Tunnel Spectroscopy and microstructre on $Bi_2Sr_2Ca_{1-x}Y_xCu_2O_{8+y}$ crystals

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Although various subjects of the superconductor-insulator transition (SIT) have been studied more than 20 years old, there are many open questions.[1] We reported that the relation between microscopic structure and transport properties for $Bi_2Sr_2Ca_{1-x}Y_xCu_2O_{8+y}$ (Y-Bi2212) crystals.[2] There is the theoretical estimate that the electrons form Cooper pairs even in the insulating state. In this study we report tunneling experiments on Y-Bi2212 crystals and experimental results are discussed with microscopic structures. Y-Bi2212 crystals were grown using a Bi_2O_3-excess self-flux method. Tunneling spectra were measured for Y-Bi2212 crystal-SiO-Ag planar junctions. The ratios x of [Y]/[Y+Ca] of the nominal composition on Y-Bi2212 crystals used for measurements were 0, 0.01, 0.05, 0.1, 0.11 and 0.12. Note that the measured Y content is larger than the nominal one. For superconducting samples the V-shaped gap structure and zero bias conductance peaks (ZBCP) were observed. While, neither superconducting gap nor ZBCP was observed for insulating samples. These results suggest that Cooper pairs break up on the insulating side of SIT. In our spectra there were also several characteristic behaviors. They may be related to inhomogeneous structures because the inhomogeneous distribution of Y was found by using a scanning transmission electron microscope in our previous work[2].

[1] A.M. Goldman, Int. J. Mod. Phys. B **24**, 4081 (2010).
[2] S. Komaki *et al.*, J. Phys.:Conferences Series **150**, 052117 (2009).