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Skin-Friction Drag Reduction over Super-Hydrophobic Materials in Fully-Developed Turbulent Flow[1] JAMES W. GOSE, KEVIN GOLOVIN, STEVEN L. CECCIO, MARC PERLIN, ANISH TUTEJA, Univ of Michigan - Ann Arbor — As part an on-going research initiative to develop super-hydrophobic (SH) materials for high-speed naval applications, a team at the University of Michigan investigated SH materials for drag reduction in fully-developed turbulent flow. The SH materials were evaluated in a high-aspect ratio (width/height) channel flow facility capable of producing average flow speeds of 20 m/s, yielding a height (7 mm) based Reynolds number of 140,000. The SH materials examined were developed for large-scale application using various technologies including spraying, chemical etching, and mechanical abrasion. The materials were applied over a 100 mm (spanwise/width) by 1100 mm (streamwise/length) area. The drag measurement methods were pressure drop along the test surface over length 150H (1050 mm) and by means of the velocity profile via particle image velocimetry. The SH materials were investigated further to determine the effects of various flow conditions including low (vacuum) and high pressures. The drag reduction measurements were coupled with extensive topological evaluation of the materials to illustrate the importance of each aspect of the individual SH features, as well as the collective structure of the surface, leading to insight regarding the relevant characteristics of an SH material's ability to reduce skin-friction in fully-developed turbulent flow.

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