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Micro-tweezers for studying vibrating carbon nanotubes ARTHUR BARNARD, MIAN ZHANG, Applied and Engineering Physics, Cornell University, MICHAL LIPSON, PAUL MCEUEN, Kavli Institute at Cornell for Nanoscience, Cornell University — Vibrational modes in suspended carbon nanotubes (CNTs) are incredibly soft, which makes them sensitive to small forces and a prime candidate as force sensors. This same property, combined with the stiffness of the CNT to stretching, makes them an unusual mechanical system characterized both by large thermally-activated fluctuations and strong nonlinear interactions between the resonance modes. How do these thermal fluctuations manifest themselves in the resonance behavior? To address this question, we developed an electrically-contacted micro-tweezer platform that is capable of lifting a pristine CNT off of its growth substrate, directly applying strain to the free-standing doubly-clamped CNT, and controlling its proximity to electrical gates and optical ring (microdisk) resonators for sensing. We measure both the mechanical resonance frequencies and quality factors of the CNT as a function of strain and temperature and compare these to recent predictions that account for the entropic effects of fluctuations on CNTs. In addition, we use these tweezers to couple a CNT to a high-Q optical resonator and demonstrate remarkably strong optomechanical coupling.

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