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Gate Tunable Supercurrent in Nb-Bi2Te2.3Se0.7-Nb topological Josephson junctions

The field-effect transistor is the basis technology of semiconductor nanoscale devices1. It was believed that a field-effect transistor (FET) is impossible in superconductors due to the high charge density and since the electric field decays exponentially from the surface. In recent papers show that superconductivity in various systems can be suppressed by the application of gate voltages. In order to describe the phenomenon that leads to the critical current suppression in metallic superconducting structures, a field-effect hypothesis has been formulated, stating that an electric field can penetrate the metallic superconductor. The existence of such an effect would imply the incompleteness of the underlying theory, and hence indicate an important gap in the general comprehension of superconductors.
In this paper, we study symmetric full suppression of critical current for very low applied critical gate voltages VG ± 0.6 V. in ballistic superconductor-topological insulator-superconductor (S/TI/S) Josephson junctions. Our analysis demonstrated that this effect is caused by injection of quasiparticles into a device. To prove our hypothesis, we have reproduced the most distinctive features of previous experiments using titanium and niobium Diem bridges. We also investigated several types of silicon in our experiments. Importantly, we do not claim this work to nullify the results of previous works.

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