Layer-By-Layer Self-Assembly of CIGS Nanoparticles and Polymers for All-Solution Processable Low-Cost, High-Efficiency Solar Cells

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Thin film solar cells made from copper indium gallium selenide (CIGS) materials have shown great potentials of providing low cost, high efficiency panels viable for wide spread commercial usage. Layer-by-layer (LbL) self-assembly is a low-cost, versatile nanofilm deposition process, however introduces polymers in the nanoparticles films, which reduces charge transport thereby affecting solar cell efficiency. This research aims to study various polymer materials to replace currently used insulating polymers in LbL, such as poly(sodium-4-styrenesulfonate) (PSS) and polyethyenimine (PEI). This poster will present processes and results of CIGS nanoparticles synthesis using controlled heating of CuCl, $InCl_3$, $GaCl_3$, and Se in oleyamine; functionalization of the particles to disperse in organic and aqueous-based solvents for LbL; and initial outcomes of CIGS, polymers LbL film fabrication and characterization. The size distribution of synthesized nanoparticles cleaned through alternate suspension and precipitation in chloroform and ethanol shows a peak at 72 nm. Particles light absorption properties measured with ultraviolet-visible-near infrared (UV-Vis-NIR) spectroscopy shows good spectrum coverage with band edge near 1100 nm. The X-ray diffraction (XRD) results of the particles confirms the composition and tetragonal chalcopyrite crystal structure of CIGS materials. Chemical-bath-deposition of cadmium sulfide (CdS) and spray-coating of zinc oxide (ZnO) films are used along with LbL absorbing film in realization of a solar cell device. The fabricated devices are tested using semiconductor characterization instrument.

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