GRADUATE STUDENT RESEARCH SEMINAR SERIES (2021)

MOTION OF VISCOUS DROPLETS ON SOFT VISCOELASTIC SUBSTRATES

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Wetting on soft solids by liquid droplets have many unique characteristics which are defined by a macroscopic deformation of the solid surface caused by the liquid surface tension. A moving contact line that causes dynamic wetting of soft solids has many industrial and biological applications related to fluid transport. Although the wetting mechanisms of a static liquid drop on soft solids is well known, the dynamic wetting mechanism due to a moving drop remains poorly understood. Soft solids with low elasticity are viscoelastic in nature with a time dependent shear modulus that control the dynamic response of the solid. We study the response of a soft viscoelastic substrate due to a drop moving with a constant velocity and show the surface deformation and liquid contact angle changes with the drop velocity. We also study the case of droplet durotaxis where a variable thickness in the substrate gives rise to spontaneous velocity in the droplet. We measure drop velocity by assuming the motion to be dominated by the viscous dissipation within the solid substrate only, considering a rigid and nearly inviscid drop. Next we also develop a thin film fluid flow model of a moving viscous droplet on a deformable substrate. The general dynamics of a viscous fluid on a deformable solid is inherently two-way coupled. We discuss the problems and future plans towards developing a coupled fluid-solid interaction model during dynamic soft wetting.

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