Preparation and Characterization of Bi_2Te_3 films by Electrodeposition

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Introduction

Bismuth telluride (Bi_2Te_3) and the Bi-Te solid solution have been of considerable interest as thermoelectric materials. We have reported the preparation of Bi_2Te_3 and its solid solution films by electrodeposition from the nitric acidic solution containing $Bi(NO_3)_3$ and TeO_2 [1,2].In this system, there are two problems,
(1)it is difficult to prepare the electrolytic solution, because Bi^{3+} ion is easily hydrolyzed in the aqueous solution,
(2)the film composition can be controlled only by the composition of electrolytic solutions.

Using the Bi^{3+}-EDTA complex, we try to solve above problems.

Experimental

Bismuth telluride and its alloy films were electrodeposited from aqueous solutions containing various concentrations of Bi^{3+}-EDTA complex and TeO_2, pH=1.0 ~~0.1~~, on Ti sheets. The usual three-electrode cell was used and the electrode potential was controlled using a potentiostat. X-ray diffraction, scanning electron microscopy, inductively coupled plasma atomic emission spectroscopy, and Hall effect measurement were carried out for the characterization of films.

Results and Discussion

The current-potential relations observed in various solutions; (a) 1.5mM TeO_2, (b) 2.0 mM Bi^{3+}-EDTA, (c) 1.5 mM TeO_2 + 2.0 mM Bi^{3+}-EDTA, are shown in Fig. 1. In Fig. 1(c), the large cathodic current began to flow at potentials more negative than –0.05V and the limiting current observed at potentials between –0.20 and near –0.50V is equal to the sum of the limiting currents observed for the TeO_2 and Bi^{3+}-EDTA complex solutions. These facts implied that the underpotential deposition of Bi^{3+} -EDTA complex to Bi-Te alloy occurred. And these results indicate that the composition and electric properties of films can be controlled by the electrode potentials [3].

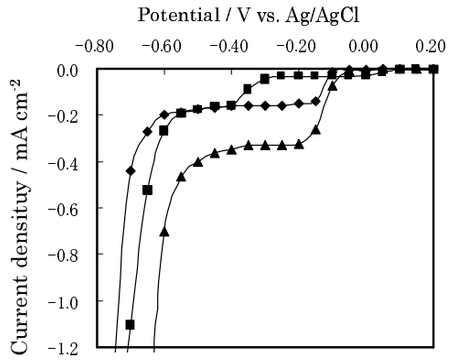

Fig.1 Current-potential curves
(a) ◆ : TeO_2 1.5 mM (b) ■ : Bi-EDTA 2.0 mM
(c) ▲ : TeO_2 1.5 mM +Bi-EDTA 2.0 mM

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References

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