Chapter 7

Summary and Future Scope

Room Temperature Ionic Liquids (RTILs) are attracting increasing attention for electrochemical investigations and applications. Their unique physical and chemical properties make them an ideal replacement for conventional electrolyte media in electrochemical setups. A wide electrochemical window, appreciable conductivity, nonvolatility and nonflammability, excellent thermal and chemical stability are some of their advantageous features that make them attractive media for electrochemical investigations and electrochemical applications. From academic point of view, RTILs provide a unique environment for studying electrochemical phenomena. Because of all these reasons, RTILs are currently under intense scrutiny for a wide variety of applications and fundamental investigations. Despite intense research activity going on worldwide about the use of RTILs, there are still some fundamental and practical issues that require greater attention to materialize use of these novel media to the fullest of their potential. Focus of the work presented in this thesis was to address and analyze some of these issues.

A comprehensive analysis of our investigations presented in this thesis leads us to the following conclusions:

1. Both rise in temperature and addition of cosolvent disrupt the structural organization of imidazolium based RTILs. Hence a cautionary approach needs to be followed while using these options to circumvent the viscosity related challenges of RTILs on any physical, chemical or electrochemical process, where structure specific effects of RTILs are useful.

2. Low diffusion coefficients of analytes in RTILs lead to small diffusion field thickness comparable to scale of electrode roughness. Hence for electron transfer at electrode/RTIL interface, electrode roughness is expected to play a more significant role than in conventional solvents.

3. Solute-solute and solute-solvent interactions are very important for the kinetic and
thermodynamic aspects of transport and electron transfer phenomena in Imidazolium based RTILs. These interactions are responsible for concentration dependency of diffusion coefficients and slow kinetics of heterogeneous electron transfer reaction in imidazolium based RTILs.

4. Quite unusual but strong ion pairing effects are seen in imidazolium based RTILs. Impact of ion pairing not only depends on concentration of ion counter to the electrogenerated species but it also depends upon potential of the working electrode and over all composition of RTIL. We propose that ion pairing effect in RTIL electrochemistry is related to the potential dependent double layer structure at electrode/RTIL interface.

5. Stabilization of electrogenerated species strongly affects the thermodynamic, kinetic and mechanistic aspects of heterogeneous electron transfer and associated chemical reactions in imidazolium based RTILs.

6. Imidazolium based RTILs are an excellent media for design of redox based sensors and electrosynthesis.

Work presented in this thesis makes us to presage that imidazolium based RTILs can be an excellent media for electroreduction of haloalkanes to hydrocarbons, current-less electrosynthesis and molecular catalysis of electrochemical reactions.