ESRF	**Experiment title: Study of the dynamics of structural reorganizations in amphiphilic systems by stopped-flow experiments**	**Experiment number**: SC-878
Beamline:	**Date of experiment**: from: 4. 10. 2001 to: 7. 10. 2001	**Date of report**: 3. 2. 2002
Shifts:	**Local contact(s)**: T. Narayanan	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

M. Gradzielski, St. Schmölzer, D. Gräbner

Lehrstuhl für Physikalische Chemie I, Universität Bayreuth, D-95440 Bayreuth

Report:

The dynamics of morphological reorganisations in amphiphilic systems is currently a topic of intensive research in colloidal science. One way to directly monitor such structural transformations with a high temporal resolution is given by means of stopped-flow experiments to a scattering technique. As the typical structural sizes to be observed are in the range of 1-50 nm SAXS is a perfectly suited observation technique and the high flux available on the ID2 beam line allows to follow the structural evolution of such amphiphilic systems with a time-resolution of down to 10 ms. Such experiments have been successfully employed by us for instance for the study of the formation of monodisperse unilamellar vesicles in the case of catanionic surfactant mixtures [1].

One may imagine a large variety of different morphological transitions in amphiphilic systems due to the morphological richness of their structures. In our experiments we studied some different typical transformations that may occur in amphiphilic systems.

An example for such a structural transition is shown in fig. 1. Here we followed the disintegration of micellar aggregates that can be brought about by changing the solvent quality, i. e. by making the originally present water a less hydrophilic solvent. This can be done by admixing a solvent like propylene glycol. In fig. 1 scattering curves are given for the case of a 100 mM solution of $C_7F_{15}COO$ Na that is mixed with an identical amount of propylene glycol. One sees that the originally present micellar peak decreases rapidly in intensity without changing its position significantly. However, it is interesting to note that the intensity reaches a minimum after about 20 s and increases significantly again for longer times. Evidently their occurs a fast dissolution step (τ_1 = 3.4 s) that reduces the micellar aggregation significantly that is followed by a slower re-aggregation step (τ_1 = 27.8 s) in which micellar structures are rebuild again. This is a very interesting effect that would not be expected for simple micellar kinetics but has to be attributed to non-linear kinetic effects due to the fact that the original equilibrium structure is perturbed in a very strong way.

In a similar study (fig. 2) we followed the disintegration of aqueous micelles of a 100 mM solution of $C_8F_{17}SO_3$ NMe_4 that is induced by mixing with an equal volume of ethanol. Here originally very long and entangled rod-like micelles are present (which render the solution viscoelastic) and after the mixing process small spherical micelles are formed. It can be noted that with ethanol the disintegration process takes place much faster and even more interesting, compared to the former example, is the fact that here at intermediate stages the scattering from micelles disappears almost completely. This means that at intermediate times of 1-10 s basically no micelles are present and they are reformed from monomers. It can also be deduced that upon admixture of the ethanol the large rod-like micelles are decreasing significantly in length and relatively small micelles are formed quickly apparently as fragments of the rod-like micelles that are formed in the disintegration process.

These are just 2 examples for morphological transitions in amphiphilic systems but it is evident that SAXS coupled to the stopped-flow method is a powerful method for the study of such interesting structural transitions.

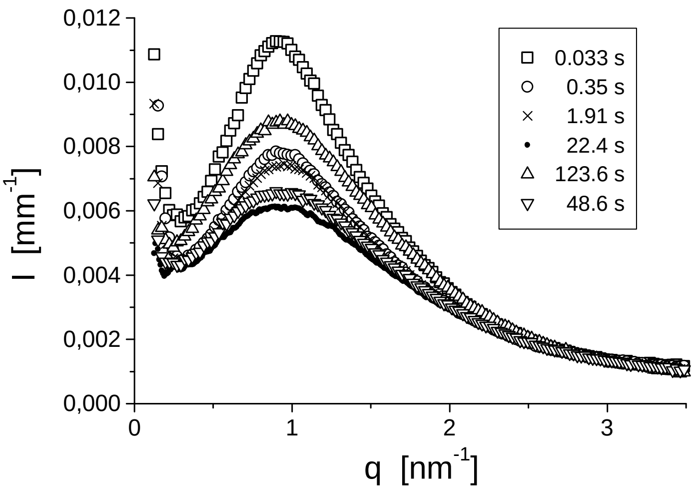

Fig. 1: SAXS curves for the mixing a solution of 100 mM $C_7F_{15}COO$ Na with an identical amount of propylenglycol

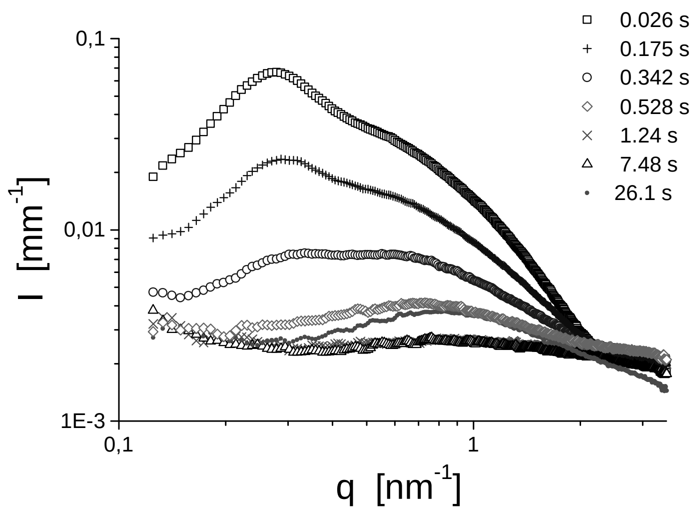

Fig. 2: SAXS curves for the mixing a solution of 100 mM $C_8F_{17}SO_3$ NMe_4 with an identical amount of ethanol

[1] St. Schmölzer, D. Gräbner, M. Gradzielski, T. Narayanan, *Phys. Rev. Lett* 88, 258301-1-4 (2002)