Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Turbulent boundary layer measurements over permeable substrates CHRISTOPH EFSTATHIOU, MITUL LUHAR, University of Southern California — Turbulence flows of scientific and engineering interest are often bounded by permeable walls. Laser Doppler Velocimetry (LDV) measurements in turbulent boundary layers (upstream friction Reynolds number $Re_\tau = 1690 \pm 70$) over foams with porosity $\phi = 97.0 \pm 0.5\%$ and pore sizes ranging from $s = 0.29 \pm 0.02$mm to $s = 2.1 \pm 0.3$mm ($Re_k = 1.9 - 8.2$) showed substantial changes to the mean velocity and turbulence intensity profiles. A constant slip velocity ($\approx 0.3U_e$) near the interface was measured for all substrates, while a mean velocity deficit was found for $0.004 \leq y/\delta \leq 0.4$. For the largest pore sizes, an outer peak in stream-wise turbulence intensity was observed at $y/\delta \approx 0.1$. Spectral analysis showed structures of 1-6δ in stream-wise length, extending from the interface to $y/\delta = 0.4$ that are consistent with a Kelvin-Helmholtz type instability. The experiments described in this talk address how identical substrates of varying thickness affect flow structure at the limit where pore size and substrate thickness are comparable. Measurements are made in boundary layers over the same foams but with varying thickness $h/s = 6 - 17$. Particle Image Velocimetry measurements will also be presented.

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Date submitted: 31 Jul 2017 Electronic form version 1.4