Fabrication and Transport Properties of Josephson S/F/S Junctions

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Abstract. Josephson superconductor-ferromagnet junctions offer a promising platform for advancements in cryoelectronics, including applications such as qubits, superconducting spintronics, and memory units. This is due to the transport of a supercurrent through the ferromagnet, which can generate a spin-polarized supercurrent. However, studying these phenomena requires the fabrications of appropriate structures. Therefore, our research focuses on the fabrication and characterization of superconductor/ferromagnet/superconductor (S/F/S) structures with both micrometer and submicrometer dimensions, using NbN as a superconductor and NiCu, Ni and Co as ferromagnetic materials. To achieve high-quality layers with clean interfaces, the S/F/S trilayers were prepared in-situ by pulsed laser deposition.

Then, micrometer-scale structures were fabricated using standard optical lithography methods. However, the dimensions of the structure are limited by the resolution of this process. Therefore, standard optical lithography does not allow for the preparation of submicrometer-scale structures. To overcome this limitation, we employed focused ion beam (FIB) for the fabrication of submicrometer and nanometer structures. Subsequently, the transport properties of the fabricated S/F/S structures were investigated using a Physical Property Measurement System (PPMS).

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