Electrodeposition and characterization of nanosized metallic copper from deep eutectic solvent

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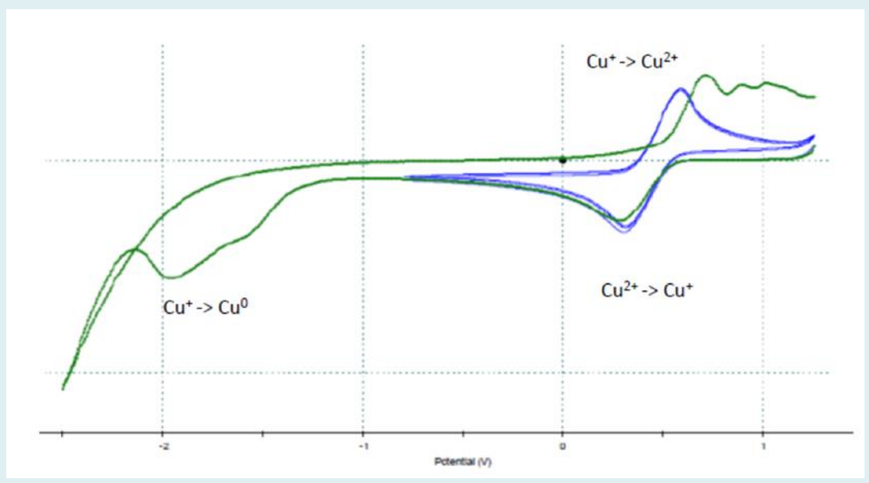
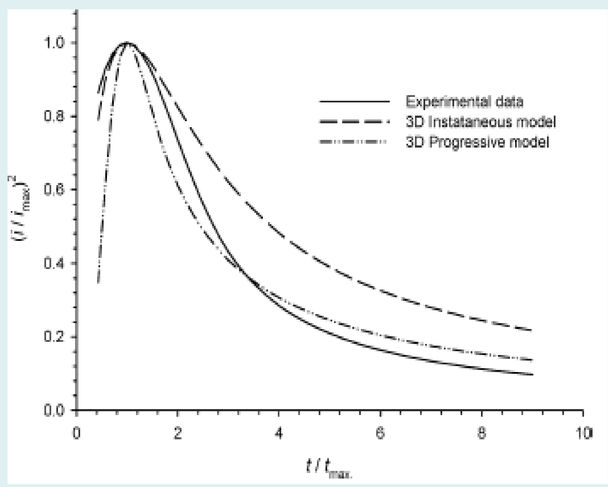
Introduction:

Deep eutectic solvents (DESs) are widely acknowledged as a new class of electrochemical media constituted by an eutectic mixture of Lewis and Brønsted acids and bases, mainly obtained from natural sources, characterized by low cost and low toxicity, high electrical conductivity and low melting point. The present study deals with the electrodeposition of copper from Ethaline 200 (Choline Chloride/Ethylene Glycol molar ratio 1:2) under ambient atmosphere.





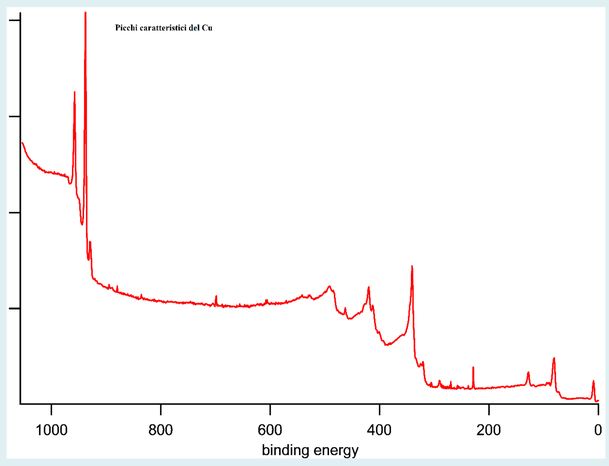
Experimental:

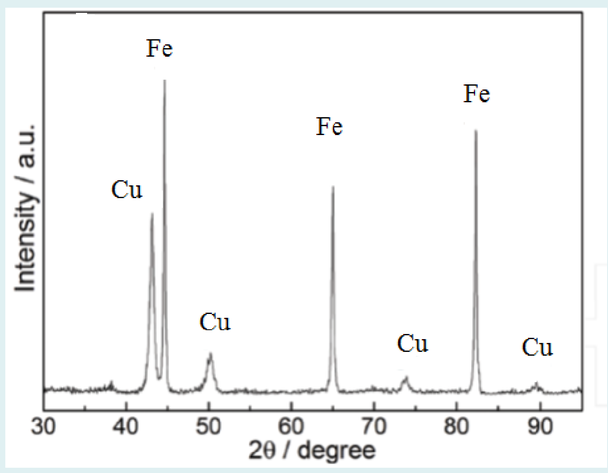
The DES was prepared by mixing stoichiometric amount of ChCl and Ethylene Glycol and adding copper chloride The electrochemical experiments were performed at 60°C in open air.

Figure 1: (left) Picture of the Ethaline 200 containing $CuCl_2$ 5 mM, (above) CVs obtained in open air at 60°C and (right) non-dimensional plots, I_2/I_{2max} vs. t/t_{max} of the experimental data compared to Scharifker/Hills' models (3D Instananeous and 3D progressive).

Discussion and Conclusions:

Copper deposits were obtained from the DES medium at different conditions. The most homogeneous and smooth deposits were obtained in potentiostatic conditions at -1.5 V and 60°C. A mixed instantaneous - progressive mechanism of nucleation and growth leads to the formation of nanocrystalline copper deposits.





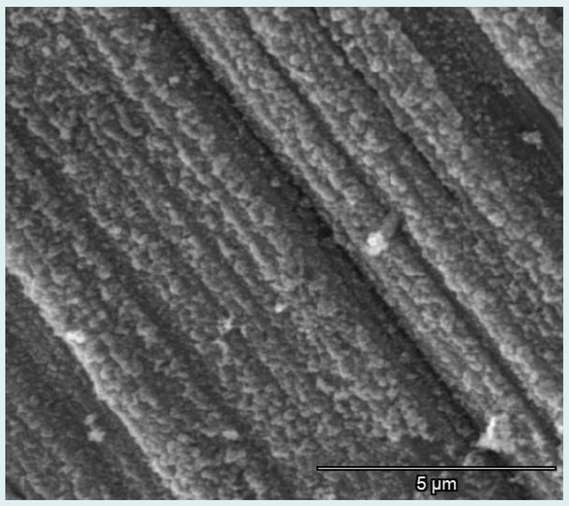


Figure 2: XPS (left), XRD (centre) and and SEM image (right) of the copper deposit on steel substrate obtained at at -1.5 V.

Acknowledgements:

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