PHYSICAL MATHEMATICS SEMINAR

To Bounce or Not to Bounce: Impact of Viscoelastic Drops on Dry, Nanotextured Surfaces

VIVEK SHARMA

Massachusetts Institute of Technology

ABSTRACT:

The deposition of drops of complex fluids on non-wetting surfaces is an important problem for many applications, including spraying of water-based pesticides and herbicides onto plant leaves, for print electronics and bioassays using ink jet printing, spray-based paints, etc. At the realistic impact velocities, water drops show splashing or rebound when sprayed onto intrinsically hydrophobic, microtextured plant leaves such as the lotus leaf. However, addition of a small amount of high molecular polymer has been demonstrated to suppress the droplet rebound. The high extensional viscosity of polymer solutions during the drop retraction phase was initially cited as the possible mechanism for anti-rebound. An alternate proposed mechanism relies on increased dissipation in polymer solutions near the receding contact line. Using drop impact experiments on both natural and synthetic micro- and nano-textured surfaces with controlled wetting characteristics, we examine the role of viscosity, surface tension, elasticity and inertia on expansion, retraction, bounce and splash of well-characterized viscoelastic fluids. By using interference lithography to produce periodic textures with sub-optical wavelength, we show that it is possible to increase the areal density of textural elements sufficiently to induce complete droplet rebound even for high molecular weight polymer solutions. On these nanotextured surfaces, the radius of gyration of the polymer coils in solution, R, approaches the feature length scale, l, and non-continuum effects near the three-phase contact line are no longer negligible. While these nanotextured surfaces could offer significant advantages for self-cleaning and biofouling resistant applications, we show that though suppression of rebound is often claimed, the answer to the question "to bounce or not to bounce" for viscoelastic fluids is critically dependent upon both surface texture and the viscoelasticity of impacting drops.

TUESDAY, OCTOBER 25, 2011
2:30 PM
Building 2, Room 105

Reception at 3:30 PM in Building 2, Room 290
(Math Dept. Common Room)

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