Chapter-6

Summary and Future Scope

6.1 Summary:

AAIL were successfully synthesized using amino acid and tetrabutylphosphonium hydroxide through neutralization method. Glycine, Lysine and Cysteine, three amino acids were selected for synthesizing their corresponding IL and studying their comparative physico-chemical properties. Furthermore, all three IL matrix were used for the formation of noble metal nanoparticle i.e. Au, Ag Pt and Pd.

From the comparative physico-chemical properties it was found that with increase in functional group in amino acid the resultant IL became more viscous and less conducting (ionic conductivity) due to higher degree of interaction between the counter ions. Molecular interaction of the IL is estimated by FT-IR, NMR and TGA analytical technique. However, ILs did not show any type of phase supported by Cryo-TEM and SAXS which can detect self-assembled nature of molecules in ILs.

Phosphonium hydroxide, itself was found to reduce metal salt for the formation of MNPs. However, the stability of MNPs formed in this case is very less, in a very short period the particle agglomerates. Whereas for the first time we introduced the concept of biocompatibility and nontoxic nature of amino acid for the production of MNPs. Here, we successfully synthesized nanoparticle Au, Ag, Pt and Pd with significant stability. Most interesting part of the synthesis is that, the size of NPs can easily be tuned by changing the type of amino acid in the IL. Conformation of metal nanoparticle formation is supported by XPS and HRTEM analysis. NMR clearly indicates the participation of phosphonium cation in the reduction of MNPs, however, the way of stabilization of MNPs is not clearly proved. It is assumed that both functionality of amino acid and a layer of IL over metal nanoparticle help in the stabilization of MNPs.

Second part, that is the extension of the thesis is related to the synthesis of SiO$_2$ microsphere at air/water interface using a novel amphiphilic surfactant i.e. LET. The syntheses of SiO$_2$ detailed here provides two intrinsic advantages such as: (i) the products are formed in high yield through very simple and more importantly through expeditious steps, (ii) the process does not require rigorous pH adjustment procedures. Synthesized SiO$_2$ is stable in all physical
environment like various pH, high temperature etc. To use above advantage, nanocomposite of SiO₂ is synthesized with Pt and Ag nanoparticle by electrolytic and γ-radiolysis method. Synthesized nanocomposite of SiO₂-Pt is explored for electrocatalytic oxidation of methanol in acidic medium. The mass activity of the catalyst is $1.7 \times 10^3$ mA/gPt, highest in comparison to many similar type of catalyst with significantly high stability in acidic medium. Furthermore, SiO₂ is also used to make composite with conducting polymer i.e polyanthranilic acid (PAA) which might be suitable for various technological application.

6.2 Future scope:

[1] Study about the AAILs interaction with MNPs open a scope of further modification of composite (IL+MNPs) for future application in catalysis especially in biological systems due its biocompatible nature.

[2] IL-MNPs composite have a wide application in biosensor where, MNPs work as receptor and IL help in transduction of signal though covalent interaction with signal transforming surface such as electrode surface though various kind of functionality.

[3] By using amphiphilic surfactant mass production of SiO₂ is possible in future which will be a very good support for Pt especially for electro catalysis in fuel cell. Such type of application and area of research can fulfill the future demand of energy.