Abstract

Spectroscopy is a sensitive and useful technique to investigate the complex molecular systems and processes in modern science. Particularly, fluorescence spectroscopic techniques have been used extensively in the field of chemistry and biology to monitor a wide range of molecular processes such as interactions of solvent with fluorophore, rotational diffusion of biomolecules, conformational changes of macromolecules etc. Interestingly, the biomolecules confined in cellular microenvironments and the hydration properties plays crucial role in controlling their structure, reactivity and dynamics. The microheterogenous systems (i.e., organized assemblies such as micelles, reverse micelles/microemulsions, vesicles etc.) can mimic complex biological systems in much simpler form. Using organized assemblies composed of surfactants, polymers or room temperature ionic liquids (RTILs) as model systems; we have investigated the effect of confinement on various photophysical processes such as solvation dynamics, photoisomerisation, and excited state intramolecular proton transfer. We have shown how the suitable selection of room temperature ionic liquids influences the structural parameter of ionic liquid-in-oil microemulsion. Further, sensitive solvation dynamics technique has been used to monitor the heterogeneity of microemulsions using coumarin 480 (C480) as probe molecule. We have shown how confined environment and viscosity of the medium influence the photoisomerisation rate of cyanine dye molecule, 3,3′-Diethyloxadicarbocyanine Iodide (DODCI) by monitoring its fluorescence properties in micellar assemblies formed by long alkyl chain containing ionic liquid, and in binary mixtures of ionic liquid with polar solvents, respectively. The preferential binding interaction of another cyanine dye molecule, 1-ethyl-2-(4-(p-dimethylaminophenyl)-1,3-butadienyl)-pyridinium perchlorate (LDS-698) has also investigated in solution containing both micelle and Calf Thymus DNA (CTDNA). We have also investigated the modulated photophysical properties of proton transfer chromophores, curcumin and 2,2'-bipyridine-3,3'-diol ($BP(OH)_2$) in micelles and vesicle aggregates. In addition to photophysical study, this thesis also demonstrates the preparation and characterisation of vesicles in mixed surfactant solution or surfactant-cholesterol mixtures. Finally, the heterogeneity and dynamics of these newly developed supramolecular aggregates have been investigated by monitoring solvation dynamics, rotational or diffusion motion of probe molecules.

Keywords: Microheterogenous Systems, Time-resolved fluorescence Spectroscopy, RTILs, Rotational Motion, Diffusion Motion