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Carbon Removal and Optoelectronic Property Tuning in Copper Arsenic Sulfide Thin Films through Ligand Exchange and Alloying

Louis R. Schroeder, Scott A. McClary, and Rakesh Agrawal
Davidson School of Chemical Engineering, Purdue University

ABSTRACT

Solution processed thin film solar cells are attractive alternatives to conventional energy sources due to low waste generation, flexibility in substrate choice, and scalability. The novel semiconductor Cu3AsS4 in the enargite phase has a near ideal band gap of 1.4 eV and has earth abundant constituent elements; yet single-junction solar cells have yielded low efficiencies due to a secondary carbonaceous phase present, among other issues. This carbonaceous phase may be eliminated by exchanging the carbonaceous ligands with molecular metal chalcogenides. To characterize the ligand exchanged particles, UV-Vis-NIR spectroscopy, Raman spectroscopy, X-ray diffraction, scanning electron microscopy, energy dispersive X-ray spectroscopy, and Fourier transform infrared spectroscopy were used. Heat treatments of these nanoparticles yielded films with no residual carbonaceous phase. This, along with the control over properties such as the band gap, will draw attention to the material system and allow for further optimization for the use of the Cu-As-S material system in photovoltaic applications.

KEYWORDS

Solar cells, thin film, ligand exchange, nanoparticles, copper arsenic antimony sulfide