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Effect of Interface Curvature on Turbulent Skin-Friction Drag Reduction with Super-Hydrophobic Micro-Grooves RAYHANEH AKHAVAN, AMIRREZA RASTEGARI, University of Michigan, Ann Arbor — Effect of interface curvature on Drag Reduction (DR) with Super-Hydrophobic (SH) Micro-Grooves (MGs) was investigated by DNS with lattice Boltzmann methods. The liquid/gas interfaces in the SH MGs were modeled as curved, stationary, shear-free boundaries, with the interface shape determined from the Young-Laplace equation. The full range of interface protrusion angles, ranging from 0^o to -90^o, were investigated. DRs of 35% to 63% were realized in DNS, in turbulent channel flows at a $Re_{bulk} = 7200$ ($Re_{\tau_0} \approx 222$) with longitudinal MGs of size $14 \leq g^{+0} \leq 56$ & $g^{+0}/w^{+0} = 7$ on both walls, where g^{+0} and w^{+0} denote the widths and spacings of the MGs, in wall units of the base flow, respectively. The presence of interface curvature led to increases of 2.3% to 4.5% in the magnitude of DR, and drops of -3.5% to -13.5% in the slip velocity, at low protrusion angles, and drops of -2.2% to -12.5% in the magnitude of DR, and either drops of up to -16.5% or increases of up to 6% in the slip velocity, at high protrusion angles, compared to flat interfaces. In addition, the instantaneous pressure fluctuations on curved SH interfaces at low protrusion angles were significantly lower (by a factor of ~ 2) than those on flat interfaces.

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