

INVITED

Origin of High Critical Current Density in MgB₂ Thin Films

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We have fabricated high-quality c-axis-oriented MgB₂ thin films by using a pulsed laser deposition technique. The thin films grown on (1 1 0 2) Al₂O₃ substrates show an onset transition temperature of 39.2 K with a sharp transition width of ~ 0.15 K. X-ray diffraction patterns indicate a c-axis-oriented crystal structure perpendicular to the substrate surface. We observed high critical current densities (J_c) of ~ 16 MA/cm² at 15 K and under self-field, which is comparable to or exceeds those of cuprate high-temperature superconductors. The extrapolation J_c at 5 K was estimated to be ~ 40 MA/cm², which is the highest record for MgB₂ compounds. At a magnetic field of 5 T, the J_c of ~ 0.1 MA/cm² was detected at 15 K, suggesting that this compound is very promising candidate for the practical applications at high temperature with lower power consumption. As a possible explanation for the high current-carrying capability, the vortex-glass phase will be discussed.

keywords : MgB₂, thin film, critical current density