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Flux Pinning and Critical Current Density in TiO_2-doped MgB_2 Superconductor

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MgB_2 by doping TiO_2 was synthesized by the in-situ solid state reaction to study the effects of TiO_2 dopant on the flux pinning behavior of MgB_2 superconductor. From the field-cooled and the zero-field-cooled temperature dependencies of magnetization, the realm of vortex-glass and vortex-liquid states of TiO_2-doped MgB_2 were determined in the H-T diagram (the temperature dependence of upper critical magnetic field and irreversibility line). The critical current density was estimated from the width of hysteresis loops in the frame work of Bean model [1] at different temperatures. The obtained results manifest that nano-scale TiO_2 inclusions serve as the effective pinning centers and lead to the enhanced upper critical field and critical current density. It is concluded that the grain − boundary pinning mechanism is realized in TiO_2-doped MgB_2 superconductor.

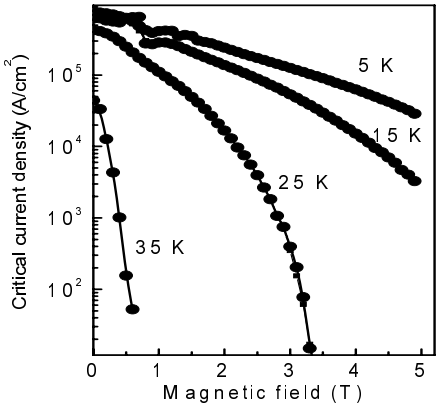

Fig. 1. Critical current density for TiO_2-doped MgB_2 superconductor at different temperatures.

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BR04

Gapless behavior in *d*-wave Superconductors Due to Coexisting Antiferromagnetism

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It is well-known that antiferromagnetism and superconductivity in the high-temperature superconductors has an intimate relationship; It is also well-known that the magnetic penetration depth measurement on the electron-doped high-temperature superconductors (e.g., $Pr_{2-x}Ce_xCuO_{4-y}$ and $La_{2-x}Ce_xCuO_{4-y}$) suggests that the superconductors have a nodeless superconducting order parameter [1], which is in contrast with the case in the hole-doped high-temperature superconductors. In our study, we find that a weak antiferromagnetic order coexisting with a nodal *d*-wave superconducting order can result in a magnetic penetration depth, and also a specific heat measurements that suggest a nodeless superconducting order. Therefore, such measurements do not rule out the possibility of a *d*-wave superconducting order in the electron-doped superconductors.

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REFERENCES

[1] See, e.g., M. Kim *et al.*, Phys. Rev. Lett. 91, 87001 (2003).