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Kinetic Analysis of Oil Exchange between Surfactant-Stabilized Emulsions Using Time-Resolved Small Angle Neutron Scattering

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Emulsion systems are dynamic and several physical mechanisms can lead to mass transport between droplets (e.g. coalescence, diffusion, micelle-driven). Understanding how oil exchanges between emulsions is also critical to developing applications such as new drug-delivery vehicles and emulsion polymerization processes. Researchers have aimed to fundamentally examine mass transport between stabilized emulsions using characterization techniques such as differential scanning calorimetry, microscopy, pulse gradient NMR, and turbidity measurements. However, all of these require the use of dissimilar oils and/or labeling droplets with fluorescent molecules.

Here, we take advantage of large differences in neutron scattering length density between hydrogenated and deuterated versions of alkane oils to use time-resolved small angle neutron scattering to directly examine mass transport between emulsions with identical chemical compositions. We specifically examined mixing between alkanes in oil- in-water emulsions stabilized by anionic (i.e. sodium dodecyl sulfate) and non-ionic surfactants. Fully deuterated and partially hydrogenated hexadecane emulsions with equal contrast relative to the solvent were prepared identically (e.g. sonication) and subsequently mixed to monitor oil exchange kinetics. As oil exchanges between droplets over time, a decrease is observed in scattering intensity due to contrast-matching conditions between the solvent and the fully-mixed oil phases. When emulsions are ideally mixed, minimal scattering is detected. This talk will summarize findings of measurements of mass-transport for emulsion systems with a large number of variable parameters including surfactant concentration, surfactant type, temperature and oil- type. Multiple physical mechanisms are suggested to play important roles in controlling transport in emulsion systems.

Speakers Gender

Female

Level of Expertise

Expert

Do you wish to take part in the poster slam

No

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