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Traces of surfactants limit the drag reduction potential of superhydrophobic surfaces in realistic applications FRANCOIS J. PEAUDECERF, JULIEN R. LANDEL, University of Cambridge, PAOLO LUZZATTO-FEGIZ, UC Santa Barbara — Large drag reductions have been measured for laminar flows over superhydrophobic surfaces (SHS), making them attractive for applications in pipelines, ships and submarines. However, experiments involving turbulent flows, typical of these applications, have often yielded limited drag reductions. A complete explanation for this issue has so far proved elusive. We propose that trace amounts of surfactants, unavoidable in the environment and in large-scale experiments, can yield poor performances of SHS, by producing Marangoni stresses when the edges of the SHS pattern are not aligned with the local flow velocity. To explore our hypothesis, we develop numerical simulations (inclusive of surfactants) for a flow over a textured SHS in a micro-channel, whose background shear is similar to a viscous sublayer. The texture consists of micro ridges perpendicular to the flow. We find that even small amounts of surfactants can prevent any drag reduction. As an experimental test, we flow de-ionised water with known surfactant concentrations through SHS micro-channels with texture similar to the simulations, while performing micro-PIV. At negligible surfactant concentrations, we find higher velocities between the ridges, as expected by classical models. However, as the concentration increases, we discover that the slip velocity drops to very small values even in the presence of a plastron. Our results show that the drag-reducing potential of superhydrophobic surfaces can be limited in realistic flow conditions

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