"Wet-chemistry deposition of semiconductor nanostructures for IR photovoltaics"

Photovoltaic (PV) devices usually exploit mid-range band-gap semiconductors which absorb in the visible range of the solar spectrum. However, much energy is lost in the IR and near-IR range. Efficient PV devices require fine tuning of the energy levels at interfaces between the absorber and the electrodes. Since IR absorbers possess a small band-gap, such tuning is difficult using common electrodes. Towards optimized energy level alignment of electrodes with IR absorber material, the advantages of small band-gap, bulk-like PbS deposited by facile, cheap, and direct chemical bath deposition, were combined with the good electronic properties of ZnO nanowire electrodes, towards low cost photovoltaic devices utilizing IR and near-IR light. Next, in order to increase the stability of such devices, CuSCN growth as a solid hole conductor replacing the liquid electrolyte was studied. Complete superfilling of CuSCN onto ZnO nanowire arrays was achieved using pulsed electrodeposition in aqueous mild basic electrolytes. Finally, the knowledge gained in the first projects was implemented to further tune the electrodes to the IR absorber material for the fabrication of efficient PV cell. Bulk-like PbS was deposited on p-CuSCN nanowire arrays grown electrochemically, to produce an all-solid, wet-chemistry deposited, low cost PV device. Significant photocurrents indicate efficient light-induced hole transfer at the PbS/CuSCN interface. The ability to harvest electrons from a narrow band-gap semiconductor, deposited on a large surface-area electrode using wet chemistry, can advance the field towards high efficiency, low cost IR and near-IR optoelectronic devices.
