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Flow through an Array of Superhydrophopic Pillars: The Role of the Air-Water Interface Shape on Drag Reduction[1] JEONG-HYUN KIM, JONATHAN ROTHSTEIN, University of Massachusetts Amherst — In this study, measurements of the pressure drop and the velocity fields associated with the flow of water through a regular array of superhydrophobic pillars were systematically performed to investigate the role of the air-water interface shape on drag reduction. A microfluidic channel was created with circular and superhydrophobic apple-core-shaped pillars bridging across the entire channel. The apple-core-shaped pillars were designed to trap an air pocket along the side of the pillars. The shape of the interface was systematically modified from concave to convex by changing the static pressure within the microchannel. For superhydrophobic pillars having a circular cross section, D/D_0 =1.0, a drag reduction of 7% and a slip velocity of 20% the average channel velocity along the air-water interface were measured. At large static pressures, the interface was driven into the pillars resulting in a decrease in the effective size of the pillars, an increase in the effective spacing between pillars and a pressure drop reduction of as much as 18% when the interface was compressed to D/D_0 =0.8. At low static pressures, the pressure drop increased significantly even as the slip velocity increased as the expanding air-water interface constricted flow through the array of pillars.

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