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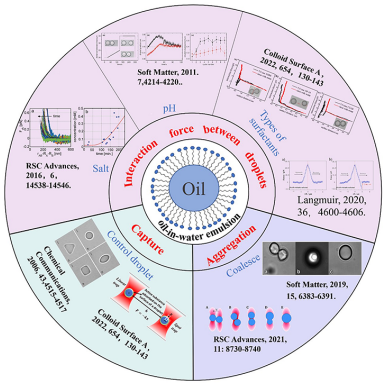
New study reviews ability of optical tweezers to quantitatively measure interaction forces between single droplets.



Oil-in-water emulsions, which consist of oil droplets suspended within water, are vital to the food, cosmetics, water treatment, and other industries. Optimizing these emulsions, however, requires a microscopic understanding not readily provided by macro-level measurement methods. Huang et al. reviewed studies that use optical tweezers – which directly exert forces on individual droplet to measure interactions – to quantitatively measure the interaction forces of oil-in-water emulsions at a micro level.

The review summarizes recent advances in using optical tweezers to capture, control, and measure the interaction forces between droplets, showing how their performance changes in different environments such as salt, polymers, ionic surfactants, and nonionic surfactants solutions. The authors also fit the data to establish theoretical models to understand the types of forces involved in oil-in-water emulsions and how they contribute to stabilization.

“This review provides useful information for industries affected by oil-in-water droplets, including those new to the field,” co-author Shuai Liu said. “For researchers who already study optical tweezers, this review outlines current problems with using optical tweezers for this application.”

The authors explained that the optical-tweezer method does not physically disrupt the oil-in-water droplets, so that interaction forces between droplets with diameters ranging from 1 to 10 micrometers can be quantitatively and accurately measured. These characteristics enable researchers to directly probe and show the stability of oil-in-water emulsions under different environments.

Some future directions for research include improving both theory and experiments so interactions between droplets of different sizes or shapes in various environments, Liu said.

Source: “The application of optical tweezers in oil-in-water emulsions,” by Ju Huang, Cheng Zhang, Junjie Liao, Ming Duan, Shuai Liu, *Physics of Fluids* (2024). The article can be accessed at https://doi.org/10.1063/5.0227676.