Magneto-Optical Imaging of Superconducting MgB2 Thin Films

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Abstract

The high-temperature superconductor MgB2 has been studied by static and time-resolved magneto-optical imaging as a function of applied magnetic field and AC current. The averaged cross-sectional field and current profiles show a good overall agreement with the critical-state model for the field-dependent measurements. Deviations can be attributed to the irregular finger-like flux penetration typical for MgB2. From the phase dependent measurements both shielding current and transport current profiles are obtained, which are quantitatively in good agreement with theory. The flux front growth in the MgB2 thin film has been studied with respect to static and dynamic driving forces and analyzed in terms of the directed percolation depinning (DPD) model. The calculated exponents for static (a=0.58 $\pm$ 0.09) and dynamic (a= 0.78 $\pm$ 0.16) measurements are in agreement with the theory. The difference in the values emphasizes the distinct effect of the driving force on the flux front growth. Based on these results MgB2 can be placed in the same universality class as YBCO and Nb.