21 世紀 COE & 極限量子科学研究センター
ジョイントセミナー

Superconductivity of MgB_2 thin film and single crystal

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場所：理学部 H 棟 6 階中セミナー室 (H601)

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概要： One of the most peculiar properties of superconductor MgB_2 is two-gap nature of its superconductivity. First principle calculations of MgB_2 showed the existence of two distinct groups of energy gaps that originate from two dimensional Sigma-band and three dimensional Phi-band. By producing the high-quality c-axis-oriented magnesium diboride (MgB_2) thin film and well shaped MgB_2 single crystals we could study the details of two gap superconductivity.

For the MgB_2 thin film, we studied the I-V and M-H relations and found the very high critical current density Jc, with values of ~ 4 x 10^7 A/cm^2 at 5 K for zero-field. This suggested that MgB_2 thin film could be a very promising candidate for practical applications such as the superconducting microelectronic device. However, the critical current was found to be seriously limited by a phenomenon called the vortex avalanche. Details of the magneto optical observation of the penetrated magnetic flux with various conditions will be discussed.

For the MgB_2 single crystals, the upper and lower critical field were studied and compared with the prediction of two-gap superconductivity. We also found the pronounced peak effect in the critical current near at the upper critical field. We also observed the fully disordered (spinodal) and fully ordered (Bragg glass) vortex lattice in these single crystals by using fast transport measurement technique and by measuring I_c at variously prepared vortex states.

[1] "MgB_2 superconducting thin films with a transition temperature of 39 Kelvin." Science **292** 1521-1523 (2001)

[2]"Dendritic magnetic avalanches in carbon-free MgB2 thin films with and without a deposited Au layer." Applied Physics Letters **87**, 152501 (2005)

[3] "Comparison of temperature and angular dependence of the upper critical field in Mg1-xAlxB2 single crystals in dirty-limit two-gap theory. " Phys. Rev. B **73**(6), 064520 (2006)

[4]"Onset of Dendritic Flux Avalanches in Superconducting Films." Phys. Rev. Lett. **97**, 077002 (2006)