

The Forces between Deformable Emulsion Droplets on the Nanoscale

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Much of the ability to produce advanced materials relies on a well developed understanding of surface forces. Static interactions between surfaces have been studied for decades, but a comprehensive quantitative understanding of dynamic interactions in biological or other suspended soft matter systems is still being developed. Colloidal forces, hydrodynamic interactions and surface deformations contribute to the total interaction between droplets. Measurement and interpretation of these interactions are complicated by interfacial deformation. We employed a novel experimental method(1) to study the interaction forces between oil droplets using AFM and recent theoretical developments(2) to *quantitatively* interpret the experimental results for oil droplets in the presence of an anionic surfactant(3) or tri-block copolymer.

The droplet radii are on the order of 30 to 80 microns, therefore colloidal forces, hydrodynamic interactions and interfacial deformation are all significant components of the total interaction. The first system discussed was used for model verification and employs an anionic surfactant, SDS. Employing the model developed by Carnie *et al* has resulted in quantitative agreement between the experimental data and the theoretical predictions that are impressive for both equilibrium force measurements and for the dynamic force interactions(3). In the second case, Pluronic tri-block copolymers of the form PEO_xPPO_yPEO_x were adsorbed to form steric brushes at the oil-water interface. These systems exhibit significant hydrodynamic drainage forces as well, but the theoretical description is complicated by drainage through the steric layer. Effects of changing brush layer thickness on static and dynamic forces will be also discussed. These results help provide a significant step forward in the understanding of the nature of the interactions between moving deformable surfaces at the nanoscale from colloidal and hydrodynamic forces.

1. Dagastine, Stevens, Chan, Grieser, *J. Colloid Interface Sci.* **273**, 339 (2004).
2. Carnie, Chan, Lewis, Manica, Dagastine, *Langmuir* **21**, 2912 (2005).
3. Dagastine, Manica, Carnie, Chan, Stevens, Grieser, *Science* **313**, 210 (2006).