



"Soft-Matter Seminar"

The role of surfactants, Hofmeister ions, and pH on the liquid/liquid interface of oil droplets in water: new insights from nonlinear light scattering spectroscopy.

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Abstract:

Emulsions consist of one liquid dispersed as droplets in another liquid, such as butter and milk. Despite the importance of emulsions in our daily lives, protocols for control of properties and stability are very often empirical, and the molecular mechanism behind emulsion formation, stability and dynamics remains unknown. Emulsion properties are to a large extent determined by their molecular interfacial properties. Since the (oil) droplet interfaces of emulsions are surrounded by a liquid (water) phase they are difficult to access for molecular surface-specific probes. Molecular interfacial properties are therefore generally inferred from experiments on planar interfaces. However, since the surface to volume ratio of an emulsion is typically $10^4 - 10^7$ times larger than that of a planar interface, it could be asked if changing one of the key physical parameters of a system by such a large amount would not result in differences in chemical and physical behaviour.

Sum frequency scattering (SFS) spectroscopy [1] offers a unique way of obtaining molecular information (chemical composition, molecular orientation, order and chirality [2]) of the interfaces of micro- and nanoscopic particles in a solution [3,4] or in a solid matrix [5]. We present vibrational SFS measurements on 100 nm oil droplets in water, which essentially provide a vibrational spectrum of the oil, the water phase and interfacial species such as ions and surfactants. Probing SDS surfactant adsorption find that the interfacial density of adsorbed SDS is more than one order of magnitude lower than that at a corresponding planar interface [6,7]. From our data we can derive a maximum decrease in interfacial tension, which turns out to be at least an order of magnitude lower than on a corresponding planar interface (5 mN/m, instead of 42 mN/m). We further find large differences between chain conformations of oil and SDS surfactant [8]. Finally, we present data on the orientation of water and the effect of (Hofmeister) ions and pH on the surface structure.

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