

SURFACTANT GELS WITH VESICULAR STRUCTURE

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Surfactants are an important class of chemicals, which are used not only as detergents but also in many other areas, such as cosmetics, pharmacy, and the food industry. In aqueous solution, surfactants form aggregates due to their amphiphilic character. This self-assembly leads to micelles and liquid crystalline phases with a variety of structures. Furthermore, non-equilibrium structures, such as vesicles, can be formed, for example, due to shear forces applied when mixing formulations. The structure of a surfactant solution has a large influence on its rheological properties. In particular, vesicular structures often show gel-like properties.

We have investigated mixtures of surfactant, fatty alcohol, and water, which show gel-like properties even at high dilution. A system containing sodium dodecyl sulfate (SDS) and cetyl alcohol (CA) [1] with a combined mass fraction of 3 % at varying SDS/CA ratio was studied in detail in order to explore the origin of the gel-like behavior observed at low SDS/CA ratios. The chain melting temperatures of the surfactant/cosurfactant aggregates were determined by proton NMR and differential scanning calorimetry, while the phase structure was investigated by neutron and x-ray scattering as well as by cryo-transmission electron microscopy. Using pulsed field gradient NMR the diffusivity of water in the different samples could be obtained. Gel-like samples were found to show a large fraction of water that has an apparent diffusion coefficient up to three orders of magnitude lower than the one of free water. Combining the results obtained by the different methods a structural model which can explain the gel-like properties could be developed [2]. The gel character is due to large jammed uni- and multilamellar vesicles. As the SDS/CA ratio increases the stacked bilayer membranes cannot be swollen by water any more and a dispersion with a low volume fraction of small compact aggregates results.

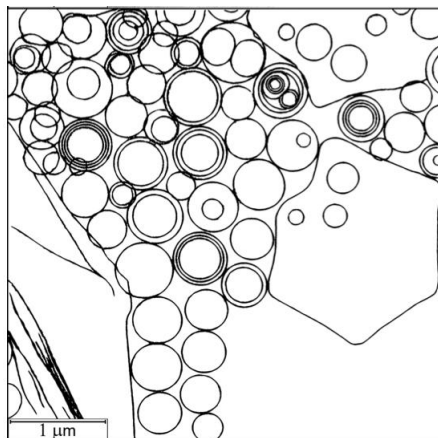


FIGURE 1 – VESICULAR STRUCTURES OF A 3 % SDS/CA/D₂O MIXTURE, RECONSTRUCTED FROM TRANSMISSION ELECTRON MICROSCOPY

[1] R. J. Goetz, M. S. El-Aaser, *Langmuir* 1990, 6, 132.

[2] F. Grewe, J. Ortmeyer, R. Haase, C. Schmidt, "Colloidal gels formed by dilute aqueous dispersions of surfactant and fatty alcohol", in "Colloid Process Engineering", ed. by M. Kind, W. Peukert, H. Rehage, H. Schuchmann, Springer, Heidelberg, 2015, pp. 21-43.