

# Modeling Voltammetry of a Rotating Disk Electrode

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## Abstract

The last few years experienced a rapid growth in the application of Ionic Liquids (IL's) to electrodeposition. IL's offer a variety of advantages over aqueous electrolytes. In general, IL's show large chemical and thermal stability, high ionic conductivity and an electrochemical window much larger than water. These properties together with their negligible vapor pressure enable their use at different temperatures without any risk of generating harmful vapors and joined to the absence of hydrogen discharge interfering with electrodeposition processes, as they are essentially hydrophobic, making them the best candidates to be used for the obtainment of homogeneous electrodeposited thin films. This study focuses on the silver electrodeposition from a silver tetrafluoroborate solution in 1-butyl-3-methyltetrafluoroborate BMImF/BF<sub>3</sub>. We notice that practical deposition rate at even concentrations were much lower in ionic liquids as compared to water electrolytes. An investigation of mass transport has been undertaken. Hydrodynamic voltammetry with Rotating Disk Electrode (RDE) of ferrocene/ferrocinium solutions in BMImF/BF<sub>3</sub> have been performed in order to estimate diffusion coefficient for the different systems. Eventually, simulation of the RDE voltammetry based on the FEA (Finite Elements Analysis) have been performed. Laminar flow has been imposed to compute the steady state solution of the Navier-Stokes equation (laminar flow) and then it has been solved the electrochemical process in the high conductivity regime. Thus, solving only the transport proprieties neglecting the potential drop of the electrolyte. Two different processes have been simulated: the actual voltammetry in IL and an equivalent voltammetry in water. The former allows to validate the model by means of comparison with the experimental voltammograms, the last allows to rationalize the peculiar mass transport properties of the IL's. In particular, thanks to the comparison of the concentration profiles and fluxes at the steady and quasi-steady states of the potential scan for both systems, we clarified the nature of the unexpected peaks show by the experimental voltammograms.