

Electrochemistry in Neoteric Ionic Liquids

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The use of room-temperature ionic liquids has become increasingly popular recently as "green solvents". In particular, applications to organic synthesis [1,2] and metal electrodeposition [3] have shown the potential value of these solvents in the industrial context.

Because ionic liquids are; a) inherently conducting (the solvent acts as the electrolyte), b) exhibit large electrochemical windows, c) dissolve a wide range of materials and d) their properties can be modified synthetically, they are well placed for application in electrochemical research in areas such as organic / inorganic electrosynthesis, batteries, super-capacitors and fuel cells.

We have embarked on a research programme to investigate the applicability of ionic liquids in electrosynthesis. This work involves investigating the electrochemical behaviour of simple reversible redox species such as ferrocene and acetylferrocene, and simple organic species such as benzaldehyde and anthraquinones, in various ionic liquids.

For the reversible electrochemical systems, cyclic voltammetry was used to determine the diffusion coefficients of the electroactive species in solution and to obtain heterogeneous rate constants, k^0 , for the electron transfer reactions. Variable temperature measurements allowed determination of the activation energy for diffusion as well as the activation energy for the electron transfer reactions. Figure 1. shows a typical CV of acetylferrocene in N-butyl,methyl piperdine bis-(trifluoromethylsulfonyl)imide.

In the case of reversible and irreversible organic systems (benzaldehyde and anthraquinone reduction in 1-butyl-3-methylimidazolium bis-(trifluoromethylsulfonyl)imide and 1-butyl-3-methylimidazolium hexafluorophosphate respectively), cyclic voltammetry was also carried out as a function of potential sweep rate and the kinetic parameters associated with electrochemical reaction were obtained by digital simulation.

Results for these studies will be presented and compared with those from electrochemical studies in organic solvent systems. The results will also be discussed in terms of the usefulness of ionic liquids in organic electrosynthesis.

Fig. 1. Cyclic voltammogram of $0.004 \text{ mol dm}^{-3}$ acetylferrocene in N-butyl,methyl piperdine bis-(trifluoromethylsulfonyl)imide recorded at 100 mV s^{-1} .

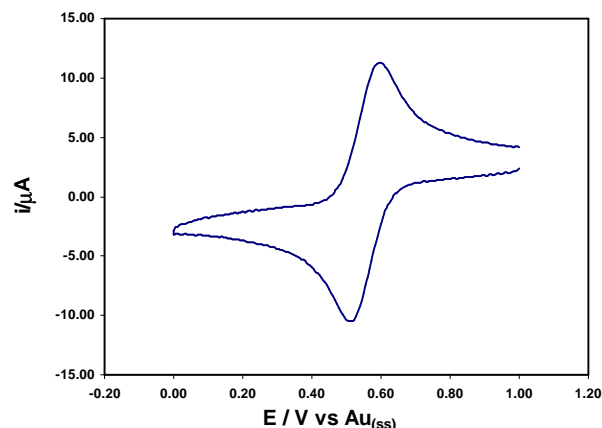
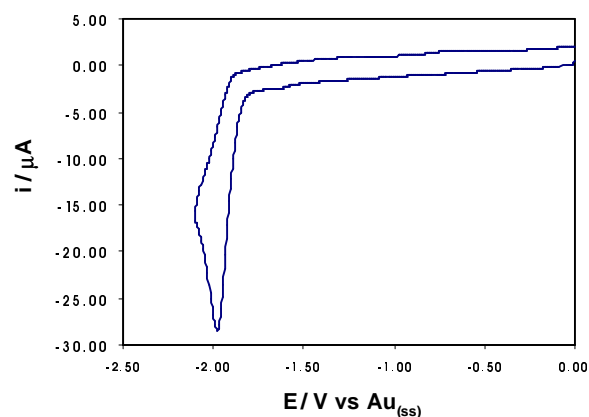


Fig. 2. Cyclic voltammogram of $0.010 \text{ mol dm}^{-3}$ acetylferrocene in 1-butyl-3-methylimidazolium bis-(trifluoromethylsulfonyl)imide recorded at 100 mV s^{-1} .



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References:

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