Editorial

Self-Assembly of Semiconductor Metal Oxide Nanostructures

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In recent years, one-dimensional (1D) semiconductor metal oxide nanostructures, such as nanowires, nanorods, and nanotubes, have been the intensive research focus for their potential applications in optical, electrical, optoelectronic, photocatalytic, and hydrophilic/hydrophobic fields. To improve the output efficiency of the nanodevices in various fields, assembling nanostructured building blocks into two-dimensional (2D) or three-dimensional (3D) hierarchical structures is prerequisite.

As guest editors, we are pleased to organize a special issue with a variety of topics within self-assembly of 1D semiconductor nanostructures, as well as the combination of synthesis and application aspects. This is the first special issue on self-assembly of 1D semiconductor nanostructures that brings together papers concerning recent developments in synthesis and self-assembly of nanocrystals. This special issue consists of a collection of two review articles, seven articles that are contributed from Japan, China, and Israel's scientists.

The review article by H. Zeng's group overviews the fabrication methods of ZnO-based transparent conductive thin films and emphasizes optimum processing parameter conditions and growth mechanism of the as-obtained film on flexible substrate. The review by C. Lai summarizes the synthesis and properties of one-dimensional TiO₂ nanomaterials (bare 1D TiO₂ nanomaterial and 1D hierarchical TiO₂) and their photovoltaic performance in dye-sensitized solar cells (DSSCs).

The article by H. Zhang et al. studies the effect of alumina dopant on transparency of tetragonal zirconia, and they found that low transparency of the resultant yttria stabilized tetragonal zirconia doped with alumina specimens does not suggest a beneficial effect of alumina dopant even when nanometric grains and high density have been achieved. Finally, they also proposed a possible formation mechanism. X. Wu and coworkers synthesize hierarchical ZnO nanostructures assembled from nanosheets through a facile hydrothermal route. Their results show that sulfur powder plays a critical role in the morphology of the products. Room temperature photoluminescence property of the hierarchical ZnO nanostructures shows an ultraviolet emission peak at 385 nm. Scientists from that the Hebrew University demonstrate two alternatives for self-assembled patterning within the nanoscale resolution of optically active semiconductor nanocrystals. The first is substrate selective and uses high-resolution surface patterning to achieve localized self-assembly. The 2nd method uses surface with poly(methyl methacrylate)-(PMMA-) resistant patterning adsorption of the nanocrystal with covalent bonds and lift-off. Wang's group reports synthesis of silica-coated TiO₂ nanotubes. They discuss the effects of gas-supported process on tubular morphology, crystallinity, and photocatalytic activity. It is found that the sample prepared at hydrothermal treatment and calcination shows perfect open-ended tubular morphology and increased crystallinity. And the photoactivity of the as-product is proved to be 5 times higher than that of TiO₂.

nanoparticles. X. Wu's group showed large-scale synthesis of ZnS nanobelts by simply thermal evaporation of ZnS powder in the presence of Au catalysts at 1020°C. Room-temperature photoluminescence measurements showed that the as-synthesized ZnS nanostructures had a strong green emission bands at a wavelength of 427 nm; they attributed it to deep-level emissions induced by defects or impurities. Gao et al. synthesize mesostructured ZnO with excellent methanol sensing properties by a structure replication procedure through the incipient wetness technique. Their experimental results show that mesostructured ZnO material shows the higher sensitivity and stability in comparison with the non-porous ZnO prepared through conventional coprecipitation approach. Finally, X. Wu et al. report formation of flowerlike Ag₂O/ZnO heterostructure hybrids by a simple two-step procedure without any surfactants. The as-prepared heterostructure composite showed Ag₂O nanoparticles coated uniformly on the surface of ZnO microflowers. They propose a possible growth mechanism of the products based on the experimental results. PL measurements of the as-obtained product reveal a strong UV band-edge emission peak at 383 nm.

Acknowledgments

The guest editors would like to thank all of the above authors who contributed articles to this special issue for Journal of Nanomaterials. We feel that these contributions provide a cross-section to the current development and future research focuses of self-assembly of 1D semiconductor nanostructure. We also hope that this collection of articles will inspire researchers and stimulate new ideas in relative research field.

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