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Nanoscale Supersolidity in ^{4}He Adsorbed on a C_{20} Molecule
YONGKYUNG KWON, HYEONDEOK SHIN, SOOMIN SHIM, Div. of Quantum Phases and Devices, School of Physics, Konkuk University — We have studied adsorption of ^{4}He on the surface of a single C_{20} fullerene molecule using the path-integral Monte Carlo method. For a full incorporation of the surface corrugations on the molecular surface the ^{4}He-C_{20} interaction is treated with a sum of empirical helium-carbon interatomic pair potentials. Radial density distributions show layer-by-layer growth of ^{4}He, and a detailed analysis of energetics and angular density distributions reveals that the strongly-bound first layer, located at a distance of $\sim$ 4.9 Å from the center of the C_{20} molecule, is in various quantum states as the number of ^{4}He atoms changes. This layer, when completed with 32 atoms, is found to be a commensurate solid with an icosahedral lattice structure. We observe that near the completion of the first layer, mobile vacancies can be activated at a low temperature of $T = 0.31$ K, which results in a finite superfluid fraction as well as a crystalline order. This is a manifestation of vacancy-based supersolidity on a nanometer scale. Finally we analyze the effects of ^{3}He impurities on the superfluidity of the ^{4}He adlayer on a C_{20}.

Yongkyung Kwon
Div. of Quantum Phases and Devices, School of Physics, Konkuk University

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