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Synthesis and Thermoelectric Properties of $CuSbS_2$

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ABSTRACT

Copper antimony sulfide, $CuSbS_2$ nanoparticles have a large potential of being a good thermoelectric material because they are made up of earth abundant elements. Thermoelectric materials can convert thermal energy into electricity, so that the wasted energy can be saved. Also, by using this earth abundant material, we can make thermoelectric materials much cheaper. The hypothesis of this study is that $CuSbS_2$ could have a large Seebeck coefficient, one of the most important factors of thermoelectric materials, because of the complexity of its band structure. The other hypothesis is that thermal transport could be significantly suppressed through nanostructuring. There are three main methods used in this study. First, the synthesis (mass production) of the $CuSbS_2$ nanoparticles was performed by a redox reaction in an oxygen-free environment. The second method is the material characterization including electron microscopy X-ray diffraction and energy dispersion spectroscopy. Finally, the thermoelectric properties characterization was performed, including the measurements of Seebeck coefficients and electrical conductivities. The initial results show comparable thermoelectric performance to other thermoelectric materials made by earth abundant elements. We successfully developed the recipe to synthesize $CuSbS_2$ nanoparticles and our measurements contribute to the knowledge of thermoelectric properties of this material. Further work includes tuning the relative density and carrier concentration to enhance $CuSbS_2$'s thermoelectric properties.

KEYWORDS

$CuSbS_2$, thermoelectric properties, Seebeck coefficient, electrical conductivity, power factor, X-ray diffraction.

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