

Micellar phase transitions induced during nanoscale friction experiment

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Amphiphilic molecules in solution are well-known to aggregate into micelles at concentration above the critical micellar concentration (CMC).

Those micellar systems undergo structure changes as a function of the surfactant concentration. Especially morphology of the micelles evolved from spherical to platelet shape via intermediary cylindrical and worm like structures [1].

Transition from one phase to another can also be achieved at a constant concentration by changing physical or chemical parameters such as pressure, temperature, Ph...

The system studied is strontium 3,5-dimethylhexanoate reverse micelles (SDMH) deposited onto mica muscovite from dispersion in a dodecane/ hexane mixture. A droplet of the dispersion is deposited onto the substrate, after evaporation of the solvent some parts of the surface are covered by a mono-micellar film.

Nanofriction experiments and measurements are achieved by means of an Atomic Force Microscope coupled with a Lateral Force Microscope (AFM/LFM).

A high superficial diffusion of the micelles, induced by the lateral force applied by the AFM tip (≈ 20 nN) during the scans, is observed. As the scans number increases, the number of aggregates decreases and their sizes and morphology evolve successively from spherical to cylindrical, worm like and finally lamellar aggregates.

The heights of the different aggregates are in the range of 2 to 3nm, which is close to the micelles size obtained from transmission electron microscope investigations [2].

The dynamic friction coefficient obtained on the stabilized platelet aggregates, quantitatively measured as described in reference [3], is low ($\mu = 0.18$). It confirms the role played by the hydrocarbon chains as friction reducer. These results are in good agreement with the macrotribological experiments performed on a conventional sphere/plane tribometer using a lubricant (dodecane) containing SDMH as friction reducer additive [4].

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