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Weighing Molecules with Carbon Nanotubes ABHIJAT GOYAL, TADIGADAPA SRINIVAS, Department of Electrical Engineering, The Pennsylvania State University, University Park, PA 16802, PETER EKLUND, Department of Physics, The Pennsylvania State University, University Park, PA 16802 — We have constructed a sensitive mass balance by coating a thin quartz transducer with debundled carbon nanotubes. The transducer operates in theshear mode at 29 MHz. Application of the nanotube film to the transducer downshifts the frequency as expected (mass loading), but we observe an unexpected increase in the Q-factor, i.e., the nanotube loading reduces the mechanical losses in the resonator. This nanomechanical resonator is also sensitive to mass loading of the internal pores of the nanotubes. By exposing the nanotube-coated resonator to various gases (e.g., inert gases, N2, SF6, etc.), we are able to easily observe the adsorption/desorption of the gases. At constant temperature and pressure, we observe an interesting Mˆˆ0.45 shift in the resonance frequency, where M is the molecular mass. The mass exponent we observe in these mass-balance experiments results is in good agreement with that published recently [1] on the collision-induced changes in the resistance and thermolectric power of thin nanotube films. The theory behind exponential mass dependence will be discussed and relates to the deformation of the nanotube wall and the residence time of the molecule on the tube wall.

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