Influence of the growth conditions in the properties of the CdTe thin films deposited by CSVT

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Abstract

We present in the results of this work, the influence of oxygen and the gradient of temperature in the processing of CdTe thin films, by using the close space vapor transport (CSVT) technique. In general the kinetic process is strongly influenced by these parameters; where a reduction in the growth rate, grain size; an increase in the intergrain barrier height; and structural changes are present. © 2001 Published by Elsevier Science B.V. All rights reserved.

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1. Introduction

In the traditional CdS/CdTe solar cell, the role of oxygen, for instance, has not yet been completely determined. Some authors suppose that the oxygen molecules do not behave as p-dopants to CdTe [1,2], and others suppose that the presence of oxygen during deposition, increases the acceptor density in CdTe [3,4]. Other authors consider that the presence of oxygen has some disadvantages and some benefits. The disadvantages are related to a decrease in the grain size with a tendency to increase the charge carrier recombination in the bulk of CdTe. The benefits are connected with a better coverage in the thin films, and therefore a reduction in the pinhole density [2].

The influence of substrate temperature, for a fixed value of the source temperature, in the grain size and in the crystalline perfection of the CdTe and CdS thin films deposited by CSVT, has also been studied by photoluminescence measurements [5,6].

We present in this work, the results on CdTe thin films properties as deposited by CSVT, in variable oxygen partial pressure, with several gradient temperatures between the substrate ($T_{su}$) and source ($T_{so}$) graphite blocks. The samples were characterized by using X-ray diffraction, photoconductivity, and atomic force microscopy techniques.

2. Experimental

The CdTe thin films were deposited on glass substrates (corning 50) by the CSVT-HW technique, using CdTe powder (99.999%). The atmospheres used during the CdTe deposition were Ar alone and a mixture of Ar and O$_2$, with Ar and O$_2$ partial chamber pressures (PCP) of 100 and 400 mtorr (O$_2$ partial pressures in the range 0–50%). Two set of growths were made, one of them in Ar atmosphere and the other in Ar + O$_2$ atmosphere. The intentional oxygen partial pressure in the chamber was varied from zero to 0.2 torr, keeping constant $\Delta T = T_{so} - T_{su} = 200^\circ$C.