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High temperature superfluidity in a commensurate phase of adsorbed ^{4}He RAINA OLSEN, Oak Ridge National Laboratory — It is well known that a substrate can have a significant effect on the phase diagram of adsorbed atoms. For instance, ^{4}He adsorbed on graphene forms a solid structure commensurate (aligned) with the substrate which has a density much smaller than the density of bulk solid ^{4}He. This occurs because the underlying periodic potential stabilizes the solid by opening an energy gap between the commensurate solid and the longest wavelength lattice excitations which would otherwise change the structure. Here we report calculations of superfluidity for ^{4}He in a periodic adsorption potential with variable lattice spacing, using a Bogoliubov transformation to calculate the energy spectrum of the excitations. We find a gap in energy between the superfluid state and the longest wavelength excitations. When this superfluid energy gap is large enough, there should be few excitations even at temperatures above the lambda point, where superfluidity is not observed in the bulk. This occurs only when the lattice spacing of the substrate corresponds to the lattice spacing of bulk solid ^{4}He. In contrast, when the substrate periodicity is too large, as is the case with graphene, a classical commensurate solid is expected instead. We discuss other possible materials.

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