

Current-voltage Characteristics of SIFS Josephson Junctions

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We present a quantitative study of the current-voltage characteristics (CVC) of diffusive superconductor/insulator/ferromagnet/superconductor (SIFS) tunnel Josephson junctions. In order to obtain the CVC we calculate the density of states (DOS) in the F/S bilayer for arbitrary length of the ferromagnetic layer, using quasiclassical theory. For a ferromagnetic layer thickness larger than the characteristic penetration depth of the superconducting condensate into the F layer, we find an analytical expression which agrees with the DOS obtained from a self-consistent numerical method. We discuss general properties of the DOS and its dependence on the parameters of the ferromagnetic layer. In particular we focus our analysis on the DOS oscillations at the Fermi energy. Using the numerically obtained DOS we calculate the corresponding CVC and discuss their properties. Finally, we use CVC to calculate the macroscopic quantum tunneling (MQT) escape rate for the current biased SIFS junctions.