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Controllable Synthesis of ZnO Tetrapod Nanocrystals

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ZnO nanocrystals have been one of the most extensively studied owning to their various applications such as in catalysis, for solar-energy conversion, and in optoelectronic devices. In particular, room-temperature UV lasing and electricity generation from ZnO nanorod arrays have been newly demonstrated, which triggers extensive activities in searching for novel, facile synthetic methods for uniformly sized ZnO nanocrystals with well-defined anisotropic morphologies.

Nanocomposite bulk-heterojunctions constitute the most efficient class of polymer-based solar cells; however, their superior performance is contingent upon on a complex architecture that is extremely difficult to control. The ideal nanocomposite solar cell architecture allows the small domain sizes and large interfacial area required for optimal charge separation while still providing directed pathways for rapid carrier conduction to a set of carrier-selective electrodes. Among nanocrystals of various shapes, tetrapod nanocrystals comprising four limbs connected at a central core have obvious potential advantages in photovoltaic devices because their shape makes it impossible for them to lie flat within the film. From these points of view, ZnO tetrapod nanocrystals are promising candidate for the fabrication of highly efficient organic-inorganic hybrid solar cells. In this work, the ZnO tetrapod nanocrystals were successfully synthesized by a facile route, i.e. using oleic acid and oleyl alcohol as a complex agent and a solvent, respectively. The size and morphology of prepared nanocrystals can be tuned through not only the growth time and the concentrations of monomers but also the molar ratio between a complex agent and a solvent. The structure and nature of the resulting tetrapod nanocrystals were characterized by transmission electron microscopy (TEM) and X-ray diffraction (XRD). Tetrapod-shaped ZnO nanocrystals in the size range of several nanometers to tens of nanometers are stable for a long time under ambient condition as well as very mono-dispersed in organic solvents such as hexane, toluene and chloroform. The ZnO tetrapod nanocrystals exhibited absorption and emission spectra typical of ZnO nanocrystals. Therefore ZnO tetrapod nanocrystals may have interesting physical properties and potential applications in polymer-based photovoltaic devices.

Keywords: ZnO tetrapod, PV application, hybrid solar cell

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Organic solar cells with Al-doped ZnO electrodes

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Organic solar cell based on poly(3-hexylthiophene) and PCBM(methanofullerene) blend attracts most attention. AZO (ZnO:Al) thin films were fabricated by rf magnetron sputtering and structural, electrical and optical properties were investigated. The device structure is ZnO/P3HT:PCBM/Au. We have studied I-V characteristics and IPCE(The incident photon-to-current conversion efficiency) spectra of ZnO thin film solar cells.

Keywords: organic solar cells,ZnO:Al