SYNTHESIS OF BISMUTH TELLURIDE NANOCRYSTALS BY ALKALIDE REDUCTION

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Attenuation of thermal conductivity has become one of the more attractive means by which to increase the dimensionless figure of merit (ZT) of thermoelectric materials. Recent theory suggests that nanocomposites incorporating semiconductor nanocrystals should demonstrate a sharp decrease thermal conductivity without drastic reductions in electrical conductivity. We have found that alkalide reduction of bismuth and tellurium halides at subambient temperatures results in the formation of Bi_2Te_3 nanocrystals with an average diameter of 2.7 nm and a narrow size distribution. Alkalides are extremely powerful reducing agents, each of which consist of an alkali metal anion charge balanced by a complexed alkali metal cation, and have been used to produce a number of nanomaterials. In this case $[K(15\text{-crown-}5)_2]^+Na^-$ was used as the reductant. The Bi_2Te_3 nanocrystals produced by this method are free of detectable surface oxidation or other impurities and are expected to exhibit very low thermal conductivity while preserving good electrical contact when incorporated into nanocomposites or as compacted monoliths, enhancing ZT as compared to bulk material.

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