Accepted Manuscript

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PII: S0925-8388(16)31391-3

DOI: 10.1016/j.jallcom.2016.05.065

Reference: JALCOM 37584

To appear in: *Journal of Alloys and Compounds*

Received Date: 12 February 2016

Revised Date: 25 April 2016

Accepted Date: 7 May 2016

Please cite this article as: V. Kosyak, Y. Znamenshchykov, A. Čerškus, Y.P. Gnatenko, L. Grase, J. Vecstaudza, A. Medvids, A. Opanasyuk, G. Mezinskis, Composition dependence of structural and optical properties of $Cd_{1-x}Zn_xTe$ thick films obtained by the close-spaced sublimation, *Journal of Alloys and Compounds* (2016), doi: 10.1016/j.jallcom.2016.05.065.

Composition dependence of structural and optical properties of $Cd_{1-x}Zn_xTe$ thick films obtained by the close-spaced sublimation

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Abstract

This paper reports the results of structural, photoluminescence and Raman characterization of thick $Cd_{1-x}Zn_xTe$ films with different zinc concentration obtained by the close spaced vacuum sublimation method. The analysis of the X-rays patterns allows us to determine the effect of the zinc concentration on crystal quality of the films. It was found that samples with $x\approx0.10$ and $x\approx0.32$ have high crystal quality. However, with increasing of zinc concentration the crystal quality decreases. This result was confirmed by the photoluminescence study. Namely, the significant degradation of optical properties for the samples with high zinc concentration ($x>0.32$) was observed. Raman spectroscopy reveals the relation between zinc concentration and vibrational properties of the films. Also, the micro-Raman method shows that obtained films are uniform and free of tellurium inclusions.

Keywords: Crystal structure, Semiconducting ternary compounds, Lattice defects, X-ray diffraction, Photoluminescence, Raman spectroscopy.

1. Introduction

Due to the high atomic number, high density and adjustable band gap (BG) from 1.50 eV (CdTe) to 2.26 eV (ZnTe) [1] the single crystals of $Cd_{1-x}Zn_xTe$ (CZT) ternary semiconductor are widely used for hard radiation detectors [1–4].

It should be noted that the presence of zinc atoms substantially increases the resistivity of CZT crystals and hence their performance as a detector [4]. On the other hand, it may lead to decreasing in crystal quality due to lattice deformation [5–7]. Also,