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Direct velocity measurement and enhanced mixing in laminar flows over ultrahydrophobic surfaces JIA OU, JONATHAN ROTHSTEIN, Department of Mechanical and Industrial Engineering, University of Massachusetts, Amherst — A series of experiment are presented studying the kinematics of water flowing over drag-reducing ultrahydrophobic surfaces. The surfaces are fabricated from silicon wafers using photolithography and are designed to incorporate patterns of microridges with precise spacing and alignment. These surfaces are reacted with an organosilane to achieve high hydrophobicity. Microridges with different widths, spacing and alignments are tested in a microchannel flow cell with rectangular cross-section. The velocity profile across the microchannel is measured with micro particle image velocimetry (μ-PIV) capable of resolving the flow down to length scales well below the size of the surface features. A maximum slip velocity of >60% of the average velocity in the flow is observed at the center of the air-water interface supported between these hydrophobic microridges, and the no-slip boundary condition is found at the hydrophobic microridges. The μ-PIV measurements demonstrate that slip along the shear-free air-water interface supported between the hydrophobic micron-sized ridges is the primary mechanism responsible for the drag reduction. The experiment velocity and pressure drop measurement are compared with the prediction of numerical simulation and an analytical model. By aligning the hydrophobic microridges at an acute angle to the flow direction a secondary flow is produced which can significantly enhance mixing in this laminar flow.

Jia Ou
Dept. of Mech. Eng., Univ of Mass, Amherst

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