Topic: Synthesis of TiO_2 Nanowire Arrays and Their Applications for Organic Solar Cells

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ABSTRACT

Organic photovoltaic cells (OPVs), especially polymer-based devices called polymer photovoltaic cells, have recently received a great attention due to the simple process and the lower and reasonable production costs compared with silicon-based solar cells. However, the efficiencies of organic photovoltaic cells are still very low compared with inorganic photovoltaic cells. There are different metal oxides that are generally used in hybrid solar cells as electron acceptor. TiO_2 is one of the attractive choices for electron acceptor materials in this solar cell due to its high electron mobility, high chemical stability, and suitable band gap. In this work, ZnO nanorod arrays were synthesized by a hydrothermal method and used as templates for the fabrication of TiO_2 nanotubes. The obtained TiO_2 nanowires were investigated by scanning electron microscopy (SEM) and X-ray diffraction (XRD). It was observed that density and alignment of nanowire arrays could be varied by preparation conditions. SEM images showed that the morphologies of TiO_2 nanowire arrays were corresponding to the ZnO nanorods templates. Various surface modifications of ZnO nanorods and TiO_2 nanotubes, including the addition of a layer of TiO_2 nanofilm, addition of TiO_2 nanoparticles, and $TiCl_4$ treatment, were studied. For fabrication of hybrid photovoltaic cells, the blended 6,6-phenyl-C_{61}-butyric acid methylester (PCBM) and poly(3-hexylthiophene) (P3HT) were coated on the obtained TiO_2 nanowires and the electrode was deposited by thermal evaporation. Surface-modified nanowires were applied as an electron transporting layer in hybrid photovoltaic cells for higher cell efficiencies. Photovoltaic properties and power conversion efficiency of devices made of TiO_2 nanowire arrays were investigated.

Keywords: TiO_2, Nanowires, Hybrid photovoltaic cell, Surface modification, ZnO nanorods