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HTS SNS JOSEPHSON JUNCTIONS WITH NOUBLE METAL INTERLAYER

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The experimental investigations of the properties of SNS HTS Josephson junctions[1] have shown that the excess current is comparable with the critical one $I_c$ is often observed on their current-voltage characteristics (CVC) even if the width of the junction is smaller than the Josephson penetration depth. According to the modern theoretical models the excess current in SNS junctions is a direct consequence of the Andreev reflection of the quasiparticles from the SN interfaces. Since the Andreev reflection is a two particle process, this probability vanished proportionally to $D^2$, where $D$ is the transparency of the SN boundaries. In the most favorable case, when the normal metal directly contacts to CuO ab-planes, this transparency $D_x < 0.1$. However in step edge SNS devices [2] one of the interfaces is perpendicular to the C axis of the HTS electrode and therefore has small transparency $D_x < 10^{-3}$. In this case $I_c = D_x D_y$, while $I_{ex} = D_x^2$ resulting in $I_{ex}/I_c = D_x/D_y < 1$.

The situation changes if one assumes that there are microshorts in the small-transparent interface and considers the boundary as a series of constrictions [3]. Each constriction provides a direct contact between normal metal and CuO planes in S-electrode and as a result has larger transparency. In this case SNS junction both $I_c$ and $I_{ex}$ are proportional to $D_{ex}^2$ and $I_{ex}/I_c = 1$. Thus small ballistic SNS junctions are suitable starting point to discuss more complicated models for HTS SNS junctions.

In the present paper the properties of ballistic constriction N-O-S-N and S-S-N types with disordered electrodes are analysed theoretically.

References
INELASTIC RESONANT TUNNELING IN S-Sm-S HIGH-Tc JUNCTIONS

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Inelastic resonant tunneling via a small number (n=2) of localized states (LS) provide quasiparticle current transport in variety of types high Tc Josephson junctions [1-3]. In frame of this point of view it is possible to explain a nonlinearity and an excess current usual in high-Tc Josephson junctions. The voltage and the temperature dependencies of junction conductance are in good quantitative agreement with the theory [2,3].

Nevertheless, the existing theory [4] describes inelastic resonant tunneling between normal electrodes across amorphous barrier. These effect result in sequential electron hopping through LS. The role of diverging superconducting density of states in superconducting electrodes did not taking into account [4].

In this paper the voltage dependent conductivity in S-Sm-S structure is calculated taking into account BCS density of states of superconducting electrodes. The difference with the existing theory in low voltage limit is demonstrated. At high voltage limit our results coincide with calculations for N-Sm-N structure [4].

References
Josephson junctions on the base of Bi$_2$Sr$_2$CaCu$_2$O$_{8+x}$ thin films

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Several kinds of Josephson junctions (JJ) based on thin films of the highly anisotropic BSCCO-2212 material will be presented. Additionally, to the fabricated a-grain boundary JJs including biepitaxial and bicrystalline we succeeded in the preparation of intrinsically stacked JJs basing on the intrinsic coupling between the CuO$_2$ planes in BSCCO material [1]. Bicrystalline JJs were prepared by PLD of BSCCO [2] onto commercially available SrTiO$_3$ bicrystal substrates followed by standard photolithographic procedures and ion milling of microbridges. Biepitaxial BSCCO films were prepared by covering a half of the single crystal SrTiO$_3$ substrate with a MgO seed layer and depositing the superconducting film onto this surface. The MgO seed layer causes a 45° rotation of the a-b plane relative to the pure substrate area [3]. The fabricated JJs worked up to temperatures of about 75 K. They showed microwave response in the current voltage characteristics (IVCs) and modulation of the critical current with applied magnetic flux. dc-SQUIDs were prepared to investigate the temperature dependence of the BSCCO magnetic penetration depth [4,5].

Using an advanced technology we succeeded in fabrication of intrinsically stacked JJs [6,7]. We will present the IVCs of such junctions for the BSCCO material and their response in external magnetic field. The IVCs can be described as a sum IVC of many resistively shunted JJs [8].

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