Stabilization of water-in-water emulsions by complex coacervate core micelles

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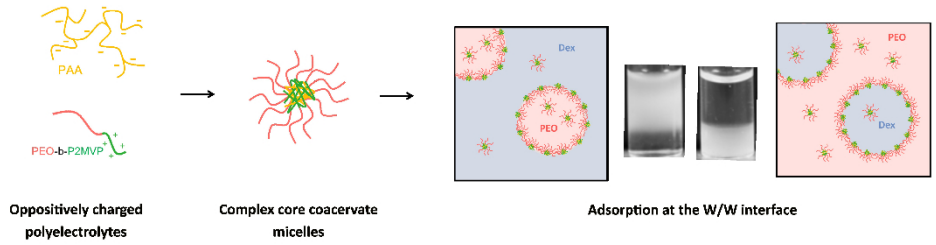
Water-in-water emulsions (WWE) form when aqueous solutions of incompatible polymers are mixed. These emulsions, that do not contain any organic phase, are of growing interest, particularly for applications that involve compartmentalization, and they are deprived of any organic phase. However, they display a large interface and low interfacial tension, making the adsorption of molecular stabilizers, such as surfactants, difficult. Moreover, these all-aqueous systems require fully hydrophilic stabilizers displaying affinity for both phases. Therefore, using particles such as protein microgels or protein-polysaccharide complexes as stabilizers, namely Pickering effect, has proved effective in improving WWE stability. [1] [2] However, the relationship between the chemical composition of the particles and their ability to stabilize WWE is poorly understood. A recent work showed that WWE composed of poly(ethylene oxide) (PEO) and dextran and formulated with dextran copolymer-based microgels displaying affinity for both phases had an excellent stability. Nonetheless, copolymer microgels are inherently ill-defined and allow only a partial comprehension of their conformation, both in bulk and at the water/water interface. [3] Moreover, to our knowledge, no study reported long-term stability (that is, for several weeks or months) for both PEO-in-dextran and dextran-in-PEO with a single stabilizer.

In this context, we designed complex coacervate core micelles (C3M), consisting of polyelectrolyte complexes stabilized by one or several neutral hydrophilic polymer segments attached to one of the polyelectrolytes. C3M are well-defined, all-hydrophilic core/corona soft particles of which size and surface chemistry (thus, affinity for both phases) can be tuned by varying the copolymer composition. [4]

We will introduce the proof-of-concept of the impressive improvement of stability of PEO/dextran WWE in the presence of C3M with a PEO corona. We will highlight the role of C3M concentration to stabilize both PEO-in-dextran and dextran-in-PEO emulsions for several months. We will also discuss the influence of ionic strength on the co-assembly of C3Ms and thus, on the stability of WWE containing them.

Keywords:
Water-in-water emulsions, polyelectrolytes, complex coacervate core micelles, stabilization



Complex coacervate core micelles formed from PAA and P2MVP-b-PEO adsorb at PEO/dextran interfaces and enhance emulsion stability by reducing creaming, sedimentation, and coalescence.

References:

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