Probing Aqueous Nanofluids Confined Between an Oil Droplet and a Charged Solid Surface

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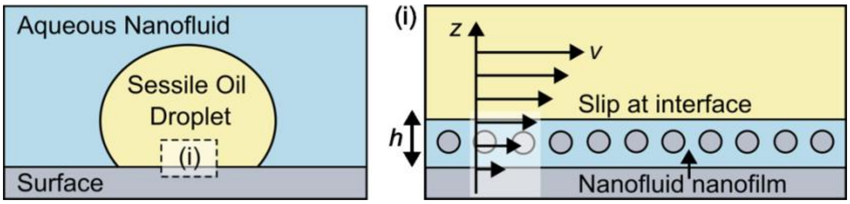
Nanoparticle suspensions, also referred to as nanofluids, are highly relevant across multiple industries for their heat flux mediation, friction reduction properties, and modification of fluid viscosity under shear. At high concentrations, aqueous nanofluids containing charged nanoparticles can form liquid-like structures, mediated by electrostatic and excluded volume effects. Upon confinement, nanoparticles organise into layers, leading to an oscillatory disjoining pressure profile which increases with decreasing separation toward a confining surface, whereby layers closer to the surface are harder to displace.[1]

The presence of this oscillatory disjoining pressure in aqueous nanofluids improves their propagation over surfaces.[2] This property has been shown to enable aqueous nanofluids to displace oil from surfaces, via the formation of nanofilms containing of 1-2 layers of nanoparticles between oil and the surface.[3] This project aims to directly probe the nanofluid nanofilm/oil interface for the first time, using colloidal probe atomic force microscopy. The nanofilm response to shear will be explored in relation to its thickness, elucidating the interfacial slip properties that are expected to aid in nanofluid nanofilms oil displacement from surfaces.



Schematic of an oil contaminated surface submerged in an aqueous nanofluid. (i) Fluid velocity profile, v, at distance z, over a nanofilm/oil interface with nanofilm thickness, h.

References

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