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How can we manipulate the properties of particle laden interfaces?

Bulk properties of particle stabilized Pickering Emulsions are determined by dispersed drops' behavior. In Pickering emulsions, particle laden interfaces create steric repulsion and interfacial viscoelasticity, altering drop behavior. By controlling these interfacial properties, emulsions can also be manipulated. However, to do this requires understanding the relationship between interfacial mechanical properties and contact angle, interface composition, and inter-particle interactions. In the Christopher lab, we have created a suite of unique techniques that allow us to characterize such relationships.

Using Bessel Beam microscopy, we have found that even monodisperse particle populations at oil/water interfaces have large contact angle distributions due to normal diffusion and particle variation. Using Stokesian Dynamic simulations, we have found that increasingly random initial particle order and stronger hydrodynamic interactions create denser networks when particles aggregate at an interface. Finally, using simultaneous interfacial rheology and microscopy, we have found that inter-particle attraction sets interfacial moduli magnitude but microstructure deformation determines global properties such as relative elasticity and yield strain. Our results indicate that it is possible to manipulate particle laden interfaces so that in the future we may manipulate bulk emulsions.

Bio:

Dr. Christopher is an Associate Professor in the Department of Mechanical Engineering at Texas Tech University, where he has worked since 2011. He received a BS in Mechanical Engineering in 2002 from Columbia University, a PhD in Mechanical Engineering and a MS in Chemical Engineering in 2008 from Carnegie Mellon, and spent 2 years as a NRC Post Doc at the National Institute of Standards and Technology. He was named 2018's TA Distinguished Young Rheologist and recipient of the 2018 Whitacre Research Award at Texas Tech. His research focuses on the rheology and flow of high interface systems through the development of novel techniques, including microfluidics, interfacial rheology, and bulk rheology.