Temperature Induced Electrical Percolation in Mixed Reverse Microemulsions

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The doping of most widely used sodium bis (2-ethylhexyl) sulfosuccinate (AOT) reverse microemulsions interface with surfactants of different nature alters elastic rigidity of the interface, changes water solubilization capacity and microviscosity of the confined water, also affects percolation of electrical conductance, etc. Such flexibility of microemulsions is very important for various biological and technological applications of these mixed aggregated systems.

The goal of the proposed work was to study the influence of additives of surfactants of both monomeric and polymeric type, ((viz. nonionic polyoxyethylene (4) lauryl ether (Brij-30), tyloxapol, pluronic F-127, triton X 100, anionic sodium cholate (SC) and cationic promethazine (PMZ) and chlorpromazine (CPZ) hydrochlorides)) on the electrical percolation threshold and sizes of water droplets in mixed reverse microemulsions with conductivity measurements and dynamic light scattering method.

Electrical conductivity of the reversed mixed micellar solutions was measured with conductivity meter Orion Star A215. The average hydrodynamic radius (R_H) of the water droplets was determined by dynamic light scattering (Zetasizer Nano ZS, Malvern Instruments, UK) equipped with a He-Ne laser operating at 633 nm and at a measurement angles of 173^0. The activation energy of temperature induced electrical percolation was calculated for each investigated microemulsion.

Electrical percolation in mixed (AOT and Brij-30, AOT and SC) microemulsions with a fixed value of the molar ratio of surfactant to water (W=20) takes place at relatively lower temperature than for reversed microemulsion based on sodium bis (2-ethylhexyl) sulfosuccinate alone. In contrast to this, quenching of percolation is observed in case of additives of cationic surfactant PMZ in temperature induced mode of electrical percolation. Tyloxapol and pluronic F-127 occupy an intermediate positions between the above-mentioned additives according to percolation suppression ability, however, the percolation threshold in the presence of pluronic (Tp=50 ℃) exceeds that of tyloxapol (Tp=40 ℃), and in the presence of triton X 100 (a tyloxapol monomer), percolation begins at an even lower temperature (Tp=35 ℃).

The revealed changes in both: a) retardation or early occurrence of percolation and b) sizes of water droplets under the influence of additives of surfactants of different nature may be will useful to clarify the fine mechanisms of electrical percolation phenomenon in reverse microemulsions as they widely are applied in mimicking of biomembranes, membrane conductance of electrical impulses, mass transfer in organisms, etc.