Anisotropic Pinning and Vortex State in Highly Lead-doped $Bi_{2-x}Pb_xSr_2CaCu_2O_{8+y}$

Tsuyoshi Tamegai, Kenji Itaka, Hiroki Taoka, and Takasada Shibauchi

Department of Applied Physics, The University of Tokyo,

7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan

Abstract

In highly lead-doped $Bi_{2-x}Pb_xSr_2CaCu_2O_{8+y}$ (BPSCCO) having planar defects (PDs), considerable enhancement of the irreversibility line and the critical current density (J_c) isreported [I. Chong*et al.*, Science **276**, 770(1997)]. We made a systematic angular dependent magnetic measurements in BPSCCO with H tilted in the plane either parallel or perpendicular to PDs using micro-Hall-probes. At higher temperatures, an anomalous increase in the magnetization (M) was found only when H is applied parallel to PDs, giving evidence for the presence of directional pinning by PDs. More dramatic effect was confirmed by direct measurements of the anisotropy in J_c using magneto-optical method. At 40 K, J_c parallel to PDs is three times larger than that perpendicular them, and the anisotropy has tendency to increase further at higher temperatures. In addition to this, several anomalies in $M-H$ curves were found when H is applied with a large angle from c-axis. At lower temperatures, M at low field region is strongly suppressed and the shape of $M-H$ curves become similar to those in pure BSCCO crystals when the angle between H and c-axis is larger than 70 degree. In the same situation, an additional anomaly was found at lower field than the peak field, which might have the same origin as anomalies found in pure BSCCO crystals possibly due to the instability of uniformly tilted vortex lattice.