Stabilization of water-in-water emulsions by interfacial lipid self-assembly

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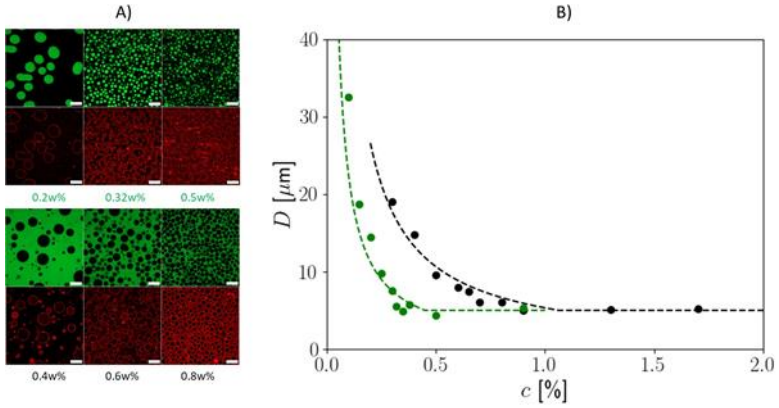

Figure 1. A) Confocal microscopy images. Green fluorescence channel (upper line) and red fluorescence channel (lower line) for different lamellar phase concentrations. Scale bar is 20 µm B) Evolution of mean droplet diameter in µm as a function of lamel

Water-in-water (W/W) emulsions produced by liquid-liquid phase separation in aqueous polymer solutions have received an increasing attention for micro-encapsulation applications. Easily produced without oil or organic solvents, these emulsions capture and accumulate various solutes, including biomolecules. Molecular surfactants, used to stabilize water/oil emulsions, are inefficient to stabilize W/W emulsions. Since fifteen years, many works have tried to tackle this issue. The main objective of this work is to develop a new, simple and robust stabilization strategy for W/W emulsions with impermeable membranes by interfacial lipid self-assembly.

A completely new stabilization mechanism was identified with the coating of droplets by lyotropic swollen lamellar phases. We show that emulsifying lyotropic lamellar phases doped with the ATPS-forming polymer solutions stabilizes the corresponding water-in-water emulsion, with spontaneous interfacial coating of the droplets by the lamellar phase [1]. By varying the amount of lamellar phase in the emulsion, we demonstrate, using confocal fluorescence microscopy, the existence of a critical minimum concentration of the lamellar phase that is necessary to stabilize the emulsion. We hypothesize that this concentration in the lamellar phase corresponds to the amount of material necessary to completely coat the interface of the droplets, as supported by a simple, geometric model [2]. More recently, we have investigated the kinetics of the system's evolution as well as the interfacial coverage by surfactant molecules, with the aim of gaining deeper insight into the coalescence phenomenon. This study has strengthened the geometric model. This very simple, precise and robust stabilization strategy is mainly based on knowledge of the structures and dilution behaviors of lamellar phases.

Keywords: W/W emulsion. Interfacial self-assembly. Lamellar phase. Polymer solution. Surfactant

References:

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