# Radio-Frequency Impedance Characteristics of Micellar Solutions and Microemulsions

**V. K. Bansal, K. Chinnaswamy, and D. O. Shah**

Departments of Chemical Engineering and Anesthesiology, University of Florida, Gainesville, Florida, USA 32611

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Molecular associations among surfactant molecules result in the formation of various structures in surfactant solutions depending upon the surfactant concentration and physico-chemical conditions. In recent years, it has been reported that besides the first CMC, abrupt changes in several properties occur at other critical concentrations, which have been referred to as second and third CMC's [1]. In the present study we have used radio-frequency impedance, viscosity, surface tension, electrical conductivity, and sodium activity measurements to determine these concentrations at which abrupt changes occur in solution properties. It was shown that dielectric loss factor is the most sensitive to structural changes occurring in surfactant solutions.

In general microemulsions are isotropic, clear, transparent dispersions of oil, water and emulsifiers. Usually a long chain surfactant or soap and a short chain alcohol are used as emulsifiers. A water-in-oil microemulsion is converted to an oil-in-water microemulsion upon increasing the water-oil ratio. Using various physical techniques such as electrical conductivity, x-ray diffraction, birefringence, freeze-etching electron microscopy and high resolution NMR spectroscopy we have shown [2–5] that cylindrical and lamellar liquid crystalline structures form in the phase-inversion region. The dielectric loss factor was measured in microemulsions as a function of water/oil ratio. Similar to structural changes in micellar solutions, microemulsions also exhibit abrupt changes in the loss factor at certain oil/water ratios. The effect of three different alcohols, n-hexanol, n-pentanol and p-methyl cyclohexanol on the dielectric properties of microemulsions was investigated. The results were interpreted in terms of ionization of soap molecules as well as molecular association between surfactant molecules. In summary, molecular associations, structural changes and ionic phenomena in surfactant solutions and microemulsions can be elucidated using radio-frequency impedance measurements. (This research was supported in part by ERDA grant no. EY-77-S-05-5341 and by a consortium of twenty major oil and chemical companies for UF Improved Oil Recovery Program.)

## References

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