Interplay of proximity effects in Superconductor/Ferromagnet heterostructures

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Proximity effects in superconductor/ferromagnet thin film heterostructures are a highly topical issue due to their potential application in superconducting spin valves or fluxonic devices [1, 2]. Physical properties can be controlled by an applied magnetic field and emerge for example as stray-field generated domain-superconductivity or spin-triplet correlations. Our goal is to investigate their interplay and tunability by an external magnetic field. We use a heterostructure system of Nb/FePd with varying strength of magnetocrystalline anisotropy and a lateral domain structure, grown by molecular beam epitaxy.

On the one hand, macroscopic magnetoelectric transport measurements reveal a confined superconducting state due to the stray fields of $L1_0$-ordered FePd. On the other hand, direct proximity effects at the Nb/FePd interface with a non-collinear magnetization presumably lead to the generation of spin-triplet Cooper pair components with long penetration depth within the ferromagnetic layer [3]. Polarized Grazing-Incidence Small-Angle Neutron Scattering (GISANS) probe exchange mechanisms on the microscopic scale and reveal a change in the ferromagnetic domain pattern by an onset of domain-wall-superconductivity. This mechanism cannot be revealed by macroscopic magnetization measurements, which makes GISANS the method of choice for detecting inverse superconducting proximity effects.

References

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