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Direct numerical simulation of turbulent flows over superhydrophobic surfaces with gas pockets using linearized boundary conditions[1] JONGMIN SEO, SANJEEB BOSE, RICARDO GARCIA-MAYORAL, ALI MANI, Stanford University — Superhydrophobic surfaces are shown to be effective for surface drag reduction under laminar regime by both experiments and simulations (see for example, Ou and Rothstein, Phys. Fluids 17:103606, 2005). However, such drag reduction for fully developed turbulent flow maintaining the Cassie-Baxter state remains an open problem due to high shear rates and flow unsteadiness of turbulent boundary layer. Our work aims to develop an understanding of mechanisms leading to interface breaking and loss of gas pockets due to interactions with turbulent boundary layers. We take advantage of direct numerical simulation of turbulence with slip and no-slip patterned boundary conditions mimicking the superhydrophobic surface. In addition, we capture the dynamics of gas-water interface, by deriving a proper linearized boundary condition taking into account the surface tension of the interface and kinematic matching of interface deformation and normal velocity conditions on the wall. We will show results from our simulations predicting the dynamical behavior of gas pocket interfaces over a wide range of dimensionless surface tensions.

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