Nanocomposites and nanomaterials

Fast fabrication and thermoelectric properties of doped $Bi_2Te_{3-x}Se_x$ bulk nanostructures

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Economic viability of current thermoelectric technology is an important issue due to relatively low efficiency of thermoelectric converters and high cost of their production. Combustion synthesis appears to be a promising, economically feasible and fast fabrication route for a vast majority of advanced thermoelectrics [1, 2].

In this report we present a fast fabrication method for doped $Bi_2Te_{3-x}Se_x$ n-type compounds based on a self-propagating high-temperature synthesis (SHS). The method requires minimum external power supply and no sophisticated equipment, and allows for exceptionally fast synthesis of single-phase thermoelectric doped $Bi_2Te_{3-x}Se_x$. High electronic and thermal transport properties were inherent for as-synthesized and sintered samples, resulting in substantially higher power factor, but lower and shifted towards higher temperatures maximum values of figure-of-merit ZT, when compared to conventionally synthesized $Bi_2Te_{3-x}Se_x$. Both nanostructuring by fine grinding and double re-sintering resulted in significant reduction in thermal conductivity and up to 20% increment in ZT of SHS-developed $Bi_2Te_{3-x}Se_x$ without loss in power factor. Substantially better thermoelectric properties were observed for copper-doped bismuth telluroselenide SHS samples in comparison with their silver-doped counterparts.

These research results infer that an SHS-based synthesis combined with multiple re-sintering is, likely, a promising simple approach relevant to cost and time efficient technology of advanced thermoelectrics. Prospects and future improvement of the method have been discussed.

1. *X. Su, F. Fu, Y. Yan, et al.* Self-propagating high-temperature synthesis for compound thermoelectrics and new criterion for combustion processing // Nat Commun.-2014.-**5**.-Art. № 4908.-P. 1-7.
2. *G. Zheng, X. Su, T. Liang, Q. Lu, Y. Yan, C. Uher, X. Tang.* High thermoelectric performance of mechanically robust n-type $Bi_2Te_{3-x}Se_x$ prepared by combustion synthesis // J Mater Chem A.-2015.-**3**.-P. 6603-6613.