Phase Diagram and Tin Whisker Growth During Electrodeposition

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Using X-ray diffraction patterns of Sn thin films generated by employing rectangular pulse current, a phase diagram was obtained that showed the effects of changes in the deposition temperature and current amplitude on the crystal structure of Sn. A difference was observed between our phase diagram and previously reported solid–solid phase diagram that shows the transition from β -Sn to α -Sn. Only the β -Sn solid phase appeared in the deposition temperature range from 0 to 60 °C. No stable α -Sn solid phase below a critical temperature of 13.2 °C in the solid–solid phase diagram was identified. Scanning electron microscopy observations of the Sn thin films indicated that Sn whiskers grew from a smooth Sn surface at an anomalous growth rate in this temperature range. The Sn thin film growth obeyed the Stranski-Krastanov mode.

Keywords: Thin film; α -Sn; β -Sn; Phase transition; Sn whisker; Phase diagram; Anomalous growth rate; Stranski–Krastanov mode

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