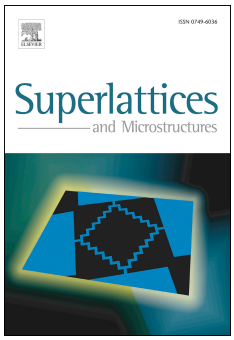
Accepted Manuscript



Optical and thermoelectric properties of nano-particles based $Bi_2(Te_{1-x}Se_x)_3$ thin films

A.M. Adam, E. Lilov, P. Petkov

PII: S0749-6036(16)30972-7

DOI: 10.1016/j.spmi.2016.09.034

Reference: YSPMI 4524

To appear in: *Superlattices and Microstructures*

Received Date: 19 September 2016

Accepted Date: 26 September 2016

Please cite this article as: A.M. Adam, E. Lilov, P. Petkov, Optical and thermoelectric properties of nano-particles based $Bi_2(Te_{1-x}Se_x)_3$ thin films, *Superlattices and Microstructures* (2016), doi: 10.1016/j.spmi.2016.09.034.

Optical and thermoelectric properties of nano-particles based $Bi_2(Te_{1-x}Se_x)_3$ thin films

A. M. Adam[1,2*], E. Lilov[1], P. Petkov[1]

1 Physics Department, University of Chemical Technology and Metallurgy, Sofia, BULGARIA.
2 Physics Department, Faculty of Science, Sohag University, EGYPT.

Abstract

Nano-particles of Bi_2Te_3 and $Bi_2(Te_{1-x}Se_x)_3$ films were deposited using vacuum thermal evaporation technique from previously prepared bulk alloys synthesized by melting method. Optical and thermoelectric properties were studied in the temperature range of 300-473K. The formation of none- and Se-doped Bi_2Te_3 nano-particles was verified by EDX and XRD analysis. TEM, SEM and AFM analysis showed the prepared films are polycrystalline in nature. The measurements of electrical conductivity and Seebeck coefficient, alongside with thermal conductivity calculations, resulted in the highest values of thermoelectric power at high temperature to be reported. The maximum value of power factor was calculated at 62.82917 $\mu WK^{-2}cm^{-1}$ for ($Bi_2Se_{0.3}Te_{1.7}$) sample at 463 K. On the addition of Se to Bi_2Te_3 film, a significant decrease of the electronic thermal conductivity (K_{el}) from 2.181 $x10^{-2}$ to 0.598 $x10^{-2}$ ($\mu W/cm.K$) could be achieved. Figure of merit (ZT) calculations showed a maximum value of 0.85 at room temperature, for Bi_2Te_3. Besides the increase of ZT value for all samples at higher temperature, surprisingly, a value of 2.75 for ($Bi_2Se_{1.2}Te_{1.8}$) was obtained. We believe our results could open avenues for new applications.

Keywords: Thermoelectric power; Nano-particles films; Bi_2Te_3; Electrical conductivity; Power factor.

**** Corresponding author:** Physics Department, University of Chemical Technology and Metallurgy, Sofia, Bulgaria.*

e-mail: adam_phy@yahoo.com

Introduction:

Environment and energy crises have become amongst the most critical issues. The development of clean, reliable and more efficient devices as energy sources is the key to improving a wide range of terrestrial applications. Thermoelectric materials have attracted the efforts of many researchers from all over the world due to their high reliability, simplicity and applications possibilities as a green power source. These materials are also able to generate power from the sun based on what is known as solar thermal energy