

Functional Nanomaterials for Electronics, Optoelectronics, and Bioelectronics

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With the miniaturization of electronic devices, and advances in nanomaterial research and production, the application of functional nanomaterials is at the forefront of scientific and industrial attention. The use of nanomaterials on their own, or as part of a hybrid structure, allows new properties to be exploited in the areas of electronics, optoelectronics, and photonics and in bioelectronics. Recent advances in carbon nanomaterials, such as nanotubes and graphene, as well as other 2D layered materials, in nanostructured organic conducting polymers, and in metal nanoparticles have broadened the scope of nanomaterials towards innovation in electronic and bioelectronic devices. This innovation has the potential to develop new consumer electronics, energy generation and storage technologies, information communications and technology, and in the areas of medical diagnosis and treatment.

This special issue is focused on utilization of functional nanomaterials for electronics, optoelectronics and bioelectronics.

Hong and colleagues have systematically compiled an important review on the study of the metal-insulator phase transition in quasi-one dimensional VO₂ structures. They discuss tailoring the metal-insulator transition by various approaches which can be employed for gas sensor, strain sensor, switching, and memory applications.

Improved photo-voltage and photo-current density is reported by Castaneda et al. in their study of microwave synthesized monodisperse CdS spheres of different size and color for solar cell applications. They have synthesized CdS spheres of sizes from 40-50 nm to 140 nm which when mixed into P3HT, result in improved photo active response. Staying with photo active materials, Lee et al. report the enhancement of dye synthesized solar cell performance by the doping of TiCl₄/Al₂O₃ in TiO₂ nanotube array photoelectrodes.

Wang et al. report theoretical calculations of the effects of barrier thickness and hydrostatic pressure effects on hydrogenic impurity wurtzite GaN/Al_xGa_{1-x}N strained quantum dots and discuss the potential for advancing the applications of group III nitride materials. In the work by Kelchtermans et al., ways to increase the solubility limit of tetrahedral Al in ZnO:Al nanorods are discussed. By using the optimum parameters they have enhanced the substitution of Al in ZnO:Al, which is useful for enhancing its conductivity and other properties.

Hwang et al. report their research on the fabrication of liquid crystal (LC) microlens using nanoparticle-induced vertical alignment. The nanoparticle induced vertical alignment of the nematic liquid crystals is applied to achieve an adaptive flat LC microlense with a hybrid-aligned nematic mode by dropping polyhedral oligomeric silsesquioxane nanoparticle solution on a homogeneous alignment layer.

Finally, Severiano et al. have reported the work on importance of the electrolyte in obtaining porous silicon and how it modifies the optical and structural proprieties. All of these papers show how nanomaterials can have a significant benefit in a wide range of materials and device research. It is hoped that readers of this special issue will see a snapshot of the breath of current research in functional materials science and engineering.