Conductivity of Water-in-Oil Microemulsion System

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Abstract

Electrical conductivity measurement was used in characterizing the water-in-oil microemulsion system and its relationship to the microstructure and composition of the system is discussed.

1. Introduction

Microemulsions are thermodynamically stable complex fluids composed of water and oil domains that are separated by a surfactant monolayer, which reduces the unfavorable oil-water contact. The topology of the oil and water domains can vary, depending on the compositions and temperature. Distinct, dispersed nanometer-size, surfactant-coated water droplets are maintained in a polar solvent at low volume fractions of water and this system is called a reversed micellar phase or a water-in-oil microemulsion.

Microemulsions have applications in enhanced oil recovery, pharmaceuticals and cosmetic industries. One of the most important applications is that, water-in-oil microemulsions have been extensively used as microreactors to prepare monodisperse nanosized particles, such as metal, metal borides and metal oxides [1]. Two basic methods of microemulsion-mediated materials synthesis are shown in Fig.1.

2.Objective

In this study, the potential use of electrical conductivity measurement to characterize the microemulsion system was investigated.

3.Testing Program

Conductivity measurement:� A mixture of known weights of surfactant, co-surfactant and oil was placed in the beaker at a constant temperature. The initial conductivity was recorded, and then water was added continuously to the surfactant solution with constant stirring. The conductivity was measured using a Thermo Orion conductivity meter, and was measured to an accuracy of �0.5%.

4.Results and Discussion

Variation in conductivity with increasing water content for three [CTAB]/[water] ratio (S) are shown in Fig. 2. The conductivity increased upon addition of water into the emulsion system. At a certain value of W_0 (water content), it will sharply decrease if water is continuously added. The increase in conductivity is due to the phenomena known as percolation of charges through the droplet clusters [2-3]. Continuously adding water into the system will make the entire emulsion system unstable, and phase separation occurs, resulting in low conductivity. Based on this measurement, when S=20, addition of 10% water phase into the octane-surfactant-mixture was the optimum, at this point the water content is the highest and still maintains� the water droplets in the oil phase.

The surface tension measurement and conductivity measurement results are shown in

�Fig. 3. From the curve in Fig. 3, it can be estimated that the CMC of CTAB was about 0.4g/L from the above measurement. It must be noted that higher concentrations of CTAB (compared to CMC) are used in the microemulsion system.

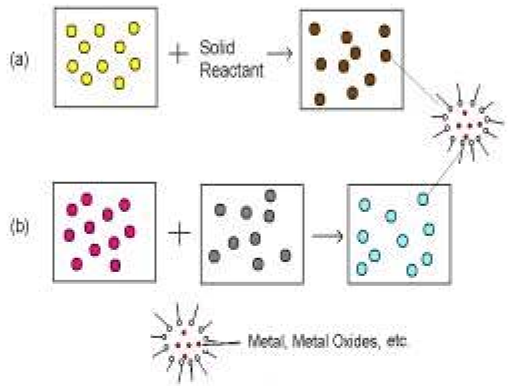

Fig. 1� Microemulsion-mediated synthesize system[1]

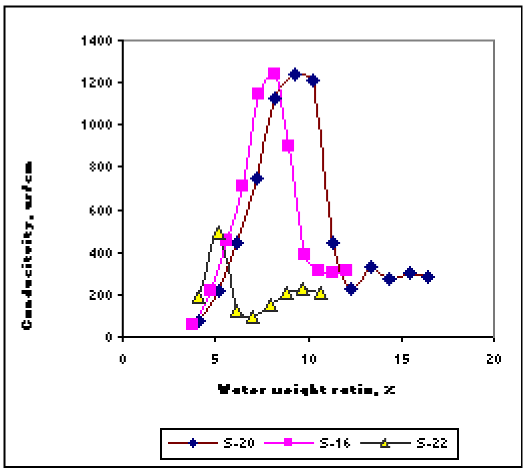

Fig. 2�� Conductivity versus water weight ratio in the CTAB/1-butanol/n-octane system conductivity

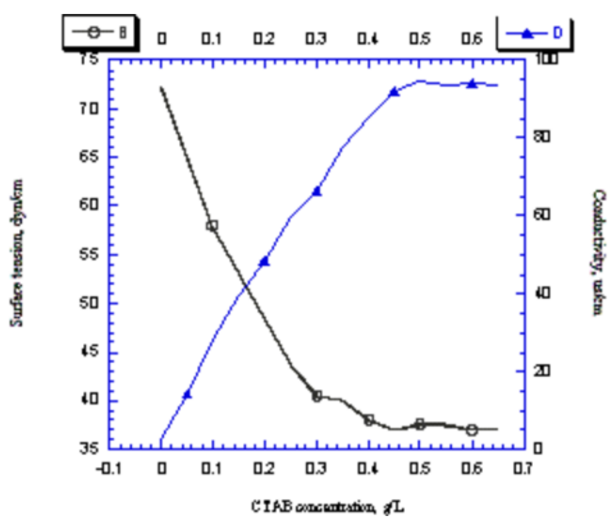

Fig. 3 CTAB Critical micelle concentration measurement (left) surface tension(right).

5.Conclusion

Conductivity measurement can be used to characterize the microemulsion system and determine the maximum amount of water that can be added to maintain the water-in-oil system.

6. Acknowledgement

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7. Reference

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[3] A.Molski and E.Dutkiewicz, �Electrical conductivity and percolation in water-in-oil microemuslions�, Polish Journal of Chemistry, 70, 959-971(1996).

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