectronic conversion efficiency for these natural dyes was recorded to be 0.96% with open circuit voltage of 0.66 V and short circuit current density of 1.97 $mAcm^{-2}$ which is promising for future biophotovoltaics applications.

Among these novel nanostructures, recent rapid advances in research involving two-dimensional (2D) layered nanomaterials and nanoplasmonics could pave the way for developing next-generation optoelectronic and photonic devices. Furthermore, the use of such 2D materials as a buffer layer for the growth of light-emitting III-V compound semiconductors by the so-called van der Waals epitaxy method has opened up a new route of heteroepitaxy, mitigating a lot of growth-related technological challenges. As an effort, this special issue features a theoretical paper relating to emerging 2D materials. X. Hu and F. Meng in "First-Principle Study on the Interaction between Fe and Trivacancy in Graphene" have reported the interaction between iron metal and monolayer graphene. In fact, this study has described a detailed investigation on the structural and electronic properties of graphene with vacancies as well as the advantages offered by having these vacancies on the graphene surface. These results certainly provide insights to engineer the electrical properties of graphene through defect addition and manipulation, being useful for industrial semiconductor applications such as the photocatalytic technology and graphene-based electronics.

In another paper, W. Sukkabot theoretically studied the impact of structure shapes on the electron-hole exchange interaction in core/shell nanostructure semiconductors. The study focused on the electron-hole exchange interaction in the morphological transformation of CdSe/ZnS core/shell nanodisk to CdSe/ZnS core/shell nanorod using atomistic tight-binding theory and a configuration interaction description. The aspect ratios were successfully used to study the structural and optical properties of such nanostructures. The single-particle and excitonic gaps are believed to be decreased by changing from disk to rod shapes. The authors concluded that light hole is suggested to be used for quantum information instead of a heavy hole. This study contributes important information to the design of high performance II-VI semiconductor nanocrystals for optoelectronic applications.

Y. J. Park et al. reported their study on the enhanced light extraction efficiency of LEDs by employing two ZnO nanostructures. The experiments were performed on two types of nanostructures including one-dimensional nanorods and two-dimensional nanosheets which were grown directly on top of LEDs. The formation of surface texturing on LEDs with ZnO nanorods offers increased escape cone and surface scattering, resulting in the enhancement of light output power of 30% compared to conventional LEDs without using ZnO nanostructures. However, due to the increased internal reflection and light absorption in ZnO nanosheets, LEDs using nanosheet structures have lower light output efficiency compared to the conventional one. The employment of ZnO nanorods shows promising approach for the enhanced output power of LEDs. More importantly, LED devices are not severely suffering from degradation of electrical properties by using ZnO nanorods.

In the paper "A Method to Control Dynamic Errors of the Stylus-Based Probing System for the Surface Form Measurement of Microstructures," H. Fang et al. proposed a simple and cost-effective method to control dynamic errors of the stylus-based probing system on measuring the surface form of microstructures. The dynamic errors were numerically simulated and suggested that the scanning speed and initial position of the measured specimen directly affect the dynamic errors. The authors proposed a solution to enhance the form measurement accuracy of microstructures by using kinematical models to predict the influence of the measurement setup on dynamic performance. The dynamic errors, therefore, can be controlled by properly choosing the optimal scanning speed and the initial position of the measured samples.

V. R. Balaji et al. presented a novel design of twelve-channel Dense Wavelength Division Multiplexing (DWDM) demultiplexer using the two-dimensional photonic crystal (2D PC) square resonant cavity. The rod radius and wavelength were optimized by linear regression analysis. The authors claimed that their DWDM exhibits high accuracy of 95% with an average quality factor close to 8000. Importantly, the proposed PC based demultiplexer has small figure size and is perfectly applied in integrated optics.

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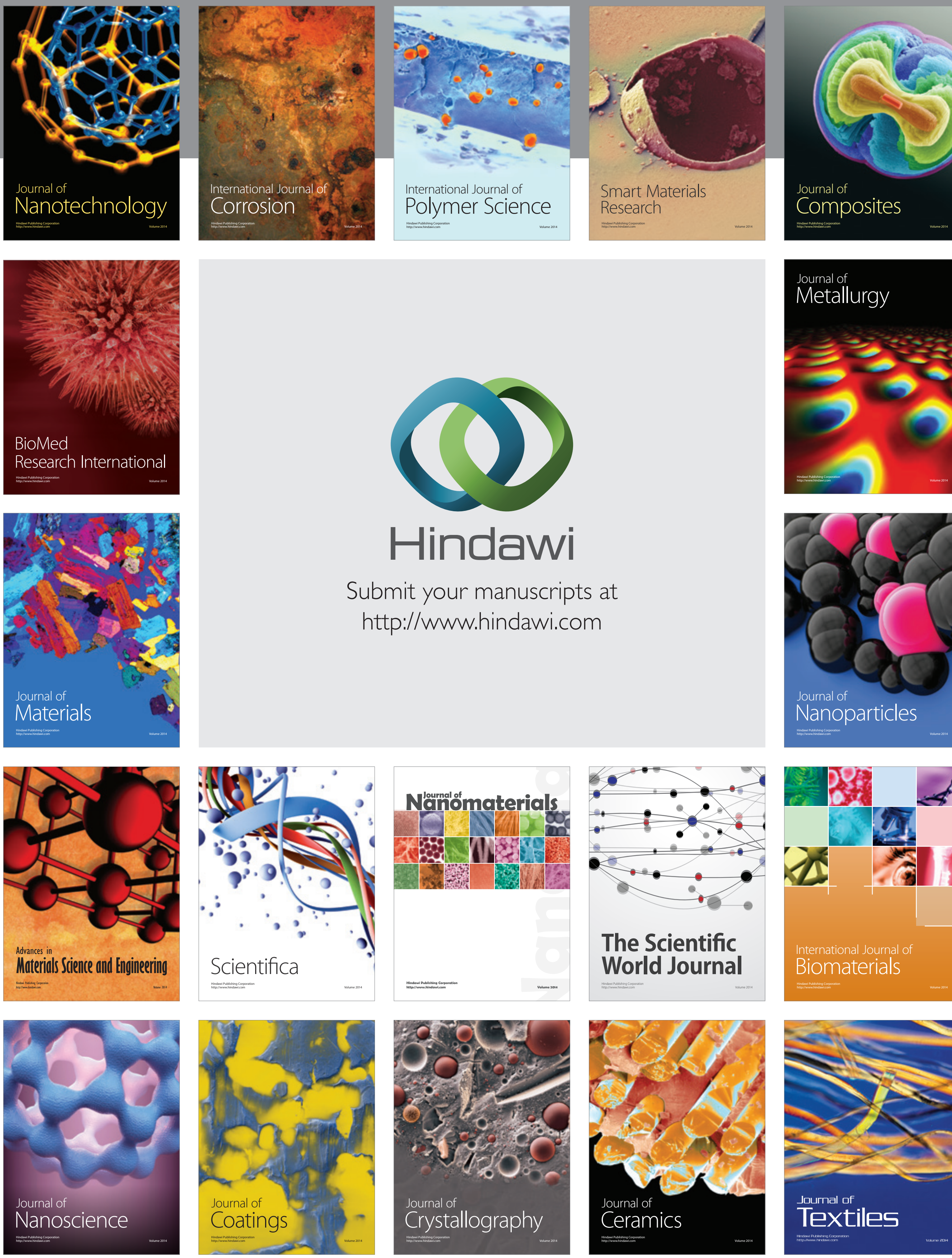
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