

Reinforced hydrogels: polymer cross-linking by emulsion droplets

A. Mikhailovskaya¹, C. Le Cœur¹, F. Cousin², C. Amiel¹, J. Goyon³, F. Rouyer³, F. Ferdeghini⁴, F. Muller⁴

¹*Institut de Chimie et des Matériaux Paris-Est, Thiais, France*

²*Laboratoire Léon Brillouin, CEA Saclay, Gif-sur-Yvette, France*

³*Laboratoire Navier, Université Gustave Eiffel, Champs-sur-Marne, France*

⁴*ECE Paris, Paris, France*

alesia.mikhailovskaia@cnrs.fr

Hybrid materials of a polymer network with inclusions of lyotropic liquid crystalline droplets can provide versatile transport of both hydrophilic and hydrophobic substances through aqueous media. Therefore, such systems have a great potential for biotechnological and food science applications. However, weak mechanical strength of the hydrogel skeleton significantly limits the use of such composites. Haraguchi *et al.* [1] proposed to prepare hydrogels with improved mechanical properties by free radical polymerization in an aqueous suspension of Laponite clay particles. In this case, the polymer chains adsorb at the surface of the particles so that the cross-linking density of the resulting physical gel network is largely increased. We combine this effect with Pickering stabilization of droplets by Laponite particles [2] to prepare hydrogel/emulsion composites. Due to the droplets acting as multifunctional cross-links, the materials demonstrate an enhanced elastic modulus in comparison with Haraguchi hydrogels. Moreover, we prepare emulsion droplets using L2 liquid crystal phase composed of inverse micelles of phytantriol in dodecane medium [3] (Figure 1), which allows to functionalize the resulting hybrid materials both with hydrophilic and lipophilic agents.

We correlate the mechanical properties with the structure by studying the multi-scale organization of the materials with electron microscopy, X-ray Scattering and Small Angle Neutron Scattering (SANS).

Keywords: hydrogel, Pickering emulsion, hybrid materials

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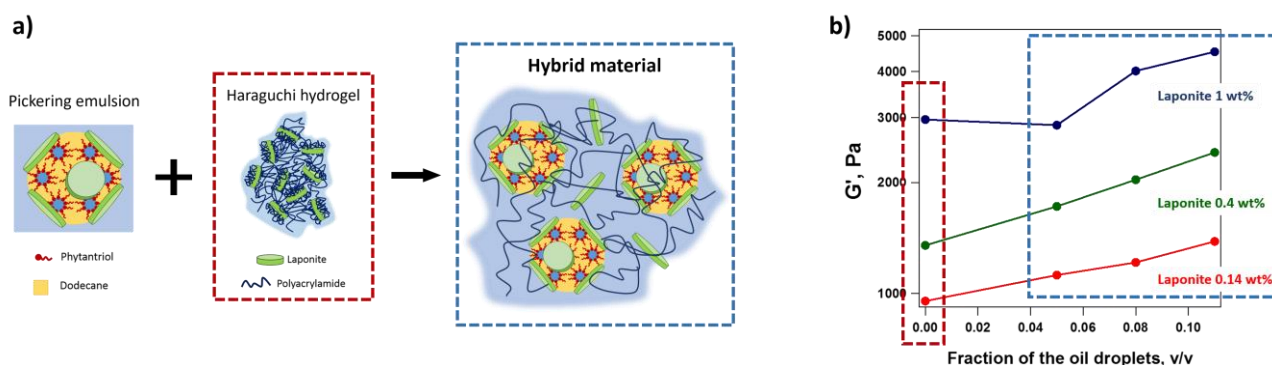


Figure 1. Sketch of the hydrogel/emulsion hybrid material structure (a) giving improved mechanical properties (b).

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References

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