THERMALLY ASSISTED FLUX FLOW IN MgB_2 : STRONG MAGNETIC FIELD DEPENDENCE OF THE ACTIVATION ENERGY

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The origin of the resistive transition broadening for MgB_2 thin films was investigated. Thermally activated flux flow is found to be responsible for the resistivity contribution in the vicinity of T_c. The origin of the observed extraordinary strong magnetic field dependence of the activation energy of the flux motion is discussed.

1. Introduction

The discovery of superconductivity in MgB_2, a material with a hexagonal layered crystal structure and the highest critical temperature, T_c = 39 K, found for an intermetallic superconducting compound [1], raised questions about its transport properties. This strong type-II superconductor with a large Ginzburg-Landau parameter $\kappa \approx 26$, a magnetic penetration length $\lambda(0)$ = 140-180 nm [2] and short coherence lengths, ξ_c (0) = 2.3 nm, ξ_{ab} (0) = 6.8 nm [3] has a rather high critical current density up to $j_c \sim 1.6\text{x}10^7$ A/cm^2 at 15 K [4]. The latter finding makes the novel superconductor very attractive for technical applications. On the other hand, a broadening of the superconducting transition, as found in resistivity measurements, would severely limit the applicability of MgB_2. Therefore, it is important to study the mechanism which causes this broadening.

Superconducting transition broadening in the presence of a magnetic field can have different reasons. It may be caused by an inhomogeneous microstructure of polycrystalline samples with additional phases having different T_c. Moreover, fluctuations play an important role in the vicinity of the superconducting transition especially for low-dimensional and layered