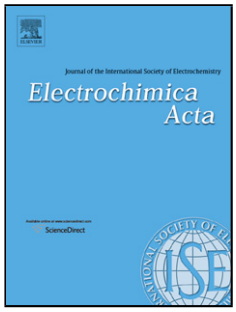

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Effects of Temperature and Thiourea Addition on the Electrodeposition of Tin on Glassy Carbon Electrodes in Acid Solutions.

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Abstract

The electrodeposition of tin on glassy carbon electrodes was studied in plain and thiourea-containing sulphuric acid solutions at different temperatures. Voltammograms exhibit a single cathodic current peak related to the electroreduction of tin ions on the glassy carbon substrate. The current of this peak increases linearly with the square root of the scan rate in the absence of thiourea, as expected for an electrochemical reaction under diffusion control. However, with the addition of thiourea, the peak current exhibits a semi-logarithmic dependence. Electrodeposition current transients show always a single peak that increases its height and appears at shorter times as the electrode potential is made more negative. The non-dimensional analysis of the current transients suggests the occurrence of an instantaneous nucleation and 3D growth under diffusion control in thiourea-free solutions. When thiourea is added, the transient current peak shifts to longer times and the non-dimensional analysis agrees with the presence of a progressive nucleation process. Seemingly, thiourea adsorbs on the electrode surface blocking active sites. This is consistent with the changes observed in the morphology of tin deposits, which change from well-distributed small crystallographic particles in the absence of thiourea, to complex and larger ones that exhibit branches at 90^0, in the presence of thiourea. Nyquist plots exhibit only two time constants at open circuit conditions, while in the potential range of tin electrodeposition two capacitive contributions appear at high an medium frequencies, followed by an inductance, assigned to a surface relaxation process, and a Warburg contribution, associated with the transport of ions to the interface, at low frequencies.

Keywords: tin, glassy carbon, nucleation, electrodeposition, thiourea, growth mechanism