

COMPARATIVE STUDIES OF CdTe/Cu AND CdTe/CdTe MULTILAYERED THIN FILMS

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An essential trouble in technology of solar cells based on CdTe thin films, is the control of the films stoichiometry. Depending on the preparation conditions, these films may contain in excess one or other of the compound components. This fact strongly influences physical properties of respective films.

A possibility to decrease films nonstoichiometry is to add (include) into the films, during their preparation, of some chemical elements selected in a convenient approach.

Our previous studies revealed that CdTe thin films evaporated onto unheated glass substrates includes a tellurium excess^{1,2)}. In present paper we present some results obtaining by studying the effect of Cu on the structure, electrical and optical properties of such CdTe films.

The studied samples were deposited onto unheated glass substrates by quasi-closed volume technique. The film substrates were placed to a rotating disk which successively passed over two evaporation sources for CdTe and Cu respectively. Two vertical cylindrical Pyrex tubes were placed between each source and substrates holder in order to limit the deposition space and to confine the vapours steam from each source. By particular arrangement of films substrates on the rotating disk, both CdTe/Cu and CdTe/CdTe multilayered films were simultaneous obtained. Total thickness of the samples varied between 400nm and 1100 nm, while the thickness of one double layer CdTe/Cu deposited in each step was about of 8 nm.

The X-ray diffraction studies on the microstructure of CdTe/Cu films revealed the presence only of a sharp diffraction peak which correspond to (111) plane of cubic CdTe. The absence of other diffraction peaks associated with CdTe or Cu indicates that respective multilayered structures present a single phase with highly oriented CdTe crystallites with the (111) planes parallel to the substrate. The post-deposition heat-treatment does not influence significantly this structure.

In difference with CdTe/Cu structures, the CdTe/CdTe multilayered films, deposited simultaneous with CdTe/Cu films, present an amorphous structure with tellurium excess which aggregates in Te crystallite form during the heat treatment of the film.

By measuring transmittance and reflectance in 500–1200 nm wavelength range, the absorption coefficient, α , for the studied samples was determined. The results revealed that CdTe/Cu multilayered films have a larger absorption coefficient (about $8 \cdot 10^4 \text{ cm}^{-1}$) in comparison with CdTe/CdTe films. The band gaps determined by extrapolating the $(\alpha h\nu)^2$ vs. $h\nu$ plots were of 1.5 eV for CdTe/Cu films and of 1.39 eV for CdTe/CdTe films.

By also studying the temperature dependence of electrical conductivity of respective samples, we found that room temperature conductivity is about $10^{-3} \Omega^{-1}\text{m}^{-1}$ and temperature dependence of the conductivity is the same for both types of samples. The calculated thermal activation energy was 1.49 eV for CdTe/Cu films and 1.41 eV for CdTe/CdTe films, values which is in good agreement with above mentioned band gap for respective film.

The obtained results revealed that deposition of alternate layers of CdTe and Cu may be a promising method for elimination of tellurium excess from CdTe films and for improving of the physical properties of such films used in optoelectronic devices technology.

1) M. Rusu, I.I. Nicolaescu, G.G. Rusu, Appl. Phys. A 70 (2000) 565-561

2) G. G. Rusu, M. Rusu, Solid State Comm., 116/7 (2000) 363-368.

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