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Tuning the phase diagram and vortex pinning in superconductor-ferromagnet bilayers via angled demagnetization

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We study the influence of the stray fields induced by the magnetic domain on the properties of superconducting films in superconductor-ferromagnet (S/F) bilayers, in which the S layer is Nb, the F layer is the Co/Pd multilayer with perpendicular magnetic anisotropy, and the insulating buffer layer in-between eliminates proximity effect. We use demagnetization procedure with the magnetic field H at an angle to the sample surface to predefine the domain patterns with variable domain widths. Subsequently, the magnetoresistance of the samples is measured in the region of the superconducting transition temperature (T_c). From these measurements we extract the magnetic field dependence of the phase transition line $T_c(H)$ and the activation energy of vortex pinning $U(H)$ for various domain widths. We find that U increases with the reduction of the domain widths. The phase transition line shows an evolution from conventional behavior with single maximal T_c at $H = 0$, to the bimodal line with two T_c maxima at nonzero H. The results will be compared to the results of similar experiment performed recently for another type of bilayers, in which F layer is Co/Pt.

In addition, we will show the preliminary results of our work on another S/F structure, built entirely from oxide films, with $SrRuO_3$ as the F layer, and YBaCuO as the S layer.

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