PHYSICAL MATHEMATICS SEMINAR

MANIPULATING LIQUID DYNAMICS ON NANOENGINEERED SURFACES

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ABSTRACT:

Nanoengineered surfaces offer new possibilities to manipulate fluid transport and enhance heat transfer characteristics for a variety of applications including lab-on-a-chip, thermal management, and energy conversion systems. In particular, nanostructures on these surfaces can be harnessed to achieve superhydrophilicity and superhydrophobicity, and to control liquid spreading and droplet wetting. In this talk, I will discuss two topics: 1) liquid spreading on superhydrophilic surfaces, and 2) droplet dynamics on superhydrophobic surfaces. In the first study, we fabricated three-dimensional nanopillars that can control spreading behavior and directionalities. In the presence of asymmetric nanopillars, uni-directional spreading of water droplets can be achieved where the liquid spreads only in the direction of the pillar deflection and becomes pinned on the opposite interface. In the presence of fine features on the pillars, we observed a multi-layer spreading effect due to their associated energy barriers. For both cases, we have developed energy-based models to accurately predict the liquid behavior as functions of pertinent parameters. In the second study, we fabricated hierarchical structures with both micro and nanoscale features. The motivation is to mimic the surface of a lotus leaf, such that the mechanisms for its superior non-wettability can be investigated. The fabricated surfaces demonstrated excellent resistance to wetting where droplets rebound at velocities greater than 4 m/s. In addition, a two-fold increase in heat transfer coefficients was observed when compared with flat surfaces with identical surface chemistries. These studies provide insights into the complex physical processes underlying liquid-nanostructure interactions.

Bio: Evelyn Wang is the Esther and Harold E. Edgerton Assistant Professor in the Mechanical Engineering Department at MIT. She received her BS from MIT in 2000 and MS and PhD from Stanford University in 2001, and 2006, respectively. From 2006-2007, she was a postdoctoral researcher at Bell Laboratories, Alcatel-Lucent. Her research interests include fundamental studies of micro/nanoscale heat and mass transport and the development of efficient thermal management, water desalination, and solar thermal energy systems. Her work has been honored with awards including the 2008 DARPA Young Faculty Award, the 2011 Air Force Office of Scientific Research Young Investigator Award, and a best paper award at 2010 ITherm.

TUESDAY, APRIL 26, 2011
2:30 PM
Building 2, Room 105

Refreshments at 3:30 PM in Building 2, Room 290

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