Materials Chemistry and Physics xxx (2013) 1–6

Contents lists available at SciVerse ScienceDirect

Materials Chemistry and Physics

journal homepage: www.elsevier.com/locate/matchemphys

Structural and electrical properties of ZnS/CdTe and ZnTe/CdTe heterostructures

D.I. Kurbatov [a,*], V.V. Kosyak [a,*], M.M. Kolesnyk [a], A.S. Opanasyuk [a], S.N. Danilchenko [b], Yu. P. Gnatenko [c]

[a] Sumy State University, Rimsky-Korsakov Str. 2, UA-40007 Sumy, Ukraine
[b] Institute of Applied Physics of NAS of Ukraine, Petropavlovskaya Str. 58, UA-40030 Sumy, Ukraine
[c] Institute of Physics of NAS of Ukraine, 46 Prospect Nauky, 03028 Kyiv, Ukraine

HIGHLIGHTS

► We have investigated properties of the ZnS/CdTe and ZnTe/CdTe heterostructures.
► Films obtained on the sublayers have improved structural properties.
► The ZnCdTe solid solutions were detected in ZnS/CdTe heterostructures by XRD method.
► The growth conditions of heterojunctions with optimal parameters were determined.

ARTICLE INFO

Article history:
Received 26 April 2011
Received in revised form
16 October 2012
Accepted 22 December 2012

Keywords:
Halcogenides
Heterostructures
Crystal structure
Electrical properties

ABSTRACT

We investigated the structural, substructural and electrical properties of ZnS/CdTe and ZnTe/CdTe heterostructures obtained by the close-spaced vacuum sublimation. It was found that the structural properties of CdTe and ZnTe thin films deposited on ZnS or CdTe sublayers are better than those of the films obtained on glass substrate at the same growth conditions. XRD-analysis has shown that $Zn_xCd_{1-x}Te$ (x = 0.21–0.30) solid solutions having the cubic phase were formed near the films' interfaces. Furthermore, the saturation current, the ideality factor and the value of the potential barrier height were determined by the analysis of dark current–voltage characteristics. This makes it possible to establish optimal growth conditions of ZnS/CdTe heterojunctions.

1. Introduction

Cadmium telluride based heterojunctions attract considerable interest due to their applications in different devices such as solar cells, photodetectors and hard radiation detectors, etc. [1,2]. It is well known that the properties of heterojunctions strongly depend on the performance of the interface between different semiconductor layers. The lattice mismatch between these layers has a profound effect on the parameters of the heterojunction interface. In particular, electrical properties of the heterosystems with the lattice mismatch ($\Delta a/a$) of more than 4% are completely determined by the surface states [3,4]. Thus, we can expect that for such heterosystems the performance of the heterojunction-based devices decreases. However, in some cases, the efficiency of the devices based on the mismatched semiconductor layers is rather high. For example, high efficiency (16.5%) of CdTe based solar cells, namely, *n*-CdS/*p*-CdTe heterosystems with the lattice mismatch of about 10% (in a case of hexagonal phase of the CdS) [5], has been achieved [6]. This can be explained by the formation of the $CdTe_{1-x}S_x$ solid solutions that can compensate the lattice mismatch [5,7,8].

Due to the wide range of the photosensitivity, the *n*-ZnS/*p*-CdTe based structures can be considered as promising heterojunctions for the production of the solar cells and photodetectors. However, the lattice mismatch of these heterostructures is about 16% [9]. It should be noted that such lattice mismatch corresponds to ZnS cubic phase, which is stable at low temperatures. As a result the *n*-ZnS/*p*-CdTe based solar cells have low efficiency (<3.8%) [10].

* Corresponding authors. Tel./fax: +380 542 334049.
E-mail addresses: dkurbatov@sumdu.edu.ua (D.I. Kurbatov), kosyak@eng.utah.edu, vkosyak@etech.sumdu.edu.ua (V.V. Kosyak).

0254-0584/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.matchemphys.2012.12.049