

A current density dependence on phase differences in layered superconducting structures of SISIS type

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The explored layered superconducting structure contains three massive superconductors separated by two thin insulator films. Without loss of generality we may consider that the superconductors are different. An insulator film is mathematically expressed via the Dirac delta function [1]. An order parameter and a current density depend on an applicate, because we have a one dimensional problem.

According to the superconductivity theory every physical quantity can be calculated using the Green function method [2]. The Green functions satisfy the closed system of linear differential equations. The mentioned equations have the second derivative in the configuration representation. Using the Fourier transform we have constructed the closed system of linear matrix differential equations in the t-representation [3]. The obtained equations have only the first derivative. Since a momentum is close to the Fermi momentum our calculations become rather simplified. Solving the linear matrix differential equations in the t-representation we have introduced the undefined integration constants. These constants can be defined through application of Green function continuity. This means that we need to have a boundary condition. An order parameter as a complex function is usually defined by magnitude and phase. The model with a piecewise constant order parameter allows to suppose that the outside superconductors have equal order parameter magnitudes and unequal order parameter phases. The inside superconductor has a zero order parameter phase. The order parameter magnitude of the inside superconductor is not necessary equal to the order parameter magnitudes of the outside superconductors.

Substituting the obtained integration constants into the Green functions we have obtained the current density dependence on an applicate. Calculating the current density on the junction we have obtained the current density expression as a phase difference function.

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