Submonolayer Superfluidity of ^{4}He Films on Planar Gold

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To explore the nature of two-dimensional (2D) superfluidity arising from the Kosterlitz-Thouless (KT) transition, ^{4}He films have long been studied using various techniques. Further studies on pure 2D system are still required: In the previous reports[1,2] for the submonolayer films (the KT transition temperature $T_{\mathrm{KT}} < 1$ K) on Mylar, the dynamic KT theory incompletely succeeded in quantitatively agreement with temperature dependence of the superfluid density ρ_{s} and the dissipation ΔQ^{-1}. Thus we have studied submonolayer superfluidity of ^{4}He films on planar gold substrate using a quartz crystal microbalance (QCM). In this presentation, we report new data at various submonolayer coverages ($0.1 < T_{\mathrm{KT}} < 0.8$ K), which was measured at 60 MHz with a long term stability improved by temperature control of coaxial cables placed at room temperature. In low temperature region $T/T_{\mathrm{KT}} < 0.7$ at all measured coverages, T^3 dependence of 2D phonon in normal fluid density was observed. By the adoption of 2D phonon as the background superfluid density, it was also successful to explain the entire region of temperature dependence of ρ_{s} and ΔQ^{-1} by the dynamic KT theory.

1. G. Agnolet, D. F. McQueeney, and J. D. Reppy, Phys. Rev. B 39, 8934 (1989).
2. H. Yano, T. Joha, and N. Wada, Phys. Rev. B 60, 543 (1999).

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