Keynote: Structured Surfaces – from Super-repellency to Drag Reduction

Chang-Jin "CJ" KIM

Mechanical and Aerospace Engineering Department; Bioengineering Department; California NanoSystems Institute
University of California, Los Angeles (UCLA), California, U.S.A.

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A solid surface may be geometrically structured in microscale or below, where liquid-gas interfacial tension plays an important role, to exhibit unusual properties to a liquid placed on it. Typical superhydrophobic (SHPo) surfaces are made of a hydrophobic material with microscale roughness to super-repel water drops. However, to super-repel low-energy liquids, such as oils and solvents, which partially wet all materials, the role of the roughness should increase to compensate for the material wettability. To super-repel all available liquids, including fluorinated solvents, which completely wet all materials, the repellency should be accomplished entirely by the roughness. Such superomniphobic surfaces may be considered a "mechanical" surface because the material or chemistry of the surface has no role. Although the apparent contact angle is commonly used to describe SHPo surfaces, different applications require different measures for different types of structured surfaces. Consider, for example, the widely anticipated drag reduction on SHPo surfaces. Unlike the common impression, the large contact angle on SHPo surfaces has not much to do with their ability to reduce the friction drag. Instead, the ability of the surface microstructures to retain air under water and the ability of the surface micropatterns to induce a large slip were found to determine the amount of drag reduction, as supported by many flow experiments including the recent high Reynolds number tests with a motorboat on the ocean water.