Novel substrates for Helium adsorption: Graphane and Graphene–Fluoride*

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The discovery of fullerenes has stimulated extensive exploration of the resulting behavior of adsorbed films. Our study addresses the planar substrates graphene–fluoride (GF) and graphane (GH) in comparison to graphene. We present initial results concerning the potential energy, energy bands and low density behavior of ^{4}He and ^{3}He films on such different surfaces. For example, while graphene presents an adsorption potential that is qualitatively similar to that on graphite, GF and GH yield potentials with different symmetry, a number of adsorption sites double that on graphene/graphite and a larger corrugation for the adatom. In the case of GF, the lowest energy band width is similar to that on graphite but the He atom has a significantly larger effective mass and the adsorption energy is about three time that on graphite. Implications concerning the monolayer phase diagram of ^{4}He are explored with the exact path integral ground state method. A commensurate ordered state similar to the $\sqrt{3} \times \sqrt{3}$ R30^o state on graphite is found the be unstable both on GF and on GH. The ground states of submonolayer ^{4}He on both GF and GH are superfluids with a Bose Einstein condensate fraction of about 10%.

*Research supported by DOE and the Petroleum Research Fund of ACS

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