ABSTRACT

In this dissertation, phase behavior, conductivity, viscosity, dynamic light scattering (DLS), fluorescence lifetime, steady state fluorescence anisotropy, fourier transform infrared spectroscopy (FTIR) and nuclear magnetic resonance (NMR) techniques have been employed for understanding of the physicochemical properties and microenvironment of quaternary water-in-oil (w/o) mixed surfactant microemulsions consisting of equimolar (1:1) cationic, cetyltrimethylammonium bromide ($C_{16}TAB$) and nonionic, polyoxyethylene (20) cetyl ether ($C_{16}E_{20}$)/1-butanol (Bu)/heptane (Hp) or decane (Dc), as a function of ω ((= [water]/[surfactant])= 10→50) at a fixed temperature (303K). The interfacial composition and free energy of transfer of Bu from oil to the interface (formation of microemulsion from thermodynamic point of view) have been evaluated by the Schulman's cosurfactant titration at the oil/water interface (dilution method) under comparable physicochemical conditions. In a subsequent study, the effect of the variation of alkyl chain length of cationic surfactant, alkyltrimethylammonium bromide (C_nTAB) (where,n stands for12, 14, 16 and 18) on the phase behavior, interfacial composition, interdroplet interaction, microstructure and the dynamics of confined water of quaternary w/o microemulsions, comprising equimolar (1:1) cationic (C_nTAB) and nonionic ($C_{16}E_{20}$) surfactants, 1-pentanol (Pn) and Hp or isopropyl myristate (IPM), have been examined by means of phase study, dilution method, viscosity, DLS, FTIR measurementsat a fixed ω (=25) and temperature (303K). Additionally, the influence of different inorganic salts viz. normal salt (sodium chloride, NaCl), precursor salt for nanoparticle synthesis [nickel chloride ($NiCl_2$), ferric chloride ($FeCl_3$)], water structure affective salts [potassium fluoride (KF), potassium iodide (KI)] on the transfer process of Pn ($Pn_{oil} \rightarrow Pn_{interface}$) and also, on the nature of confined water of the microemulsions have been investigated using dilution method and FTIR measurement (via D_2O probing) under similar physicochemical conditions. In continuation, the interfacial composition and thermodynamic properties of w/o mixed anionic (sodium dodecylsulfate, SDS)/nonionic (polyoxyethylene (23) lauryl ether, Brij-35) surfactant/Pn/IPM microemulsions under various physicochemical conditions, have been evaluated by the *dilution method as function of both* ω and composition [mole fraction of nonionic surfactant ($X_{Brij\text{-}35}$)]. This study was aimed at a precise

characterization of w/o mixed anionic/non-ionic microemulsions on the basis of molecular interactions between the constituents at the microenvironment, and provides insight into the nature of the oil/water interface of these systems by conductivity and DLS studies under similar physicochemical conditions. In continuation, formation and characterization of w/o mixed cationic/nonionic surfactant microemulsions comprising CTAB/Brij-35 stabilized in Pn and IPM at different physicochemical conditions [viz., variations in ω, composition ($X_{\text{Brij-35}}$) and temperature] have been examined by employing phase studies, dilution method, conductivity, DLS, FTIR (with HOD probing) and ^1H NMR techniques. Further, microbiological activities of these mixed microemulsions at different compositions were examined against two bacterial strains Bacillus subtilis (gram-positive) and Escherichia coli (gram-negative) at a fixed temperature. In final chapter, results of a systematic investigation on phase behavior and solubilization of water, in water-in-Hp or Dc aggregates stabilized by nonionic [polyoxyethelene (20) cetyl ether (Brij-58)] with composition, that is, increasing content of a cationic surfactant, CTAB (X_{CTAB}) in conjugation with Pn at a fixed surfactant(s)/Pn ratio (equals to1:2) and temperature (303K) have been presented. A correlation has been drawn between composition dependent water solubilization and volume induced conductivity studies to provide insight into the mechanism of solubilization of water in these mixed systems. The microstructure and dynamic H-bonding network in confined environment of these systems have been deciphered by DLS and FTIR measurements as a function of surfactant composition. Correlation of the results in terms of the evaluated parameters (of all types) in each chapter have been attempted to underline formation and characterization (with uses and prospective applications) of mixed surfactant microemulsions for further advancement in colloid and interface science.