Solution-processed Photovoltaics with Enhanced Performance Using an Transparent ZnO Nanorod Array

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Low-temperature solution-based deposition routes for fabricating chalcopyrite thin film photovoltaic devices using CdS-decorated ZnO Nanorod (NR) arrays is reported. To harvest incident light efficiently and tranfer photo-generated charge carriers, well-aligned ZnO NR arrays with a large p-n junction area were used via a hydrothermal synthesis. A CdS buffer layer was deposited on a transparent ZnO NR substrate via succesive ion layer adsorption and reaction (SILAR) or nanocrystal layer deposition (NCLD). $CuInS_2$ (CIS) absorber was directly coated on the prepared CdS-decorated ZnO NR substrate using molecular precursor deposition method without the need for surface passivation organics, dispersion reagent or inert atmosphere. A metal salt, thiourea, and an amine solvent yielded CIS nanocrystals at temperatures up to 250 °C in air environment. By comparing the optoelectronic properties and photovoltaic performances of planar and NR devices, the advantages of the application of nanostructured substrate over flat devices were demonstrated. The prepared CIS/CdS/ZnO NRs device yielded the best conversion efficiency of 3.30%.