Composite Comprising β -Sn and Amorphous Mn Phases Formed by Phase Separation during Electrodeposition

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Sn–Mn thin films electrodeposited in aqueous solutions having Mn/Sn charged molar ratios between 0.05 and 3.5 within a temperature range from 273 to 323 K were investigated using energy dispersive X-ray spectroscopy (EDX) and X-ray diffraction (XRD). A Mn/Sn critical charged molar ratio at which the Mn contents in the Sn–Mn thin films appreciably changed was observed. The Mn/Sn critical charged molar ratio shifted to a larger value with an increase in the deposition temperature. The EDX and XRD analyses demonstrated that the electrodeposited Sn–Mn thin films comprised β -Sn and amorphous Mn phases, and the β -Sn phase and the amorphous Mn phase formed by the phase separation at the Mn/Sn critical charged molar ratio. In addition, the Sn–Mn thin films did not include any intermetallic compounds. The Sn–Mn thin films were concluded to be composites comprising the β -Sn and amorphous Mn phases. The phase separation and the Mn/Sn critical charged molar ratio were explained by a free energy model.

Keywords: Critical charged molar ratio; β -Sn; Amorphous Mn; Phase separation; Composite; Free energy model

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