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Measurements on the melting curve of ^{4}He down to 10 mK

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Recent discovery of a nonclassical rotational inertia in solid ^{4}He below about 0.2 K by Kim and Chan has initiated an intensive study on the properties of solid ^{4}He. As Kim and Chan have interpreted their observation as the evidence of supersolid behavior, we have decided to measure very accurately the melting curve of ^{4}He because, as the slope of the melting curve is proportional to the difference in the entropy of the liquid and solid phases, there should be an anomaly at the possible supersolid transition. We have measured the melting curve of ^{4}He with the accuracy of about 0.5 microbar with ^{4}He crystals which had various concentration of defects. All our samples showed only the expected T^4 dependence due to phonons without any sign of the supersolid transition in the temperature range of 80...400 mK. Below 80 mK we observed a small deviation from T^4 dependence which, however, cannot be attributed to the supersolid transition because our recent measurements with the cell containing liquid sample only suggest that this deviation is by the temperature variation of properties of BeCu membrane of our capacitive pressure gauge. In addition to our published data with ^{4}He of natural purity [Phys. Rev. Lett. 97, 165302 (2006)] we also report our recent measurements of the melting curve with ultra pure ^{4}He (0.3 ppb of ^{3}He impurities). In these measurements we followed optically the shape of the sample crystals which had very good quality.