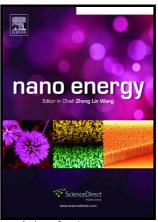
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Simultaneous regulation of electrical and thermal transport properties in $CuInTe_2$ by directly incorporating excess ZnX (X = S, Se)

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Abstract

Developing high thermoelectric performance CuInTe₂ 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 CuInTe₂. The results prove that part of the ZnX dissolves into the CuInTe₂ 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 CuInTe₂ 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 CuInTe₂ sample.

Keywords: thermoelectrics, CuInTe₂, 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

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