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Measurements of adsorbate binding on individual suspended carbon nanotubes[1] HAO CHUN LEE, BORIS DZYUBENKO, JIM COY, DAVID COBDEN, OSCAR VILCHES, Department of Physics, University of Washington — By measuring the resonance frequency shift and the conductance change of vibrating suspended single-walled nanotubes at controlled temperature and pressure we can accurately detect the adsorption of gases including He, Ar, Kr, Xe, O2, and N2. The binding energy can then be determined from the low-coverage part of the adsorption isotherms. We find that the adsorption isotherms generally resemble those on graphite but with weaker binding energies, allowing access to behavior at lower two-dimensional (2D) chemical potential than on graphite. For He-4 the binding energy is reduced by as much as a factor of two. For Ar the binding energy on all nanotubes measured is in the range 700 - 800 K, about a third less than that on graphite. This enables us to investigate the 2D critical and triple points of Ar. Puzzlingly, we find that the devices fall into two classes: one with monolayer condensation at lower pressures and sharp 2D liquid-vapor transitions, the other with condensation at higher pressures and lacking sharp transitions even well below the 2D critical point. Possible factors that may be involved are finite-size effects, commensurability, absorption on the inside of nanotubes with holes in them, nanotube bundles containing more than one kind of nanotube and having surface grooves, and amorphous carbon or other contaminants on the surface, though no combination of these factors seems to provide a satisfactory explanation.

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Hao Chun Lee
Department of Physics, University of Washington

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