Adsorption of the Surfactant Aerosol-OT to Al₂O₃ Dilute Solutions and Behaviour of the Lamellar Phase

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The adsorption of Aerosol-OT (sodium bis 2-ethylhexyl sulfosuccinate) at the sapphire/water interface has been studied as a function of concentration, temperature, pH and added salt. This gives interesting guides to the factors that govern adsorption and self-assembly. Neutron reflection measurements provide detailed information about structure and composition of surface layers. For example, the adsorption of a 2 % wt solution (Figure 1) formed a strongly aligned lamellar phase parallel to the sapphire surface. The lamellar structure was found to consist of very dense, 30 Å bilayers of surfactant with a large separating layer of 160 Å of water that becomes thinner as temperature increases. The fluctuations of the bilayers were modelled and found to be of order 25 Å. Even at low concentration, Aerosol-OT solutions form a single thin bilayer at maximum packing density [1].

Figure 1. Neutron reflectivity of 2 % wt Aerosol-OT in D₂O at a Sapphire surface

The aligned lamellar phase at the interface is in coexistence with an isotropic bulk phase. Simultaneous measurements of the aligned surface layers and the scattering from the isotropic solution (from grazing incidence and small angle neutron scattering, Figure 2) show that the surfactant structures in the isotropic bulk phase have the same lamellar spacing as that at the sapphire interface. Comparison of these results with previous work at silicon and air/solution interfaces suggests that the driving force in adsorption and formation of lamellar structures is self-assembly of hydrophobic tails rather than being induced by charge or other specific attraction to the surface. Adsorption is not sensitive to pH. However counter-ions, particularly divalent, modify the structures considerably. The simultaneous measurements of grazing incidence scattering and small-angle scattering measurements shown in Figure 2 can be used to clarify the relative contributions of bulk and surface structure.

Figure 2. Grazing incidence and small-angle scattering of 2 % wt Aerosol-OT in D₂O