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Nanowire experiments for cylinder drag in the transition regime of rarefied flows RUSTOM BHILADVALA, MINGWEI LI, THERESA MAYER, The Pennsylvania State University — The ability to measure drag forces on vibrating silicon and metal nanowires with different surface structure or chemistry will enable a convenient tabletop testbed to study the effect of boundary conditions in different regimes of rarefied gas flows. Silicon nanowires, with a thin native oxide coating, vibrating in pure dry nitrogen from high vacuum (2×10^{-10}atm) to atmospheric pressure have been used to measure drag on cylinders in rarefied flow. Knudsen numbers ($\boldsymbol{Kn}$) based on wire diameter are $0.2 < \boldsymbol{Kn} < 200$ (transition and free molecular flow regimes) in the pressure range $10^{-3} < \boldsymbol{P} < 1$ atmospheres, of importance to sensing applications. In the transition regime, analytical results [Yamamoto K. and Sera K., *Physics of Fluids*, **28**, 1286, (1985)] for drag on a cylinder using a matched Boltzmann-BGK (near-field) / Stokes-Oseen (far-field) solution show good agreement with the nanowire data, while free molecular and unsteady continuum solutions extrapolated into the transition region both predict higher damping. The data show departure from free molecular behavior beginning at $\boldsymbol{Kn}$ =10, if $\boldsymbol{Kn}$ is based on wire diameter.

Rustom Bhiladvala
The Pennsylvania State University

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