

Linking microstructure to rheology for wormlike micelles

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Wormlike micelles (WLMs) are elongated, thread-like surfactant aggregates that form thermodynamically under certain conditions. At sufficiently high concentrations, WLMs overlap and entangle with each other and this change in microstructure causes a rapid increase in viscoelasticity and zero-shear viscosity. Moreover, it provides significant shear-thinning character, a type of 'non-Newtonian' flow behaviour. These properties are very useful in a variety of industries and products, including as personal care products, drag reducing agents and fracturing fluids for oil and gas field stimulation. Despite their ubiquity, very few studies have investigated mild, non-toxic WLMs (like those found in personal care products) at concentrations relevant to industry formulations. Moreover, no model exists that is able to incorporate and link the known microstructural features of WLMs to the bulk rheological properties to which they give rise.

Here, we are seeking to investigate and link the microstructure and bulk rheology of WLMs formed by cocamidopropyl betaine (CAPB) and sodium laureth sulfate (SLES) surfactants. To do so, we have conducted small-angle neutron scattering (SANS) measurements on CAPB/SLES WLM samples whilst at an applied shear rate, a technique known as rheo-SANS. From this study we have been able to observe shear-induced alignment of WLMs via anisotropy in the 2D scattering pattern and, for the first time, we are attempting to fit full 2D scattering patterns. This will allow us to quantitatively determine the degree of alignment of WLMs with the direction of shear, as well as other physical parameters within the SANS range including cross-sectional radius and persistence length. By way of analysis and comparison of these data with bulk rheology data, we aim to establish structure-function relationships for predictive and self-consistent modelling of WLM rheology.

Level of Expertise

Student

Do you wish to take part in the poster slam

No

Travel Funding

Yes

Speakers Gender

Male

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