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Presents

Nanoengineered Surfaces for Efficient Energy Systems

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Nanoengineered surfaces offer new possibilities to manipulate fluid transport and enhance heat dissipation characteristics for the development of efficient energy systems. In particular, nanostructures on these surfaces can be harnessed to achieve superhydrophilicity and superhydrophobicity, and to control liquid spreading and droplet wetting. This talk will cover two topics: 1) liquid spreading on superhydrophilic surfaces, and 2) droplet dynamics on superhydrophobic surfaces. In the first study, three-dimensional nanopillars that can control spreading behavior and directionalities were fabricated. 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, a multi-layer spreading effect was observed, due to their associated energy barriers. For both cases, energy-based models were developed to accurately predict the liquid behavior as functions of pertinent parameters. In the second study, hierarchical structures with both micro and nanoscale features were fabricated. 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. Furthermore, this work shows significant potential for the development and integration of advanced nanostructures to achieve efficient energy systems.

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