

Andreev Reflection in the c -axis Transport of $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+x}$ Single Crystals near T_c and Search for the Preformed-pair State

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We observed an enhancement of the c -axis differential conductance (dI/dV) around the zero-bias in $\text{Au}/\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+x}$ (Bi2212) junctions near the superconducting transition temperature T_c . We attribute the conductance enhancement to the Andreev reflection between the surface Cu-O bilayer with suppressed superconductivity and the superconducting Cu-O bilayer below the surface Cu-O bilayer. The continuous evolution from depression to an enhancement of the zero-bias differential conductance, as the temperature approaches T_c from below, points to weakening of the barrier strength of the non-superconducting layer between adjacent Cu-O bilayers, which acts as a strong insulating barrier at temperatures well below T_c . Using the generalized BTK formalism, the temperature dependence of the measured dI/dV curves could be reproduced numerically, at least in a qualitative level.

In junctions prepared on slightly overdoped Bi2212 crystals we observed that the conductance enhancement persisted up to a few degrees above T_c . However, no conductance enhancement was observed above T_c in underdoped crystals, although recently proposed theoretical consideration suggests an even wider temperature range of enhanced zero-bias conductance in the underdoped than in the overdoped regime. This seems to provide skeptic perspective about the existence of the phase-incoherent preformed pairs in the pseudogap state.

keywords : Andreev reflection, preformed pairs, pseudogap, $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+x}$ single crystals, intrinsic junctions