

# Tunable Phase Diagram in the Superconductor-Ferromagnet Hybrid

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The influence of an inhomogeneous magnetic field generated by the magnetic domains on the properties of superconductor in the superconductor-ferromagnet hybrids has become recently a subject of intense research. In particular, the exotic dependence of the superconducting transition temperature on the magnetic field,  $T_c(H)$ , has been observed experimentally, and later described theoretically, in the hybrids in which the superconductor and ferromagnet are spatially separated. The theory predicts strong dependence of this effect on the magnetic domain size [1], but these predictions have not been fully tested yet.

In this talk I will describe the experiment which allows us to test in detail the theoretical predictions. We use the superconductor-ferromagnet bilayer which consists of niobium layer, 200Å thick, as the superconductor, and Co/Pt superlattice with perpendicular magnetic anisotropy as a ferromagnet. We manipulate the domain size by the angle-dependent demagnetization procedure, and observe a continuous tuning of the phase transition line, from a conventional linear  $T_c(H)$  with a single maximum at  $H=0$ , to an reentrant behavior with multiple  $T_c$  peaks. While most of the observations confirm the theory, some disagreement is also found. In addition, we study the influence of domain sizes on the vortex matter, and find an unusual nonmonotonic dependence of the critical current density on the magnetic field, which results from the enhancement of the flux flow in the presence of domains.

[1] A. Yu. Aladyshkin et al., Phys. Rev. B 68, 184508 (2003).

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