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Phase transitions on the surface of an individual carbon nanotube
ZENGHUI WANG, PETER MORSE, JIANG WEI, OSCAR VILCHES, DAVID COBDEN, University of Washington — Noble gases adsorbed on the surface of graphite exhibit two-dimensional (2D) analogs of 3D gas, liquid and solid phases, as well as commensurability phenomena related to the periodic substrate potential. Here, by employing individual suspended single-walled carbon nanotubes as vibrating mass balances with a sensitivity of a few atoms, we demonstrate that analogous phases occur on the cylindrical nanotube surface. As theoretically predicted we find that the binding of both Ar and Kr is weaker on the surface of a nanotube than on graphite, and we see evidence for formation of 1D atomic chains in grooves between two bundled nanotubes. We observe a 2D melting transition in Ar, and a commensurate phase preempting a liquid-vapor transition in Kr. The transitions are very sharp, indicating that they act as very uniform substrates. The experiments open up new regimes of statistical mechanics to experiment and offer excellent prospects of methodically investigating the interplay between adsorbates and substrate electrons. This work was supported by NSF grant number 0606078.

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