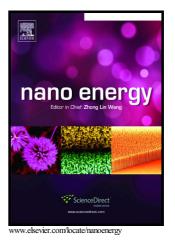
### Author's Accepted Manuscript

Spontaneous solid-state foaming of nanocrystalline thermoelectric compounds at elevated temperatures

Samuel A. Humphry-Baker, Christopher A. Schuh



 PII:
 S2211-2855(17)30219-7

 DOI:
 http://dx.doi.org/10.1016/j.nanoen.2017.04.018

 Reference:
 NANOEN1898

To appear in: Nano Energy

Received date: 15 September 2016 Revised date: 3 April 2017 Accepted date: 9 April 2017

Cite this article as: Samuel A. Humphry-Baker and Christopher A. Schuh Spontaneous solid-state foaming of nanocrystalline thermoelectric compounds a elevated temperatures, *Nano Energy* http://dx.doi.org/10.1016/j.nanoen.2017.04.018

This is a PDF file of an unedited manuscript that has been accepted fo publication. As a service to our customers we are providing this early version o the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain

### **ACCEPTED MANUSCRIPT**

# Spontaneous solid-state foaming of nanocrystalline thermoelectric compounds at elevated temperatures

Samuel A. Humphry-Baker<sup>a,b\*</sup>, Christopher A. Schuh<sup>a</sup>

<sup>a</sup>Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139, USA

<sup>b</sup>Department of Materials, Imperial College, London SW7 2AZ, UK

\*Corresponding author email: shumphry@ic.ac.uk

#### Abstract

Nanocrystalline thermoelectric materials have improved properties, but are difficult to process to full density. During routine thermal processing operations such as powder consolidation and annealing, such compounds can spontaneously form pores, thus degrading their thermoelectric and mechanical properties. We systematically investigate pore formation during heat treatment of cold-pressed compacts of nanocrystalline Bi<sub>2</sub>Te<sub>3</sub>, combining dilatometry and electron microscopy to quantify pore morphology and the rate of pore growth. Pores are found to nucleate on Te-rich precipitates, which are ultimately attributable to a non-equilibrium solubility shift associated with defects in the nanostructured compound, and they grow by diffusional creep under the driving force of Te vapor pressure. This mechanistic insight reveals that, ironically, the same nonequilibrium processing and nanostructure desirable for improved thermoelectric performance also encourage foaming and challenge the formation of stable high density material. With an improved mechanistic understanding, however, we are also able to suggest strategies for improved materials design and processing.

Download English Version:

## https://daneshyari.com/en/article/5452060

Download Persian Version:

https://daneshyari.com/article/5452060

Daneshyari.com