Domination of Glassy and Fluctuation Behavior Over Thermal Activation in Vortex State in MgB_2 Thin Film

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We have investigated the mixed-state magnetoresistance of high quality c-axis-oriented MgB_2 thin film for magnetic field from 0.5 T to 5.0 T, applied normal to ab-plane. The temperature dependence of magnetoresistance was well described by vortex glass and fluctuation theories for different temperature regimes. We observed glassy exponent of $\nu(z-1) \sim 3$ and upper critical field of $H_{c2}(0) \sim 35$ T, which is consistent with previous data obtained from direct $H_{c2}(0)$ measurements. Interestingly, the thermally activated flux flow region was observed to be very narrow, suggesting that the pinning strength of this compound is very strong. This finding is closely related to the recent reports that the bulk pinning is dominant in MgB_2 and the critical current density of MgB_2 thin film is very high, comparable to that of cuprate superconductor. The present results further suggest that MgB_2 is beneficial to technical applications.

Keywords: MgB_2, thin film, magnetoresistance, vortex glass, fluctuation