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Novel Synthesis of Nanoparticles Using Impurity-Free Precursors for Photovoltaic Applications

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ABSTRACT

Solution-processing routes for making solar cells have gained momentum due to its ability to fabricate uniform thin films over large area substrates which would reduce the overall cost of production. Current approaches to synthesizing nanoparticles have impurity issues that affect the efficiency of photovoltaic devices. In this paper, a novel impurity-free route is developed, which couples recent amine-thiol chemistry, specifically the ability to dissolve pure metals, with traditional methods of producing nanoparticles. Copper indium disulfide (CIS) nanoparticles, a simpler subset of a greater material system, is used as a proof of concept for this new synthesis method. Reaction parameters are varied to optimize nanoparticle properties which were analyzed through multiple characterization techniques. In addition, binary compounds that are formed prior to the final nanoparticle are investigated to further understand the reaction mechanism. The novel route is successful with the formation of pure phase CIS nanoparticles, although there is difficulty in growing the nanoparticles to a significant size. Different binary compounds are formed at different temperatures, however the final nanoparticles are the same within a certain temperature range. In conclusion, this new synthesis route is viable, warranting future work to extend its applicability to other material systems.

KEYWORDS

Photovoltaic, Solution-processing, Nanoparticles, Binary compounds, Synthesis