

Precipitation in the van der Waals gaps by adding transition metals to thermoelectric BiSbTe

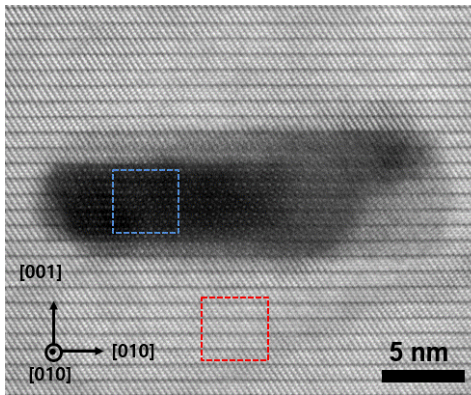
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Bismuth Antimony Telluride (BST) is widely used for thermoelectric conversion technology such as thermoelectric generation and cooling, since it can convert heat energy into electric energy in response to temperature. Extensive research efforts have been conducted to improve the efficiency of BST. It is known that 60° twin boundaries in BiTe can provide free electron source for transport. [1] Also, large grain size and dispersion of 2nd phases are favorable to enhance the scattering of the phonons, and thus contribute to the reduction of the lattice thermal conductivity. [2]

In this study, we added the fourth minor elements in BST to induce multi-scale microstructure, and thus tune the thermoelectric properties. Here, we report the microstructure evolution such as grain size, dislocation density and formation of the 2nd phase upon the amount of the additional elements. Further, it was found that the additional elements induces formation of nano-sized precipitate in the van der Waals gaps (see the figure), where atomic diffusion is expected to be faster. [3] The nano-precipitate formation mechanism will be deeply discussed in this talk based on the microstructural information. For phase identification of the precipitates and their effects on the strain nearby, atomic structure and chemical analysis was investigated using scanning transmission electron microscopy (STEM), (Titan 80-300, FEI Corporation) equipped with Cs-probe corrector and EELS. In addition, 3-dimensional atom probe tomography (3D-APT) (LEAP4000XHR, CAMECA) in KIST was utilized to analyze the compositional distribution around the nano precipitates.

The present work provides insight into the atomic diffusion as well as various transport behaviors through van der Waals gaps of thermoelectrics.



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