Suppression of the Superconductivity by Si^+ Implantation in $Bi_2Sr_2CaCu_2O_{8+x}$ Single Crystals : a Study Using Intrinsic Josephson Junctions

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Small mesa structure containing a few intrinsic Josephson junctions was fabricated on the surface of Si^+-implanted $Bi_2Sr_2CaCu_2O_{8+x}$ (Bi2212) single crystals with different Si^+ dosage using photolithography and ion-beam etching technique. We investigated the effect of Si^+ implantation with varying dosage on the superconducting gap in the CuO_2 double layers and the resulting tunneling critical current density of the intrinsic Jospehson junctions. To that end, we measured the temperature dependence of resistance and current-voltage (*I-V*) characteristics along the *c*-axis by three- and four- terminal methods. The multiple quasiparticle tunneling branches with large hysteresis were observed in the *I-V* curves at ~14 K. For given Si^+ dosage the tunneling critical current density J_c was more depressed for junctions located closer to the mesa surface. At the same time, the voltage interval between the neighboring quasiparticle branches, or equivalently the superconducting gap, decreased with increasing the Si^+ dosage.

Keywords: intrinsic Josephson junctions, Si^+ implantion, suppression of superconductivity
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