Carbon Nanoskin Formation at the Liquid-Liquid Interface

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The liquid-liquid interface is a high energy interface that can be stabilized using interfacially active molecules. The employed surfactants self-assemble at the oil-water interface, exposing their polar head group to water and apolar tail group to the oil phase, which allows using the liquid-liquid interface as a template for two-dimensional assembly. Here, we report the in-situ formation of 2D carbon nanosheets at the liquid-liquid interface, starting from reactive hexayne surfactants that undergo a two-dimensional interfacial polymerization under mild conditions.

Our laboratory had previously used a hexayne surfactant with a methyl ester head group and a reactive hexayne segment to fabricate functional carbon nanosheets at the air-water interface [1]. In the work presented here, we now employed an amphiphile composed of a polar phosphonic acid as a head group, a highly reactive hexayne reactive segment, and a long alkyl chain (Figure 1). The precursor amphiphiles spontaneously self-assemble at the oil-water interface and can be crosslinked by mild heat treatment or UV irradiation, forming a thin Janus 2D carbon nanosheet. In contrast to molecular surfactants, the resulting carbon nanosheet presents distinctive properties of a Pickering emulsion, such as buckling upon a change in the interfacial area. The transition from molecular surfactant stabilization to a colloidal stabilization of the interface can be followed by drop tensiometry as well as interfacial rheology and allows to gain fundamental insights into the emulsion stabilization process. Furthermore, the mechanical and barrier properties (retention properties) of the formed carbon nanosheets are investigated in depth.

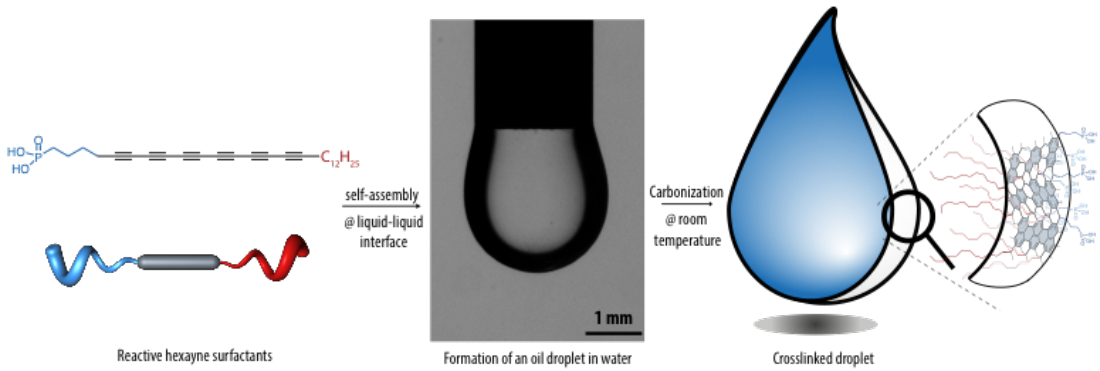

Figure 1. In situ formation of a carbon film at the liquid-liquid interface (a) Interfacially active hexayne molecules. (b) Self-assembly at the oil-water interface (c) 2D polymerization to form carbon nanosheets

[1] Schrettl, S.; Frauenrath, H. et al, *Nature Chem.* **2014**, *6*, 468.