

**SUMMARY
AND
CONCLUSION**

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The present dissertation describes the results on physico-chemical studies on μ Es involving water, 1-butyl-4-methylpyridinium tetrafluoroborate, [b4mim][BF₄], and 1-butyl-3-methylimidazolium methanesulfonate, [bmim][MS], in the polar domain. Additionally the binary mixture of [bmim][MS] and water was studied with an intention to use them as the polar component in μ E.

In **Chapter 1**, comprehensive studies on water/ (Tween-20+n-alkanol)/n-heptane microemulsions were performed using a number of techniques, viz., phase manifestation, dilution method, DLS and viscosity measurements. Results were analyzed in the light of the above mentioned experiments. Based on the observations, the following conclusions could be made:

- (1) The clarity of microemulsion formulation was reduced with the increase in cosurfactant chain length with an optimum efficacy tendered by n-hexanol.
- (2) While the surfactants reside at the oil-water interface, the cosurfactants were partitioned in between the oil and oil-water interface.
- (3) Spontaneity of microemulsion formation increased with increase in cosurfactant chain length, increase in temperature and decrease in the volume of the dispersed phase, water.
- (4) The formation of microemulsion was found to be an enthalpy controlled process.
- (5) Larger numbers of droplets were formed at the expense of size. With the increase in temperature and ω value, size reduction was also evidenced by DLS measurements.
- (6) Depletion in the aggregation number of surfactant per droplet was compensated by the cosurfactant molecules. However, the compensatory effect was not affected by temperature.

A symmetric variation in different physico-chemical properties were noted with the increase in the cosurfactant chain length. However, n-octanol, being oilier in nature than a cosurfactant, tendered different behavior.

Chapter 2 describes the detailed investigations on 1-butyl-4-methyl pyridinium tetrafluoroborate ([b4mpy][BF₄]) / (Tween 20 + n-pentanol) / n-heptane ionic liquid-in-oil microemulsion system. Although the cosurfactant increased turbidity of the microemulsion, however, it was essential for the attainment of stable microemulsion. Cosurfactant controlled the curvature of the microemulsion droplets; it simultaneously also imparted better stability by solvating the cationic component of the ionic liquid. Larger number of droplet formation was aided by the cosurfactant. Sensitivity towards temperature decreased with increasing amount of cosurfactant, as revealed through the combined dynamic light scattering and viscosity measurements. Oxyethylene group of Tween 20 formed coordinate linkages with the IL cation, which resulted in the rigidity of the polar domain. The IL, in excess of the amount required for coordinating the surfactant head groups, behaved like the bulk component as revealed through the fluorescence anisotropy measurements. Electron microscopy and small angle neutron scattering studies could further shed light on the morphology of the microemulsion droplets, which are considered as the future perspective.

In **Chapter 3**, physico-chemical investigations on the binary mixture of [bmim][MS] + water were carried out both in the dilute and concentrated regime of [bmim][MS] using different techniques. There occurred a synergistic interaction between the [bmim][MS] and water. The surface tension decreased monotonously with a halt at 0.3 M [bmim][MS]. The absorption and emission spectral behaviors were significantly different. The steady state fluorescence anisotropy and excited state lifetime were dependent on the concentration of [bmim][MS] in water. It was finally concluded that initially increasing the IL concentration led to the formation of an ion-pair, whereby the cationic component, which was surface active, was interfacially absorbed. Micelle-like aggregates were formed above a certain concentration, which was similar to ionic clusters. Above 50 mole% ionic liquid, a three dimensional quasi crystal-like network was formed which deactivates the water molecules.

Chapter 4 describes the studies on combined phase behavior, method of dilution, viscosity, dynamic light scattering, electrical conductance and

spectroscopic probing techniques in understanding the physicochemical properties of pseudoternary microemulsion system 1-butyl-3-methyl imidazolium methanesulfonate ([bmim][MS] \pm water) / (Tween-20+n-pentanol) / n-heptane. From phase manifestation it was observed that clarity of microemulsion decreases upto 50 mole % of the IL as after 50 mole %, the added water cannot disturb the structuredness of IL, thus above that said IL mole fraction, the IL become such an entity where water become inactive. For lower IL content microemulsion, spontaneity of the microemulsion decreases with increase in the volume of the dispersed phase whereas it increased above 50 mole % of the IL. Size of the microemulsion increases with increase in the volume fraction of the polar phase, this was also evidenced through the viscosity measurements. Although comprised of ionic species in the polar domain, the present microemulsion systems were found to be less conducting. Both the absorbance and fluorescence intensity decreased with increasing volume fraction of the polar phase. A red shift in the absorption and fluorescence spectra was obtained due to the increased polarity of the solvent.