Thermoelectric characterization and thermostability of doped-tetrahedrite nanoparticles synthesized by modifed polyol process

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Thermoelectric materials, which convert waste heat into electricity, are a potential avenue toward alleviating the current energy crisis. We developed a bottom-up modified polyol synthesis to produce tetrahedrite ($Cu_{12}Sb_4S_{13}$), a thermoelectric material that is typically produced by time and energy inefficient solid-state methods. This proposed synthesis produces high yields of nanostructured and phase-pure tetrahedrite materials with one hour of heating at 220°C. Characterization of these nanoparticles was carried out by powder x-ray diffractometry, scanning electron microscopy, and energy dispersive x-ray spectroscopy. Thermopower, electrical resistivity and thermal conductivity measurements produced figure of merit (ZT) values, which describe the efficiency of energy conversion. Our solution-phase synthesis successfully incorporates a wide variety of dopants, including Zn, Fe, Ni and Co on the copper-site, as well as Se on the sulfur-site. These nanopowders have showed improved ZT values relative to compounds fabricated by conventional solid-state methods. Doping Mn and Ag on the copper-site, Bi and Te on the antimony-site, and Se and Te on the sulfur-site is currently underway. In order to integrate these materials into relevant applications, it is necessary to investigate the thermostability of the tetrahedrite materials. Differential scanning calorimetry and thermogravimetric analysis are currently being used to characterize thermostability data as a function of dopant identity and concentration.