Reentrant Solidification of First Layer of ^{4}He Film on Graphite

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According to many experimental observations and theoretical calculations, the first adsorbed layer of ^{3}He films on graphite surfaces is believed to solidify from the fluid phase to the $\sqrt{3}\times\sqrt{3}$ phase with increasing areal density at low temperatures, then forming some adsorption structures, and finally resulting in the incommensurate solid phase. A plausible adsorption structural phase diagram has been proposed.[1] ^{4}He films are also thought to exhibit a similar evolution. However, there is almost no experimental observation to discuss the evolution of the adsorption structure of ^{4}He films except the results of heat-capacity measurements at high temperatures.

I present the results of heat-capacity measurements of dilute ^{3}He-^{4}He mixture films; these measurements serve as a potential method to clarify the nature of a ^{4}He film. Similar measurements were performed for the second adsorbed layer and have revealed that the second adsorbed layer of ^{4}He does not solidify into the so-called "4/7 phase."[2] The results of this work strongly suggest that the first adsorbed layer of ^{4}He films solidifies only for a very narrow range of areal density near that of the $\sqrt{3}\times\sqrt{3}$ phase and also at higher areal densities. These behaviors are contrary to the expected evolution.

1. M. Morishita, *J. Phys. Chem. Solid* **66**, 1425 (2005) and references therein.
2. M. Morishita, *J. Low Temp. Phys.* **171**, 664 (2013).

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