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Thermodynamics and Structure of One Monolayer of Simple Atoms Absorbed on Carbon Nanotube Bundles[1]

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Following the discovery and production of carbon nanotube bundles more than fifteen years ago, ideas about the properties of one-dimensional (1d) lines of atoms which could be formed in or on interstitials or grooves in the bundles were either revisited or generated for the first time. It is well known that in an infinite ideal 1d system there is no long range order and no phase coexistence, an argument first put out by Peierls and discussed in Landau and Lifschitz text. Nevertheless, the possibility of forming finite length 1d chains of atoms with gaseous, fluid, or solid properties, and no phase transitions, was intriguing. The fact that the outside surface of the bundles is a curved basal plane of graphite (graphene) is also interesting, because if films could be grown starting on grooves on the outside of the bundles those lines will grow, eventually, onto the graphene to form long and narrow quasi 2d systems to be compared to those adsorbed on flat basal plane graphite. In this experimental talk I will introduce the subject and some of the techniques used, emphasizing results on two of the simplest physisorbed atoms, ^{4}He and Ne. The He atom has been studied with DC and AC calorimetry, adsorption isotherms, and neutron diffraction, while Ne is currently being studied with thermodynamic measurements. Ideas from current and future experiments will conclude the presentation. The current work is being done in collaboration with Subramanian Ramachandran, Zenghui Wang and David Cobden.

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