Gold Electrodeposition from Ionic Liquids: An Alternative to Conventional Aqueous Baths

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Ionic liquids have been proven to be suitable as electrolytes for the electrodeposition of different metals as well as semiconductors materials [1]. In this work, an alternative bath for gold electroplating based on 1-butyl-1-methylpyrrolidinium dicyanamide (BMP-DCA) is proposed. The selection was based on the physical and chemical properties of the ionic liquid, including its viscosity, conductivity and strong complexing capability [2]. The bath was prepared by adding $HAuCl_4.3H_2O$ to the as received-ionic liquid, experiments were performed under laboratory atmospheric conditions. The water up-take of the ionic liquid was followed by Karl-Fischer titration and its effect on conductivity and on the electrochemical profile was evaluated. Cyclic voltammograms were carried out using glassy carbon (see figure 1), nickel and copper as electrodes in order to characterize the gold reduction processes on the different substrates. Results suggested a two step reduction, under diffusion control. Nanocrystalline gold thin films were obtainable under potentiostatic control (-1 V, 1500 s) on copper and nickel electrodes at temperatures from 20 to 80ºC. The influence of temperature on the kinetics and morphology of gold deposits will be discussed. Characterization of the deposits was performed by XRD, SEM and TEM.

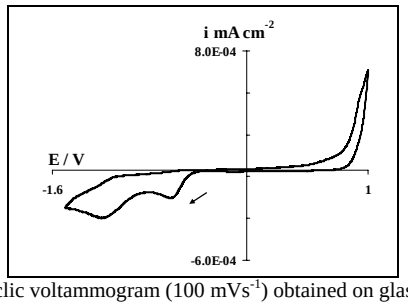

Fig. 1 Typical cyclic voltammogram (100 mVs^{-1}) obtained on glassy carbon in 0.020 M $HAuCl_4.3H_2O$ + BMP-DCA at 298 K.

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References

[1] Abedin S.Z.E, and Endres F., Chemphyschem, **2006**, *7*, 58
[2] Deng M-J, Chen P-Y, Leong T-I, Sun I-W, Chang J-K and Tsai W-T, Electrochem. Commun., **2008**, *10*, 213.