Intrinsic Tunneling Spectroscopy for Pb-Substituted BSCCO

Hitoshi Kambara, Itsuhiro Kakeya, and Minoru Suzuki

Department of Electronic Science and Engineering, Kyoto University, Kyoto daigaku Katsura, Nishikyo-ku, Kyoto 6158510, Japan

It is known that the c-axis critical current density J_c of BSCCO is significantly suppressed in the underdoped region. [1] On the other hand, partial substitution of Bi with Pb in BSCCO increases J_c even then temperature dependence of the c-axis resistivity exhibits intense upturn like underdoped BSCCO. We measured intrinsic tunneling spectroscopy (ITS) in mesa structures ($S = 1 \times 1\mu\mathrm{m}^2$) of $Bi_{1.9}Pb_{0.1}Sr_2CaCu_2O_{8+\delta}$ (PbBi2212) and Hall effect in PbBi2212 cleaved thin crystals. The ITS measurements reveal large superconducting gap of $2\Delta \sim 70$meV (at 10 K). This result corresponds to a typical value of an underdoped Bi2212. The Hall coefficient at 300 K was obtained as $R_{\mathrm{H}} \sim 2 \times 10^{-3}\mathrm{cm}^3\mathrm{C}^{-1}$. The doping level p of the PbBi2212 is estimated through the comparison with LSCO as 0.13, which is in the underdoped region. It is found that J_c of PbBi2212 is less deviated from Ambegaokar Baratoff critical current density $J_c^{AB} \approx \pi\Delta/2eR_NS$ than the case of underdoped Bi2212. Here R_N is the normal tunneling resistance obtained from high voltage extrapolation of the current-voltage characteristics. It is interpreted that the Pb substitution makes the tunnel barrier lower, resulting in a reduced anisotropy in k-space and a high superconducting pair density even with a lower doping.

[1]Minoru Suzuki, Takashi Hamatani, Yoshiharu Yamada, Kenkichi Anagawa and Takao Watanabe, J. Phys. Conf. Ser. **150**, 052252 (2009).