Laboratory RheoSAXS studies of non-ionic surfactants

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Non-ionic surfactants are widely used in the form of cleaning agents, detergents, wetting agents, emulsifiers and solubilizers in cosmetics, to name just a few. Here, we demonstrate the results of a combined rheological and X-ray scattering (RheoSAXS) study of a non-ionic ethoxylate surfactant in water system. The experiments were done using the unique RheoSAXS module for SAXSpoint 5.0 by Anton Paar. The RheoSAXS module is based on the DSR 502 rheometer head, which is fully integrated into the SAXSpoint sample chamber. This setup allows for full rheological measurements during a small-angle experiment. Combined RheoSAXS studies of surfactant systems such as non-ionic surfactants reveal material properties that are not accessible with other techniques or simple shear-cell add-ons.

Using this setup, we were able to characterize not only the macroscopic properties such as the sample’s flow behaviour but also simultaneously changes to the nanostructure of the non-ionic surfactant polyoxyethylene alkyl ether (CmEn)-water two-component system. These systems are known to form planar lamellae at no shear or low shear rates, however, at higher shear rates and in dependence of the temperature onion-like structures can evolve [1]. For analyzing the present surfactant system the sample was measured at varying shear rates and temperatures. An in-depth evaluation of the nanostructure was done using the generalized indirect Fourier transformation (GIFT) approach [2].

Summa summarum, in this study the formation of an onion-like structure of the non-ionic polyoxyethylene alkyl ether surfactant at higher shear rates was studied. Furthermore, a detailed data evaluation revealed valuable information on the structure of bilayers as well as their flexibility in dependence of the shear rate [3].

Figure 1. 2D scattering patterns of C12En in water at 30 °C. SAXS data was measured at various shear rates.