ZnO Nanowire Based Solar Cells

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Efficient solar-to-electric energy conversion with inexpensive solar cells and materials is one of the most important challenges we face in the 21st century. Last decade has produced a number of new ideas and solar cell designs that are now at beginning stages of their technological evolution curves. Foremost amongst these new cell designs is the dye sensitized solar cells (DSSCs). In a DSSC, a monolayer of a photosensitive dye is adsorbed on a mesoporous nanocrystalline wide-band-gap semiconductor, usually TiO_2, in the presence of an electrolyte. Photons are absorbed by the dye to excite electrons and the excited electrons are rapidly injected into the TiO_2 and directed to an external load. The electrons are returned to the charged dye through an electrochemical reaction with a redox couple (I_3^-/I^-) at the cathode to complete the circuit. To increase electron transport rates through the semiconductor film we replaced TiO_2 nanoparticles in conventional DSSCs with ZnO nanowires. We used ZnO nanowires to assemble both dye- and quantum-dot-sensitized solar cells where the wide-band-gap ZnO acts as an electron acceptor. In quantum-dot sensitized solar cells, the dye molecules are replaced with CdSe quantum dots as the sensitizer. This talk will describe the synthesis and characterization of the nanowire solar cell components and their assembly into working solar cells.