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Dynamics of spontaneous emulsification at particle-laden interfaces: a coupling between interfacial microstructures and interfacial flows.
PARISA BAZAZI, HOSSEIN HEJAZI, university of Calgary — Interfaces between two immiscible liquids are omnipresent in nature and industrial process including enhanced oil production, CO₂ sequestration, and drug delivery. A thermodynamically stable dispersion of liquids, i.e. microemulsions, may develop at the fluid interfaces under specific circumstances such as having close to zero interfacial tension. In this work, we investigate the possibility of spontaneous emulsification at the particle-laden oil-water interfaces and examine the extent to which the phenomena are analogous to those of surface active molecules. It is shown that the nanoparticle-micelle complexes are formed at the interface of an aqueous drop submerged in an oleic phase promoting spontaneous emulsifications and double emulsion formation. Thus, the interface is covered with less than one-micron droplets of emulsified phase. The microemulsion detachment from the interface and their non-uniform distributions trigger fluid circulations inside the aqueous drop. The induced interfacial flow alters the drop shape, contribute in fluid mixing and consequently enhance the emulsification process. We quantify the emulsification rate and the fluid motions at the interfaces and provide plausible physical mechanisms describing the fluid dynamics of the process. We ultimately demonstrate the possibility of generating interfaces with specific microstructures and interfacial properties only by tuning the particle-surfactant concentrations.

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