VII Encuentro Argentino de Materia Blanda

How to use Self- and Direct assembly to design Smart Materials based on Fatty Acids?

Fameau, Anne-Laure [1].

1. INRAE, LILLE, FRANCE Email: alfameauinra@gmail.com

All of the physical matter around us is composed of atomic or molecular building blocks. Controlling the assembly of these building block units holds the key for producing materials with new properties. Our research is focused on the self- and directed assembly of matter at all length scales, i.e. from molecular to macroscopic scale. We are interested in multiscale approaches to understand the interactions, which govern the assembly of colloids both in bulk and at interfaces. We develop new strategies to control the interactions and design responsive materials. These systems could find applications in a wide range of industrial and environmental processes such as in food, cosmetics, crude oil treatment and extraction.
Soft materials, such as foam and emulsion systems, which respond to external stimuli, are on the leading edge of materials research. The macroscopic responsivity relies on the ability to react at microscopic or mesoscopic scales. Stimuli-responsive surfactants that can change their structure in response to a trigger such as pH, temperature or light have attracted great attention due to their versatile applications in various fields. A change in the molecular structure of the surfactant activated by stimuli can affect the self-assembled structure in water and the interfacial activity, which can in turn tune the macroscopic properties such as emulsion and foam stability. Responsive foams correspond to foams for which stability can be reversibly tuned between ultrahigh stability and immediate destabilization under stimuli [1]. We will illustrate how we can use fatty acids, which are green anionic surfactants, to produce multi-stimuli responsive self-assemblies and foams [2-6] (Figure 1).
Other technologically important materials are made by assembling colloidal particles into structures that often start with simple chains or filaments. A variety of techniques are available to assemble particles into chains,but so far it has proven challenging to make permanent chains that are flexible. We will present a new method for making highly flexible particle chains based on capillary attractions between particles coated with liquid fatty acids, which is broadly similar to the way sandcastles are bound by small volumes of liquid (Figure 2). We will illustrate how the lipid capillary bridges between colloidal nanoparticles can be used to provide new opportunities for assembling nanoparticles in the form of filaments, networks and self-repairing gels [7].

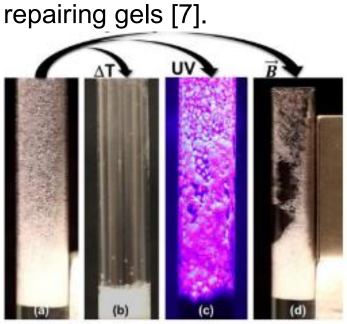

Figure 1: Illustration of the ability of fatty acids foam with carbon black particles to respond to three different external stimuli. Foams **(a)** before and after **(b)** an increase in temperature; **(c)** UV irradiation; and, **(d)** exposure to a magnetic field.

Figure 2: Illustration of nanocapillary bridged filaments assembled into 2D gel-like network. The network upon mechanical damage can be repaired by external magnetic field, highlighting the self-healing properties of filaments.

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EXACTAS UBA

Instituto de Nanosistemas INS_UNSAM

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