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Leveling-Off of the Resistance at Low Temperatures in Granular In/InO_x Thin Films

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Abstract

We observed leveling-off of the resistance in granular In/InO_x thin films in the zero-temperature limit . The temperature T_b at which the leveling-off appears gets larger as the sheet resistance R_n increases. This is consistent with the concept that the leveling-off of the resistance is due to the dissipation of the bosonic phase and that the dissipation is enhanced as the resistance increases. The magnetic field dependence of the saturated resistance R_b at low temperatures fits the modified square-root cusp-like form $R_b/R_n=a\exp[-b(B/B_c-1)^{-1/2}]$ for the magnetic field in the range $B_c<B<B_f$, where B_c is the onset magnetic field of the resistance leveling-off. a and b are constants of order 1. For $B>B_f$ transport properties are described by the theory of the fermi insulator. From the results, we attribute the leveling-off to the dissipative quantum tunneling of vortices, which supports the models predicting the vortex-motion-induced insulating phase related with the concept like "dirty boson" [1] and "bose metal" [2].

[1] M. P. A. Fisher, Phys. Rev. Lett. **65**, 923 (1990).
[2] D. Das and S. Doniach, preprint cond-mat/9902308.

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