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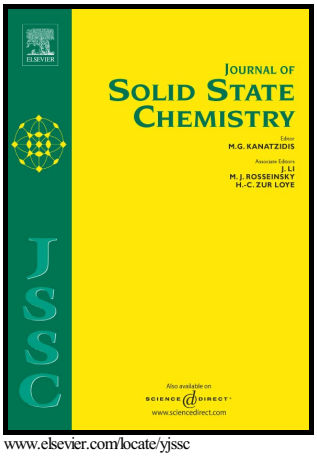

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Modulation of carrier concentration and microstructure for high performance $Bi_xSb_{2-x}Te_3$ thermoelectrics prepared by rapid solidification

Rigui Deng[a], Xianli Su[a*] ,Tingting Luo[a], Junjie Li[a], Wei Liu[a], Yonggao Yan[a], and Xinfeng Tang[a*]

[a]State Key Laboratory of Advanced Technology for Materials Synthesis and Processing, Wuhan University of Technology, Wuhan 430070, China

X. Su (suxianli@whut.edu.cn)

X. Tang (tangxf@whut.edu.cn)

*Corresponding authors.

Abstract:

In this study, a series of $Bi_xSb_{2-x}Te_3$ were prepared by vacuum melting, melt spinning combined with the plasma activated sintering (SPS) process. The influence of Bi/Sb ratio on the phase composition and thermoelectric properties were systematically discussed. The carrier concentration increases gradually with the increasing Sb content. Due to the optimized carrier concentration while preserving high Seebeck coefficient through adjusting Bi/Sb ratio, $Bi_{0.46}Sb_{1.54}Te_3$ sample obtains the highest power factor of 3.90 $mWm^{-1}K^{-2}$ at room temperature. Moreover, the microstructure is effectively modified by adjusting the linear speed of the copper roller, where the average grains size decreases gradually with the increasing speed of melting spinning (MS). The sample synthesized with the MS speed of 20 m/s possesses the widest distribution of grains size spanning from several nanometer to tens of micrometer, which scatters the phonons with wider range of mean free paths, resulting in the lowest lattice thermal conductivity of 0.64 $Wm^{-1}K^{-1}$ at 350 K. Benefitting from the decreased lattice thermal conductivity and enhanced power factor, a peak *ZT* value of