Colloidal Particles at Interfaces: from Fundamentals to Functional Materials

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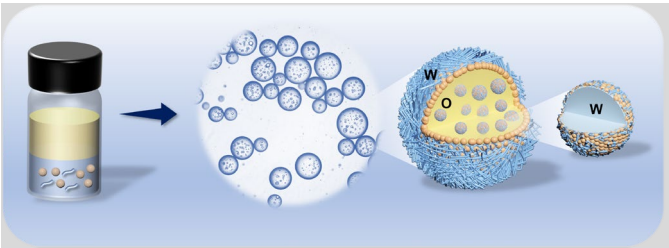
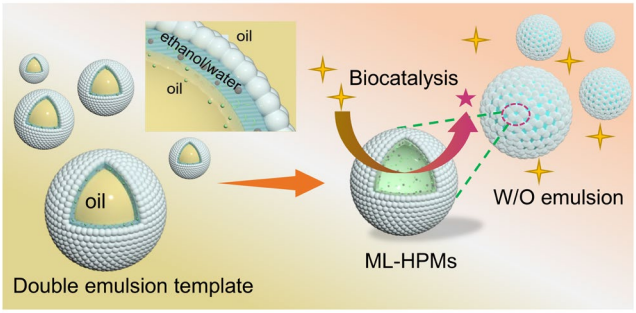
The phenomenon of adsorption of solid particles at fluid interfaces to stabilize emulsions or foams have been known for more than a century. Today, particle-stabilized emulsions, often referred to as Pickering emulsions, are receiving growing attention as they are encountered in oil recovery and have long been used in personal care products and food industry. Pickering emulsions have been stabilized by inorganic, polymer-based and protein-based particles. They are also used as template to prepare colloidosomes and hierarchically porous materials.

In the first part, we demonstrated that two types of plant-derived particles, namely zein nanoparticles (ZNPs) and cellulose nanocrystals (CNCs), can be used as stabilizers in a facile one-step emulsification process to generate an all-natural water-in-oil-in-water (w/o/w) Pickering double emulsion. The simultaneous adsorption of ZNPs and CNCs effectively stabilizes both external and internal emulsion droplets with different curvatures. The formation and stabilization mechanism of such double emulsion were shown to involve as the formation of amphiphilic aggregates by ZNPs and CNCs, as well as the phase inversion process. The co-encapsulation of both polar and apolar cargos (e.g., β-carotene and epigallocatechin gallate, EGCG) in our prepared all-natural double emulsions was achieved with better protection in different environments. This study presents a novel and efficient approach to prepare a green and renewable Pickering double emulsion, which could be valuable for potential applications in foods, pharmaceutics and cosmetics[1].



In the second part, we reported hydrophobized proteinaceous colloidosomes to act as both colloidal emulsifier and enzyme carrier, achieving a breakthrough in protein-based w/o Pickering interface biocatalysis (PIB) system. The engineering proteinaceous colloidosome is formed using an oil-in-(ethanol/water)-in-oil double emulsion stabilized by commercially-available silica particles with zein as the skeleton, physically modifying the colloidal proteinaceous stabilizer with hydrophobicity and immobilizing enzyme simultaneously. Furthermore, magnetic responsiveness is imbedded in the colloidosome, allowing for rapid enzyme recovery. As compared with biphasic and conventional w/o emulsion (enzyme in

droplets) catalysis, this novel PIB system shows superior catalytic efficiency. In addition, from materials to synthesis, the preparation of such proteinaceous colloidosomes is facile and in accordance with the concept of green and sustainable chemistry. Therefore, it is promising for more potential applications in food and bioengineering, as well as bio-materials.[2]



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