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PII: S0022-4596(17)30457-7
DOI: <https://doi.org/10.1016/j.jssc.2017.11.012>
Reference: YJSSC20012

To appear in: *Journal of Solid State Chemistry*

Received date: 5 September 2017
Revised date: 29 October 2017
Accepted date: 5 November 2017

Cite this article as: Xiaoxuan Zhang, Dan Feng, Jiaqing He and Li-Dong Zhao, Attempting to realize n-type BiCuSeO, *Journal of Solid State Chemistry*, <https://doi.org/10.1016/j.jssc.2017.11.012>

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Attempting to realize n-type BiCuSeO

Xiaoxuan Zhang¹, Dan Feng², Jiaqing He², Li-Dong Zhao^{1*}

¹School of Materials Science and Engineering, Beihang University, Beijing 100191, China

²Department of Physics, Southern University of Science and Technology, Shenzhen 518055, China

*Corresponding author. zhaolidong@buaa.edu.cn

Abstract

As an intrinsic p-type semiconductor, BiCuSeO has been widely researched in the thermoelectric community, however, n-type BiCuSeO has not been reported so far. In this work, we successfully realized n-type BiCuSeO through carrying out several successive efforts. Seebeck coefficient of BiCuSeO was increased through introducing extra Bi/Cu to fill the Bi/Cu vacancies that may produce holes, and the maximum Seebeck coefficient was increase from $+447 \mu\text{VK}^{-1}$ for undoped BiCuSeO to $+638 \mu\text{VK}^{-1}$ for $\text{Bi}_{1.04}\text{Cu}_{1.05}\text{SeO}$. The Seebeck coefficient of $\text{Bi}_{1.04}\text{Cu}_{1.05}\text{SeO}$ was changed from p-type to n-type through electron doping through introducing Br/I in Se sites, the maximum negative Seebeck coefficient can reach $\sim -465 \mu\text{VK}^{-1}$ and $-543 \mu\text{VK}^{-1}$ for $\text{Bi}_{1.04}\text{Cu}_{1.05}\text{Se}_{1-x}\text{I}_x\text{O}$ and $\text{Bi}_{1.04}\text{Cu}_{1.05}\text{Se}_{1-x}\text{Br}_x\text{O}$, respectively. Then, after compositing $\text{Bi}_{1.04}\text{Cu}_{1.05}\text{Se}_{0.99}\text{Br}_{0.01}\text{O}$ with Ag, n-type BiCuSeO can be absolutely obtained in the whole temperature range of 300-873 K, the maximum $ZT \sim 0.05$ was achieved at 475 K in the $\text{Bi}_{1.04}\text{Cu}_{1.05}\text{Se}_{0.99}\text{Br}_{0.01}\text{O}+15\% \text{ Ag}$. Our report indicates that it is possible to realize n-type conducting behaviors in BiCuSeO system.

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