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Interface effects in superconductor-ferromagnet heterostructures

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At interfaces of ferromagnetic (F) and superconducting (S) layers proximity effects can lead to significant changes in their order parameters. When the magnetic state of the F-layer is inhomogeneous, magnetic domains can spatially confine the superconductivity in an adjacent S-layer [1]. Our goal is to obtain an understanding of such proximity effects between the two layers. Furthermore, the lateral magnetic depth profile near the S/F-interface and the dependence of the superconductivity on the magnetic configuration still have to be scrutinized.

As a prototype system we use thin film heterostructures of ferromagnetic FePd with a superconducting Nb toplayer. The heterostructures are grown using molecular beam epitaxy. To obtain FePd in the L10-ordered phase with a magnetic anisotropy perpendicular to the surface plane, growth temperatures between 230℃-350℃ are used [2].

Resistivity measurements as a function of an external magnetic field H reveal the effect of the magnetic stray fields on the superconducting state. When the superposition of the stray fields and H reaches its minimum, superconductivity nucleates over the domain with magnetization direction opposite to H. To investigate the depth profile of the lateral magnetization fluctuation Grazing-Incidence Small-Angle Neutron Scattering (GISANS) is performed near the superconducting critical temperature.
[1] Z. Yang *et al.*, Nat. Mater. **3**, 793-798 (2004).
[2] V. Gehanno *et al.*, Phys. Rev. B, **55**, 12552 (1997).

Primary author: Ms STELLHORN, Annika (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS-2) and Peter Grünberg Institut (PGI-4), JARA-FIT, Germany)

Co-authors: Mr SARKAR, Anirban (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS-2) and Peter Grünberg Institut (PGI-4), JARA-FIT, Germany); Mr KENTZINGER, Emmanuel (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS-2) and Peter Grünberg Institut (PGI-4), JARA-FIT, Germany); Mr WASCK, Markus (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS-2) and Peter Grünberg Institut (PGI-4), JARA-FIT, Germany); Mr SCHÖFFMANN, Patrick (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science at Heinz Maier-Leibnitz Zentrum, Germany); Mr FU, Zhendong (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science at Heinz Maier-Leibnitz Zentrum, Germany); Mr PIPICH, Vitaliy (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science at Heinz Maier-Leibnitz Zentrum, Germany); Mr SYED MOHD, Amir (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science at Heinz Maier-Leibnitz Zentrum, Germany); Mr MATTAUCH, Stefan (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science at Heinz Maier-Leibnitz Zentrum, Germany); Mr BRÜCKEL, Thomas (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS-2) and Peter Grünberg Institut (PGI-4), JARA-FIT, Germany)

Presenter: Ms STELLHORN, Annika (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS-2) and Peter Grünberg Institut (PGI-4), JARA-FIT, Germany)

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