Preparation and Characterization of Cu doped p-CdTe and In doped n-CdTe films by Electrodeposition

Makoto Takahashi, Naoyuki Ohnishi, Hideo Goto*, Akira Nishiwaki*, Koichi Wakita* and Makoto Watanabe
Department of Applied Chemistry, Chubu University
*Department of Electronic Engineering, Chubu University
Matsumoto-cho 1200, Kasugai, Aichi 487-8501, Japan

Introduction

Cadmium telluride (CdTe) is one of the most important semiconductors and its thin film has been used for solar cells, nearinfrared optical devices, and so on. Since Basol had reported that CdS/ CdTe hetero-junction solar cells had been prepared by electrodeposition [1], many laboratories have fabricated CdS/CdTe solar cells with electrodeposition. We think that in order to further improve the efficiency of CdTe based solar cells, it is important to control the electronic properties (carrier concentration, mobility etc) of CdTe films. We report the growth, structure, composition and electronic properties of Cu-doped p-CdTe and In-doped n-CdTe films prepared by electrodeposition.

Experimental

CdTe films were electrodeposited from acidic solutions containing various concentrations of 1 mM TeO_2, 0.1 M $CdSO_4$ and various concentration of $CuSO_4$ or $In_2(SO_4)_3$ on Ti substrates.

The usual three-electrode cell was used and the electrode potential was controlled using a potentiostat. Heat treatment of films was carried out with an IR image furnace under a N_2 gas flow at 350C for 3 hr. X-ray diffractometer (XRD), X-ray photoelectron spectroscopy (XPS), etc were carried out for the characterization of films. And the resistivity and carrier concentra- tion of films were measured by van der Pauw method and Hall effect measure- ments at room temperature.

Results and Discussion

The dependence of the carrier concentration and Cu concentration of the films on $CuSO_4$ concentration (log $[Cu^{2+}]$) is shown in Fig.1 Since the type of the conductivity of the CdTe films deposited in a solution containing $CuSO_4$ is p type, the majority carrier of the films is hole. The hole concentration (log (p)) increases by 17.3 to 20, as the $CuSO_4$ concentration increases from 5 x 10^{-8} M to 1 x 10^{-5} M. And Cu concentration in the film increases with the increasing $CuSO_4$ concentration in the solution. These results indicate that the carrier concentration of electrodeposited CdTe films can be controlled by the $CuSO_4$ concentration in an electrolytic solution.

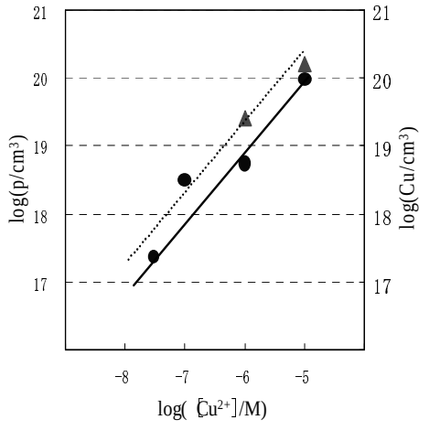

Fig.1 Carrier concentration and Cu concentration of CdTe films as a function of CuSO4 concentration in the electrolytic solution. ● :hole, ▲ :Cu

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References

[1] B. M. Basol, J. Appl. Phys., 55, 601 (1984)