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Skin-friction Drag Reduction in Turbulent Channel Flow with Idealized Superhydrophobic Walls AMIRREZA RATSEGARI, RAYHANEH AKHAVAN, The University of Michigan, Ann Arbor, MI 48109-2125 — Skin-friction drag reduction by super-hydrophobic (SH) surfaces was investigated using Lattice Boltzmann DNS in turbulent channel flow with SH longitudinal microgrooves on both walls. The liquid/gas interfaces in the SH microgrooves were modeled as flat, shear-free surfaces. Drag reductions (DR) ranging from 5% to 47% were observed for microgrooves of size $4 \leq g^{+0} = w^{+0} \leq 128$ in channels of bulk Reynolds number $Re_b = U_b h/\nu = 3600$ ($Re_{\tau_0} = u_{\tau_0} h/\nu \approx 230$), where g^{+0} and w^{+0} denote the widths of the slip and no-slip surfaces in base flow wall units. It is shown that in both laminar and turbulent flow, DR scales as $DR = U_s/U_b + \varepsilon$. In laminar flow, where DR is purely due to surface slip, $\varepsilon = 0$. In turbulent flow, ε remains negligible when the slip length is smaller than the thickness of the viscous sublayer. For $DR > 40\%$, where the effect of surface slip can be felt in the buffer layer, ε attains a small non-zero value. Analysis of turbulence statistics and turbulence kinetic energy budgets confirms that outside of a layer of size approximately one slip length from the walls, the turbulence dynamics proceeds as in regular channel flow with no-slip walls.

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