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Novel Synthesis of CIGS Nanoparticles for Scalable, Benign Inks for Solution Processed Solar Cells

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ABSTRACT

One potential production route to high efficiency, low cost, photovoltaics (PVs) which was explored is Copper Indium Gallium Sulfide (CIGS) nanocrystal inks for solution processed PVs. A common CIGS nanocrystal ink synthesis utilizes ligands—molecules attached to the particle surface—for colloidal stability, size control, and shape control. It is desirable to devise a novel synthesis which will incorporate a ligand that allows suspensions in more benign solvents than current methods—a desirable characteristic for large scale production. In order to develop the aforementioned synthesis of CIGS nanoparticles, an optimization study of synthesis parameters was performed. Selection of an appropriate solvent, and sulfur source was studied to obtain nanoparticles of ideal Copper, Indium, Gallium, and Sulfur content. Dissolution experiments were used to identify a variety of metal salt precursor – solvent pairings. Initial syntheses were used as a preliminary test for the suitability of the chosen mixture of precursors and solvents, and analyzed with a suite of characterization techniques. Under appropriate conditions, these methods produced CIGS material that suspended in significantly more benign solvents than those from current methods, as determined by a variety of characterization techniques. These results represent a strong proof of concept for the synthesis route that is being explored. Further optimization is needed to tune the CIGS nanoparticle composition and size distribution and work will continue to develop the synthesis to eventually use nanoparticles from this production route in the fabrication of $Cu(In_xGa_{1-x})(Se_yS_{1-y})_2$ solar cells.

KEYWORDS

Solution processing, CIGS, copper indium gallium sulfide, ligand exchange-free, nanoparticles, solar