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Proximity phenomena in heterostructures consisting of superconductor –ferromagnet

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Current demands on computing technologies and storage units, such as speed, low power consumption, and high memory density, are leading to the development of new technologies. One promising area is superconducting cryoelectronics, including qubits, superconducting spintronics, or memory cells. Devices combining two antagonistic phenomena –superconductivity and ferromagnetism –show great potential. Various effects can occur at their interfaces, such as the formation of π-junctions or triplet Cooper pairs, which enable the generation and transport of spin-polarized current. In this work, we report on the fabrication and electrical characterization of superconductor/ferromagnet/superconductor (S/F/S) nanostructures based on NbN superconducting electrodes and ferromagnetic Ni or Co interlayers. Transport measurements revealed that Co layers (20 and 50 nm thick) did not become superconducting via the proximity effect, while structures with similarly thick Ni layers exhibited zero resistance after the superconducting transition. This behavior indicates the possible formation of triplet Cooper pairs, further supported by I-V measurements showing a nearly field-independent critical current, which is characteristic for triplet superconductivity.

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