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Universal Scaling Behavior of the Hall Resistivity in MgB_2 Superconductors

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In the mixed state of superconductors, the Hall resistivity (ρ_{xy}) and the longitudinal resistivity (ρ_{xx}) are resulted from the same origin of the vortex motion; thus, these quantities can be correlated each other. Since the report of the Hall scaling theory in 1993, many experiments relating this scaling relation have been carried out in high-Tc superconductors but this theory has not been demonstrated experimentally because most high-Tc superconductors show the Hall sign reversal in the mixed-state. The Hall resistivity and the longitudinal resistivity in superconducting MgB_2 thin films have been investigated as a function of the magnetic field over a wide range of current densities from 10^2 to 10^4 A/cm^2. We observe a universal Hall scaling behavior with a constant exponent β of 2.0 ± 0.1 in $\rho_{xy} = A\rho_{xy}^{\beta}$, which is independent of the magnetic field, the temperature, and the current density. This result can be interpreted well within the context of recent theories.

keywords : Hall effect, Scaling behavior, MgB_2 Superconductor, thin film