

Abstract

Synthesis and characterization of CdSe-coated ZnO nanowires
for extremely thin absorber solar cells

Ishai Padawer
Jason Baxter, Ph.D.

Extremely thin absorber (eta) solar cells are new and promising solid-state photovoltaic devices. eta solar cells use a nanostructured interpenetrating heterojunction featuring a thin light-absorbing layer at the interface between an n-type semiconductor and a p-type semiconductor. As a first step towards the realization of a ZnO nanowire/CdSe/CuSCN eta solar cell, I report a proof-of-concept that the successive ionic layer adsorption and reaction (SILAR) technique can be used to sensitize ZnO nanowire arrays with a thin CdSe absorber layer. Scanning electron micrographs show that CdSe conformally and uniformly coats the ZnO nanowires, leaving open interstices between nanowires to be filled with CuSCN. Coating thickness depends on the number of SILAR cycles, and a thickness of ~10 nm is achieved with 150 cycles. Solar cells utilizing the CdSe-coated ZnO nanowires, but which use liquid electrolyte as the hole transport material instead of CuSCN, exhibited light harvesting efficiencies of 40-50% and incident-photon-to-electron-conversion efficiencies of 1-5% in the visible light range (400-600 nm). Response of those solar cells to visible light confirms the sensitization of ZnO nanowires with CdSe, as compared to bare ZnO nanowires which show only UV response. Effects of different sample treatments such as ZnO seeding technique, O₂ plasma cleaning, and annealing on the resulting ZnO nanowires/CdSe structure are discussed.