Surfactant self-assembly at highly curved surfaces studied by neutron scattering

G.H. Findenegg,1 D.M. Lugo,1 B. Bharti,1 J. Oberdisse2

1 Institut für Chemie, Stranski Laboratorium, Technische Universität Berlin, Germany
3 Laboratoire des Colloides, Verres et Nanomatériaux, Université Montpellier II, France

Adsorption of surfactants from aqueous media onto hydrophilic solid surfaces represents a surface aggregation similar to micelle formation in solution. From AFM studies it is known that either laterally uniform bilayers or discrete surface micelles may be formed on planer surfaces. Curvature of the surface is expected to have a strong influence on the self-assembly when the radius of curvature comes close to the size (cross-section) of the surfactant aggregates. To probe this surface curvature effect we studied the morphology of surfactant surface aggregates at silica nanoparticles using small-angle neutron scattering (SANS).

For the surfactant C12E5 adsorbed on silica particles of 16 nm diameter we find that the scattering profiles cannot be represented over the entire q range by a core-shell model as reported by Cummins et al.1, but the model of micelle-decorated silica beads gives a satisfactory representation of the data.2 The formation of small surface micelles instead of uniform bilayers (as found on flat silica surfaces) is attributed to the surface curvature of the silica particles which does not allow an effective packing of the hydrocarbon tails in a bilayer geometry. For the surfactant C12DAO, which has a much smaller head group than C12E5, spherical surface micelles are again found at silica nanoparticles of 16 nm diameter, but a morphological transition from spherical to oblate ellipsoidal surface micelles is observed as the particle size is increasing from 16 nm to 27 and 42 nm.3 The transition from spherical to oblate-shaped surface micelles can be seen as a relaxation from a strained to an unstrained curvature of the surface aggregates, since the oblate micelles represent the favoured aggregate morphology of C12DAO in the bulk solution.