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ELECTROCHEMICAL BEHAVIOUR OF TIN IN THE DEEP EUTECTIC SOLVENT CHOLINE CHLORIDE – ETHYLENE GLYCOL (1:2)

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The electrochemical behaviour of anhydrous $SnCl_2$ dissolved in the deep eutectic solvent ChCl-EG (1:2) has been studied, under argon atmosphere, for temperatures ranging from 323-373 K. Transient electrochemical techniques, such as cyclic voltammetry, chronopotentiometry and chronoamperometry were used in order to study the reaction mechanism and the transport parameters of electroactive species at a glassy carbon electrode.

The deep eutectic solvent was prepared by weighing and mixing choline chloride ($HOC_2H_4N(CH_3)_3Cl$, Sigma-Aldrich >98%) and ethylene glycol ($HOCH_2CH_2OH$, Sigma-Aldrich 99.8%) in a 1:2 molar ratio. This mixture was kept in an oven at 70^0C until a colourless homogeneous liquid was formed. Karl Fischer titrations of the as-prepared solvent revealed a water content of approximately 1400 ppm. This level can be reduced to 150 ppm by careful preparation and drying procedure using activated molecular sieves.

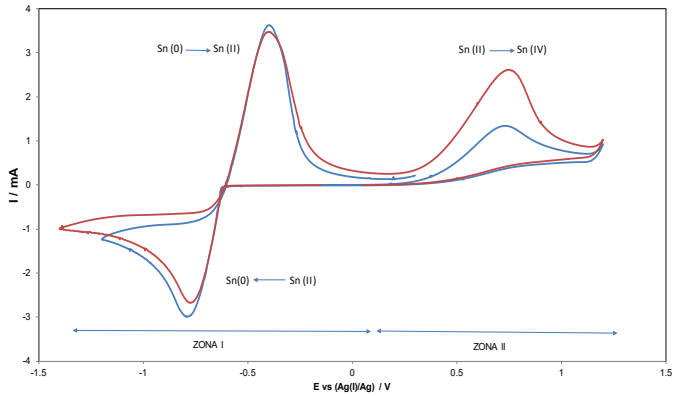

Fig.1.- CVs obtained after dissolution of anhydrous $SnCl_2$ in ChCl-EG (1:2) at a GC electrode

Examples of the good quality voltammograms recorded with a Sn(II) solution at the stationary GC electrode are shown in Figure 1. In zone I, the waves arising from the bulk deposition and stripping of tin can be observed, and in zone II the voltammogram exhibits a broad oxidation wave with a peak potential of approximately 0.75 V ascribed to the oxidation of Sn(II) to Sn(IV), which exhibit limited stability (at 323 K the tin(IV) is quickly lost from the melt by volatilization).

Electrocrystallization of tin seems to be the controlling electrochemical step. Chronoamperometric studies indicated instantaneous nucleation of tin with three dimensional growth of the nuclei.

Mass transport towards the electrode is a simple diffusion process, and the diffusion coefficient of the electroactive specie Sn(II) has been calculated. The validity of the Arrhenius law was also verified by plotting the variation of the logarithm of the diffusion coefficient versus $1/T$.

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