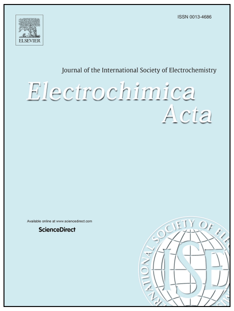

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Electrodeposition of High-Purity Nanostructured Iron Films from Fe(II) and Fe(III) Non-Aqueous Solutions Based on Ethylene Glycol

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Ethylene glycol was studied as solvent for the electrodeposition of iron from both bivalent and trivalent iron chloride solutions. Using cyclic voltammetry (CV) on Pt electrodes, the impossibility to directly reduce Fe(III) ions to metallic state Fe(0) was evidenced with the formation of Fe(II) species as intermediate step for iron plating. Linear sweep voltammetries (LSVs) were carried out on copper substrate confirming the results previously obtained on platinum. Potentiostatic deposition was performed from both Fe(II) and Fe(III) solutions in a broad potential interval (1.5-2.3 V vs Pt) to define the threshold value for iron reduction and film formation: the best results were obtained at -1.7 V vs Pt for Fe(II) solution and at -2.3 V vs Pt for Fe(III) one. Deposits were characterized with field emission scanning electron microscope (FE-SEM) showing a nanostructured morphology with no traces of oxygen in the deposits, resulting in a pure metallic plated iron: films showed a corrosion potential (E_{corr} = -0.54 V vs Ag/AgCl) in 3.5 wt.% NaCl aqueous solution similar to high purity metallurgical iron sheet (E_{corr} = -0.4 V vs Ag/AgCl). X-Ray diffraction patterns showed a preferential orientation of the nanocrystalline deposit along the BCC [110] plane. Vibrating sample magnetometer (VSM) analysis showed a good saturation magnetization (1500±100 kA/m) and low coercivity (~20 Oe) indicative of a high purity iron film.

Keywords: iron, nanocrystalline, thin films, corrosion, coercivity, VSM

1 Introduction