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Current switches based on asymmetric ferromagnet-superconductor nanostructures with allowance for a triplet channel in an external magnetic field

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Abstract

We analyze the properties of asymmetric three-layer (FSF and FFS) heterostructures consisting of a ferromagnet (F) and a superconductor (S) in an external magnetic field. The asymmetry of FS systems can be due to the difference in the parameters characterizing the F layers (in particular, noncollinearity of the magnetizations of the ferromagnets, leading to the generation of the long-range triplet component of the superconducting condensate). We consider the case of strong scattering of conduction electrons from non-magnetic impurities (the so-called dirty limit), for which we derive the equations for the pair amplitude and corresponding boundary conditions to these equations, which are valid in the presence of an external magnetic field. We discuss possible applications of these FS heterostructures as spin switches on the basis of analysis of their phase diagrams, and we give recommendations for determining the optimal parameters required for their stable operation. The occurrence of peculiar re-entrant superconductivity in the FFS systems on an increase of the external magnetic field is predicted.

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