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Radial Elasticity Measurement of Single-walled Carbon Nanotubes by Atomic Force Microscopy[1] YUEHAI YANG, WENZHI LI, Department of Physics, Florida International University, CONDENSED MATTER PHYSICS TEAM — By applying well-calibrated tapping mode and contact mode AFM upon horizontally aligned SWCNTs grown directly on quartz substrates, we have obtained effective radial modulus (E_{radial}) of SWCNTs with diameters less than 2 nm. The measured E_{radial} decreases from 57 to 9 GPa with the increase of the SWCNT diameter from 0.92 to 1.91 nm. Our experimental result is consistent with the computational data obtained using the modified molecular structure mechanics model. We have also compared our measurements with the reported experimental results obtained on SWCNTs with diameters from 2 to 3 nm. Our measurements of large diameter SWCNTs (diameter close to 2nm) are in agreement with the reported data and modeling. However, our measurements of SWCNTs with smaller diameters deviate from this previous study. This has been explained by the compressibility of the substrate and the AFM tip. By employing Hertzian theory, we specifically exploit the components of deformation of the AFM tip-SWCNT-substrate system. Further calculation using our measured E_{radial} indicates that under the same normal force the deformation of our quartz-SWCNT-silicon tip system can be as much as 96% more than the deformation of the SWCNT compressed between a rigid substrate and an AFM tip.

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