

Dilute – but elastic – emulsion: how to gelify an aqueous phase with an organo-gelator

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The oil fraction ϕ in a oil-in-water emulsion describes the packing of the droplets. It is only when this fraction exceeds about $\phi_c = 65\%$ that the emulsion becomes elastic and develops a yield stress¹. At lower liquid fraction, usual emulsions are fluid. Here, we present a simple chemical system providing us with emulsions in which fibrils emerge in water from the oil phase under cooling, leading to a gelled water phase, and thus to a yield stress at oil fractions well below ϕ_c .

In this system, an organogelator (12-hydroxystearic acid, HSA) is dispersed in the oil phase, while ethanolamine is added to the water phase. This is a chemical couple known for providing long tubular structures in water, and stable foams²⁻³; but its ability to stabilize emulsions was not yet studied.

First, we show that stable dilute emulsions ($\phi = 20$ to 50%) are easily produced at high temperature. Then, under cooling and for a given range of relative concentrations between HSA and ethanolamine, these dilute emulsions show new features: they develop an elastic behavior, fully characterized by rheometry. Microscopy techniques and X-ray diffraction demonstrate that this behavior is due to long self-assembled crystalline fibrils in water emerging from the oil droplets, giving them a hairy-like configuration (Fig.1).

Here we thus show for the first time that a single molecule - initially dispersed in oil - both stabilized the emulsion, and subsequently provide the gelification of the water phase. The mechanism of fibril creation in water, as well as time and temperature stability issues, are discussed. In parallel, the robustness of this effect is demonstrated using different oils (paraffin, myrtilol, dodecane). This works illustrates how emulsion properties can be tuned, once transfer of molecules or structures from one phase to the other can be triggered.

Keywords: emulsion – self-assembly – organogelator – hydroxystearic acid

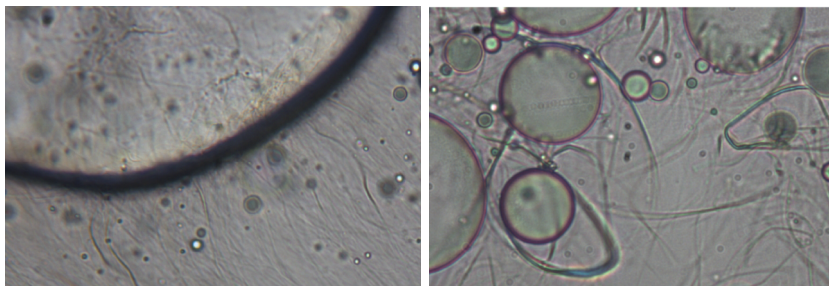


Figure 1. oil droplets from which fibers grow in water to provide an elastic behavior to the continuous phase.

References

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