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Fluid flows around nanoelectromechanical resonators O. SVITELSKIY, V. SAUER, N. LIU, D. VICK, K.M. CHENG, M.R. FREEMAN, W.K. HIEBERT, University of Alberta Physics Department and National Institute for Nanotechnology, Edmonton AB Canada — To explore properties of fluids on a nanosize scale, we fabricated by a standard top down technique a series of nanoelectromechanical resonators (cantilevers and bridges) with widths w and thicknesses t from 100 to 500 nm; lengths l from 0.5 to 12 micron; and resonant frequencies f from 10 to 400 MHz. For the sake of purity of the experiment, the undercut in the widest (w=500 nm) devices was eliminated using the focused ion beam. To model the fluidic environment the devices were placed in the atmosphere of compressed gases (He, N_2, CO_2, Ar, H_2) at pressures from vacuum up to 20 MPa, and in liquid CO_2; their properties were studied by the real time stroboscopic optical interferometry. Thus, we fully explored the Newtonian and non-Newtonian flow damping models. Observing free molecular flow extending above atmospheric pressure, we find the fluid relaxation time model to be the best approximation throughout, but not beyond, the non-Newtonian regime, and both, vibrating spheres model and the model based on Knudsen number, to be valid in the viscous limit.

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