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Promoting Giant Liquid Slip on Omniphobic Surfaces with Re-entrant Textures

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It is now well-known that by controlling the surface chemistry and topographic details of a textured surface one can generate composite air-liquid-solid interfaces or "Cassie-Baxter states." If the surface topography becomes *re-entrant* (i.e. multi-valued) and very low surface energy coatings are employed, then it becomes possible to create superoleophobic surfaces that are not wetted even by low-tension liquids such as oils and alcohols. Such robustly liquid-repellent (or *omniphobic*) surfaces lead to very high apparent contact angles, low contact angle hysteresis and the possibility of "giant liquid slip" over the microscopic air pockets or "plastron film" trapped in the re-entrant textured surface. Lithographic fabrication approaches have been proposed for developing such re-entrant textured surfaces - a major challenge with such approaches is to develop viable manufacturing protocols that can be readily extended to larger areas. In the present work we use periodic woven fiber meshes of controlled feature size and weave, coupled with a simple elastomeric fluoropolymer dipcoating protocol, to prepare a series of model re-entrant and friction-reducing surfaces. We use parallel-plate rheometry to explore the degree of friction reduction that can be achieved as the geometric details of the meshes are varied and compare the experimental results with recent scaling theories. Apparent slip lengths of greater than 500μm are observed for optimal textures and coatings. By varying the thickness and viscosity of the sheared fluid layer, the robustness of the plastron air film to increasing pressure differentials can also be explored in parallel.

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