Superconductor Science and Technology 2013 vol.26 N8

Experimental and theoretical analysis of the upper critical field in ferromagnet-superconductor-ferromagnet trilayers

Antropov E., Kalenkov M., Kehrle J., Zdravkov V., Morari R., Socrovisciuc A., Lenk D., Horn S., Tagirov L., Zaikin A., Sidorenko A., Hahn H., Tidecks R.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

The upper critical magnetic field Hc2 in thin film ferromagnet-superconductor-ferromagnet trilayer spin-valve cores is studied experimentally and theoretically in geometries perpendicular and parallel to the heterostructure surface. The series of samples with variable thicknesses d F1 of the bottom and dF2 of the top Cu41Ni 59 ferromagnet (F) layers are prepared in a single run, utilizing a wedge deposition technique. The critical field Hc2 is measured in the temperature range 0.4-8 K and for magnetic fields up to 9 T. A transition from oscillatory to reentrant behavior of the superconducting transition temperature versus F-layer thickness, induced by an external magnetic field, has been observed for the first time. In order to properly interpret the experimental data, we develop a quasiclassical theory, enabling one to evaluate the temperature dependence of the critical field and the superconducting transition temperature for an arbitrary set of system parameters. A fairly good agreement between our experimental data and theoretical predictions is demonstrated for all samples, using a single set of fit parameters. This confirms the adequacy of the Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) physics in determining the unusual superconducting properties of the studied Cu41Ni59/Nb/ Cu41Ni59 spin-valve core trilayers. © 2013 IOP Publishing Ltd.

http://dx.doi.org/10.1088/0953-2048/26/8/085003