## On the scaling analyses of the flux pinning force density estimated for two types of $MgB_2$ specimens

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Magnetic hysteresis loops have been measured for polycrystalline and powder $MgB_2$ samples. Hysteresis loop width $\Delta M$ measured for polycrystalline sample was less than one order of magnitude smaller than that measured for powder sample. Magnetic field dependence of the critical current density estimated from the $\Delta M$ is essentially divided into three regions which may correspond to the characteristic vortex states discussed by Blatter *et al.*[1] The irreversibility field $B_{\rm irr}$ for each sample has been derived from so called Kramer plots using relevant magnetic field dependence. The scaling law of the reduced pinning force density was satisfactorily applied to the experimental results for each sample by using thus determined $B_{\rm irr}$. If we define the $B_{\rm irr}$ as a field at which the critical current density becomes $10^6\,({\rm A/m^2})$, such scaling law is apparently applicable to polycrystalline sample and not applicable to powder sample. Such discrepancy may come from that the $B_{\rm irr}$ by two types of definition belongs to different vortex state.

[1]G. Blatter, M.V. Feigel 'man, V.B. Geshkenbein, A.I. Larkin, and V.M. Vinokur, Rev. Mod. Phys. **66**, 1125 (1994).