Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

A numerical study of the effects of a superhydrophobic surface on near-wall turbulence characteristics[1] TAEYONG JUNG, HAECHEON CHOI, Seoul National University, JOHN KIM, University of California, Los Angeles — A superhydrophobic surface (SHS) in turbulent boundary layers can significantly affect near-wall turbulence, resulting in large skin-friction drag reduction. In this study, we performed direct numerical simulations of turbulent channel flow with SHS by solving both the main water flow and flow inside the air layer. The wall-parallel velocity and shear stress were maintained to be continuous across the interface between the air and water, while the interface was assumed to be flat. The Reynolds number considered was Re=5600 (based on the bulk velocity and channel height), and we varied the pitch length, gas fraction and air-layer thickness. It was found that these parameters had profound effects on the skin-friction drag, interfacial velocity and slip length. For example, with increasing the magnitudes of these parameters, the drag-reduction rate, interfacial velocity, and slip length increased. Also, near-wall vortical structures were significantly weakened, and the turbulence intensities were reduced near the SHS. At the SHS, streamwise and spanwise velocity (slip) fluctuations exist and their effects on the skin-friction drag will be discussed.

[1]Supported by NRF program (NRF-2012M2A8A4055647)

Taeyong Jung
Seoul National University

Date submitted: 29 Jul 2014 Electronic form version 1.4