Nanomedicine & Biotherapeutic Discovery

Extended Abstract

The Effect of ZnO and its Nanocomposite on the Performance of DyeSensitized Solar Cell

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Abstract

The effect of CuO doping of ZnO nanoparticles on the performance of dye sensitize solar cells (DSSCs) has been investigated. Initially ZnO nanoparticles was synthesized using co-preciptation method then ZnO-CuO nanocomposite were fabricated by a novel Pechini route using different CuO molar concentration ratios applied in dye-sensitized solar cells (DSSCs). The thermal, structural, optical and electrical characterization were done using various techniques such as (TGA/DSC), XRD, HR-TEM, FT-IR, Raman, UV-DRS, PL, I-V. The results of the XRD analysis showed that the CuO-ZnO composite has a nanometer size and the existence of new peak at 38.65O corresponds to secondary phase of CuO, which informs the doping process. UV-DRS spectra of doped samples showed red shift of reflectance band compared to pure ZnO NPs and PL spectra showed a strong emission band at 400 nm. At the optimized condition, the thin films of undoped ZnO and CuO doped ZnO were pasted on ITO glass using Pulse Laser Deposition (PLD) technique and used as working electrodes in dye sensitized solar cells (DSSCs). These working electrodes were sensitized with Eosin dye and coupled with platinum coated cathode. I-V measurements showed improved performance of ZnO-CuO nanocomposite DSSC with the efficiency of 2.9% ± 0.22% at the optimum doping (ZC1.5) were observed as compared to ZnO DSSC 1.26% ± 0.08%.

Dye-sensitized solar cells (DSSCs), the third-generation photovoltaic technology, that holds significant promise for the inexpensive conversion of solar energy to electrical energy compared to conventional silicon solar cells because of favourable environmental, low cost, nontoxic, good temperature stability, stable electrical generation and easy production solar cells, their key components, including the photoanode, sensitizer, electrolyte and counter electrode. Nano size semiconductor compound is used as photoanodes because of their functions in absorbing dye molecules and transferring electrons. It must have a high electron transport rate to decrease electron-hole recombination rate and increase conversion efficiency. Zinc oxide is one of the semiconductor compounds with different nanostructure morphologies and high electron mobility. ZnO has been considered as a promising candidate for DSSCs due to its carrier mobility and direct band gap. ZnO is a wide band gap semiconductor with 3.30 eV at room temperature. Low dimensional ZnO nanostructures have been extensively investigated due to its unique structural, electrical and optical properties. It is promising material for many optoelectronic applications such nanoscale lasers piezo-electric devices, chemical sensors and solar cells. On other hand, copper oxide is one of the candidate materials. The features of copper oxide semiconductors are relatively higher optical absorption, low cost of raw materials and non-toxic. CuO is p-type transition metal oxide with a narrow band gap (Eg ~ 1.2 eV), which close to the ideal energy gap of 1.4 eV for solar cells and allows for good solar spectral absorption. The low band gap of CuO makes it possible to absorb throughout the visible spectrum. In order to obtain better crystallization quality, better optical and electrical properties, researches have preferred doping in metal oxides. Zinc is an important transition metal element and Zn2+ has close ionic radius parameter to that of Cu2+ , which means that Zn can easily penetrate into CuO crystal lattice or substitute Cu position in the crystal. In this work, ZnO-CuO nanocomposite is used for increasing the photovoltaic performance of Dye sensitized solar cell. Initially these materials were synthesized and then characterized using TGA/DSC, XRD, HR-TEM, FT-IR, Raman, UV-DRS, PL and I-V measurements.

In this work, it is observed that the nanohole arrays could also be formed in nanoripples fabricated with the irradiation of an

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800-nm femtosecond laser in an alcohol environment. The diameter of the holes ranges from 10 nm-30 nm. Note that the nanoholes are much smaller than the wavelength of the incident laser, which is 800 nm. The structure is different with the classical laser-induced nanostructures in two aspects. For one thing, the size is in order of tens nano-meter instead of hundreds of nano-meters. For the other thing, the structures can only be formed under irradiation under irradiation in liquids environment. Specifically, under irradiation in alcohol, more nanohole arrays are formed and the holes are more uniform, as compared to those generated under irradiation in water. This method can be used for manufacturing deep-subwavelength nanostructures using laser irradiation. The nanohole arrays are characterized using a scanning electron microscope (SEM). In addition, we investigate the influence of the laser scanning speed to the deep-subwavelength nanohole arrays.

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