

Nanocone-Based Photovoltaic Solar Cells

Disclosure Number

201002491

Technology Summary

The inventors have developed and demonstrated nanocone-based three-dimensional (3D) inter-digitated p-n junctions for solar PV conversion. The 3D junction is a matrix structure formed by n-type (Zn, Cd)O nanocones surrounded by p-type semiconductor, such as CdTe and ZnTe. The novelty of our design is that nanocone junctions allow efficient minority carriers crossing the p-n junction and generate completely-depleted regions for charge collection. In addition, the bandgap energies of the semiconductors can be tuned to match the solar light spectrum by mixing related elements. This invention includes (1) methods of synthesizing (Zn, Cd)O nanocones on ITO and other solar-transparent substrates, (2) methods of synthesizing CdTe and ZnTe p-type matrix between nanocones, (3) nanostructure modeling, and (4) a method to minimize interfacial defects using pulsed thermal processing (PTP). The current stage of this invention is the demonstration of functional nanocone-based photovoltaic solar cells to the ORNL LDRD committee and to the 2010 CNMS users' conference held in Nov., 2010. Specific achievements include (1) studies of carrier transport mechanisms in nanocone- and nanorod-based junctions, (2) successful synthesis of n-type ZnO nanocones that are feasible for photovoltaic substrates, (3) fabrication of nanocone heterojunctions by depositing p-type ZnTe and CdTe layer on the ZnO nanocone surfaces, and (4) proof-of-principle tests of photovoltaic conversion using the nanocone-based solar cells. New efforts are in progress to achieve 5% ~ 25% PV conversion efficiency.

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