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Kwanlae Kim, Gwansik Kim, Sang Il Kim, Kyu Hyoung Lee, Wooyoung Lee

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Clarification of electronic and thermal transport properties of Pb-, Ag-, and Cu-doped p-type $Bi_{0.52}Sb_{1.48}Te_3$

Kwanlae Kim,[1,2] Gwansik Kim,[1] Sang Il Kim,[3] Kyu Hyoung Lee,[1*] Wooyoung Lee[1*]

[1] Department of Materials Science and Engineering, Yonsei University, Seoul 03722, South Korea

[2] Department of Manufacturing Systems and Design Engineering, Seoul National University of Science and Technology (SeoulTech), Seoul 01811, Republic of Korea

[3] Department of Materials Science and Engineering, University of Seoul, Seoul 02504, South Korea

Abstract

The feasibility of using Bi_2Te_3-based alloys in low-grade heat thermoelectric power generation has been intensively investigated via a substitutional doping approach over the last decade. However, the comprehensive and quantitative understanding of the electronic and thermal transport parameters of doped Bi_2Te_3-based alloys including their carrier concentration (n_c), carrier mobility (μ_{Hall}), density of state (DOS) effective mass (m_d^*), and electronic (κ_{ele}), lattice (κ_{lat}), and bipolar thermal (κ_{bp}) conductivities is still elusive. The understanding of these parameters is a prerequisite for designing the modules for real-time applications. In this study, we investigated the effect of Pb, Ag, and Cu doping on the thermoelectric transport parameters of *p*-type $Bi_{0.52}Sb_{1.48}Te_3$ (BST) both theoretically and experimentally. The thermoelectric transport properties of BST and their temperature dependences could be systematically tuned in a low-temperature range by controlled doping