

## Applications of Imidazolium based Ionic liquids as electrolytes in electrodeposition processes

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Room temperature ionic liquids (RTILs) have gained increasingly applications in electrochemistry. ILs are composed solely of ions and their wide electrochemical window opens new possibilities to use them as electrolytes for electrodeposition of base metals and semiconductors, especially as thin layers. Earlier many less noble metals like Al and its alloys were electrodeposited, also in nanocrystalline form, through well established chloroaluminate ILs but their highly hygroscopic nature reduced their use and new air and water stable ILs based on imidazolium derivatives like 1-n-butyl-3-methylimidazolium hexafluorophosphate [(BMI)PF<sub>6</sub>] or 1-n-butyl-3-methylimidazolium tetrafluoroborate [(BMI)BF<sub>4</sub>] have got high interest for the electrodeposition of base metals and semiconductors, especially as thin layers.

The aim of the present work is to better understand the electrochemistry and metal deposition from imidazolium based ILs via characterisation of the system using cyclic voltammetry, chronoamperometry, chronopotentiometry, scanning electron microscopy (SEM) and X-ray diffraction (XRD).

Investigations were performed in the varied temperature range (20 – 110°C) as at elevated temperature a higher deposition rate could be expected. Electrochemical characterization of imidazolium based ILs, namely, 1-n-butyl-3-methylimidazolium chloride (BMICl), 1-n-butyl-3-methyl imidazoliumtetrafluoroborate (BMIBF<sub>4</sub>), 1-n-butyl-2,3-dimethylimidazoliumtetrafluoroborate(BMMIBF<sub>4</sub>), was done using different working electrodes under various experimental conditions. It was observed that the impurities like chloride ions and imidazole in excess and presence of moisture affect the EC window of the ILs to a great extent. Co-electrolytes like LiF and LiBF<sub>4</sub> were found with no effect on the EC window of blank ILs.

Electrochemistry of Cu(I) and Cu(II), Ta(V), ions was investigated in the abovementioned imidazolium based ILs. Dense and coherent metallic deposits of copper were obtained from the solutions of CuCl and CuCl<sub>2</sub> in different combinations of ILs. Thin layers of Ta deposits were obtained on Pt and GC electrodes out of a mixture of BMIBF<sub>4</sub>+BMICl+TaCl<sub>5</sub>+LiF. Co-electrolyte LiF was found to be very effective for the electrodeposition of Ta.

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