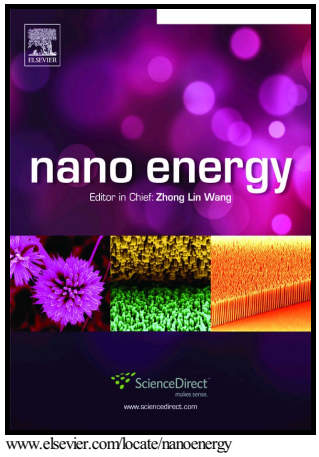

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PII: S2211-2855(16)30588-2
DOI: http://dx.doi.org/10.1016/j.nanoen.2016.12.023
Reference: NANOEN1674

To appear in: *Nano Energy*

Received date: 7 September 2016
Revised date: 1 December 2016
Accepted date: 13 December 2016

Cite this article as: Yubo Luo, Qinghui Jiang, Junyou Yang, Weixin Li, Dan Zhang, Zhiwei Zhou, Yudong Cheng, Yangyang Ren, Xu He and Xin Li, Simultaneous regulation of electrical and thermal transport properties in CuInTe by directly incorporating excess ZnX (X = S, Se), *Nano Energy* http://dx.doi.org/10.1016/j.nanoen.2016.12.023

Simultaneous regulation of electrical and thermal transport properties in $CuInTe_2$ by directly incorporating excess ZnX (X = S, Se)

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Abstract

Developing high thermoelectric performance $CuInTe_2$ based materials is technologically and environmentally intriguing, in order to achieve this, nanoscale heterostructure barrier blocking is proposed and adopted in this work by directly incorporating excess ZnX (X=S, Se) to regulate the electrical and thermal transport properties of $CuInTe_2$. The results prove that part of the ZnX dissolves into the $CuInTe_2$ matrix during the hot press process while the residual ZnX acts as a nanoscale heterostructure barrier blocking for both the hole and phonon. As a consequence, three thermoelectric parameters of the $CuInTe_2$ have been optimized simultaneously by this approach, owing to the formation of Zn_{In}^{-} point defects to improve carrier concentration, the concurrent hindering to the minority carriers resulting from the energy level difference between matrix and nano-heterostructure to enhance the Seebeck coefficient, and intensive phonon scattering by the nanoscale heterostructure barrier blocking to reduce the thermal conductivity. Eventually, a 90% enhanced ZT value of 1.52 has been obtained in the 6 wt.% ZnS added $CuInTe_2$ sample.

Keywords: thermoelectrics, $CuInTe_2$, ZnS, ZnSe, nanoinclusions, barrier blockings

Introduction

The ever-growing energy demands and depleting of traditional fossil fuels have stimulated great interest in thermoelectric materials and devices due to their potential application in power generation and solid-state cooling. In general, the efficiency of a TE material is