

Multiple emulsions and capsules stabilized by surface-active particles

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Some researchers have focused on the adsorption of solid particles at fluid-fluid interfaces and prepared emulsions called "Pickering emulsions." However, while several reports exist on simple spherical emulsions, few reports are available on the formation of more complex structures. Firstly, we show that holes on particle surfaces are a key factor in establishing the variety and complexity of mesoscale structures. Microbowls, which are hollow particles with holes on their surfaces, form multiple emulsions (water-in-oil-in-water and oil-in-water-in-oil emulsions) by simply mixing them with water and oil. Furthermore, stable potato-like emulsions are also obtained, although nonspherical emulsions are usually unstable because of their larger interfacial energies. Secondly, we observed the drying processes of Pickering emulsions and found that some wrinkles were formed on the droplet surfaces. The formulation made of Pickering w/o emulsions is desirable to achieve uniform distribution of ingredients on a wide area after drying. These findings are useful in designing the building blocks of complex supracolloidal systems for pharmaceutical, food, and cosmetic products.