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ELECTROCHEMICAL BEHAVIOUR OF COBALT IN THE EUTECTIC MIXTURE CHOLINE CHLORIDE-UREA (1:2)

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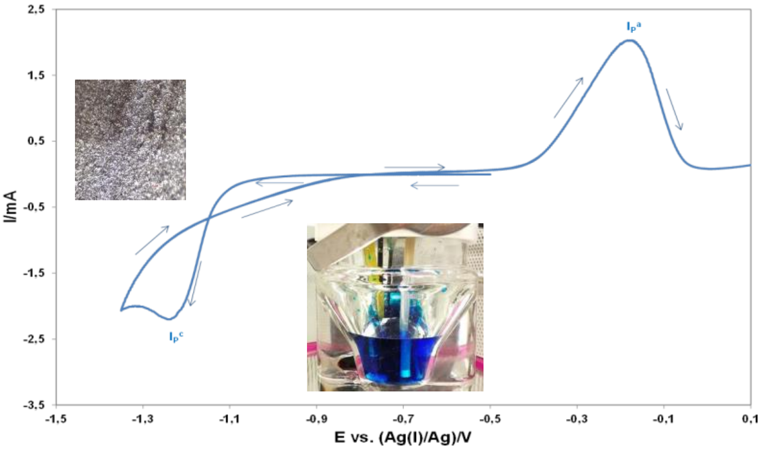
Cobalt is a metal with attractive properties (e.g. high temperature and corrosion resistance) and is one of the few metals that can maintain its magnetic properties after magnetization). These qualities, combined with the ability to be electro-deposited, make Co an ideal metal for coatings. However, the electrodeposition of cobalt in aqueous solution is generally difficult due to the narrow electrochemical window of water, and Co electrodeposition occurs together with hydrogen evolution. Therefore, ionic liquids (ILs) with larger electrochemical windows are required as electrolytes for electrodeposition of cobalt or its alloys.

As a part of a project to look into the possibilities offered by deep eutectic solvents (DES) in the electrodepositon of metals and alloys, the present work is concerned with the electrochemical behaviour of Co(II) solutions in the eutectic mixture ChCl-Urea (1:2) at W and GC working electrodes.

Anhydrous $CoCl_2$, dissolved in the rich chloride media, probably as $CoCl_4^{2-}$, giving a blue solution, which is reduced on tungsten and glassy carbon electrodes via only one electrochemical step.

$$CoCl_4^{2-} + 2e^- \rightarrow Co + 4Cl^-$$



Cyclic voltammetry and chronoamperometry were used in order to study the reaction mechanism and the transport parameters of the electroactive species at the W and GC electrodes. The results showed that the electrochemical reaction is irreversible and that electrocrystalization of Co plays an important role in the electrodeposition process. Experimental current-time transients have been compared with the theoretical models based on instantaneous and progressive nucleation.

Mass transport towards the electrode is a diffusion process, and the diffusion coefficient of Co(II) and the activation energies for diffusion have been calculated.

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