TT 26 Superconductivity - Heterostructures, Andreev Scattering, Proximity Effect, Coexistence

Zeit: Dienstag 10:15–11:45 Raum: TU H3027

TT 26.1 Di 10:15 TU H3027

Heterstructures of YBCO and spin-polarized manganites - Playing around with superconducting properties — •Joachim Albrecht[1,2], Soltan Soltan[2] und Hanns-Ulrich Habermeier[2] — [1]Max-Planck-Institut für Metallforschung, Heisenbergstr. 3, 70569 Stuttgart — [2]Max-Planck-Institut für Festkörperforschung, Heisenbergstr. 1, 70569 Stuttgart

We have grown epitaxial bilayers of $La_{2/3}Ca_{1/3}MnO_3$ (LCMO) and optimally doped $YBa_2Cu_3O_{7-\delta}$ (YBCO) on single-crystalline substrates. Owing to the vicinity of the ferromagnetic, highly spin-polarized LCMO layer the properties of the YBCO film can change substantially. We investigated in detail the transition temperature [1], the critical current density [2] and the resistivity in the normal conducting state [3] of YBCO films in bilayers and heterostructures with different geometry. It is shown in this contribution that both the magnetic stray field and the spin polarization of the manganite strongly influences the properties of the YBCO thin film.

[1] S. Soltan, J. Albrecht and H.–U. Habermeier, Phys. Rev. B 70, 144517 (2004).

[2] J. Albrecht, S. Soltan and H.–U. Habermeier, Physica C 408-410, 482 (2004).

[3] S. Soltan, J. Albrecht and H.–U. Habermeier, Solid State Comm., submitted

TT 26.2 Di 10:30 TU H3027

Experimental evidence for crossed Andreev reflections — •Detlef Beckmann[1], Heiko B. Weber[1], and Hilbert v. Löhneysen[2,3] — [1]Forschungszentrum Karlsruhe, Institut für Nanotechnologie — [2]Forschungszentrum Karlsruhe, Institut für Festkörperphysik — [3]Physikalisches Institut, Universität Karlsruhe

In our recent work [1], we have shown experimentally that electronic subgap transport in a superconducting non-local spin-valve can be described by the superposition of crossed Andreev reflection, i.e. the splitting of a Cooper pair into two different leads, and electron cotunneling, i.e. the transmission of an electron through the superconducting gap. Here, we report on experiments which allow us to discriminate both processes. We have extended our investigation from metallic point contacts to planar tunnel junctions, and replaced the non-local voltage detection (i.e. outside the current path) by a local detection scheme (along the current path). We observe a negative resistance which allows us to give a lower bound to the contribution due to crossed Andreev reflections alone.
[1] D. Beckmann *et al.*, PRL 93 (2004) 197003

TT 26.3 Di 10:45 TU H3027

Andreev reflection in hybrid InGaAs/InP structures with superconducting NbN contacts — •I. E. Batov[1], Th. Schäpers[2], A. A. Golubov[3], and A. V. Ustinov[1] — [1]Physikalisches Institut III, Universität Erlangen-Nürnberg — [2]ISG-1, Forschungszentrum Jülich — [3]Faculty of Applied Physics, University of Twente, The Netherlands

We have studied magnetotransport and differential current voltage characteristics of highly transparent superconductor/normal metal/two-dimensional electron gas junctions formed by a superconducting NbN electrode, a thin (10nm) Au interlayer, and a two-dimensional electron gas in an InGaAs/InP heterostructure. A decrease in the differential resistance with pronounced double dip structure has been observed within the superconducting energy gap. It is argued that the double-dip structure in the differential resistance is related to the transport in SN-2DEG contacts in the ballistic regime. It has been found that the reduced subgap resistance is preserved in high quantizing magnetic fields. We observed resistance oscillations as a function of magnetic field at zero dc bias current in our junctions. The effect of temperature and dc bias current on the amplitude of the magnetoresistance oscillations was studied. The experimental results are qualitatively explained by taking Andreev reflection in high magnetic fields into account.

TT 26.4 Di 11:00 TU H3027

Diamagnetic screening in Nb/Ag double layers in contact with a ferromagnet — •H. Stalzer[1], A. Cosceev[1], C. Sürgers[1], and H. v. Löhneysen[1,2] — [1]Physikalisches Institut and DFG Center for Functional Nanostructures (CFN), Universität Karlsruhe, D-76128 Karlsruhe — [2]Forschungszentrum Karlsruhe, Institut für Festkörperphysik, D-76021 Karlsruhe

The magnetization $M(T,B)$ of planar superconducting Nb/Ag and Nb/Ag/Fe heterostructures (thicknesses $d_{Nb} = 200\,nm$, $d_{Ag} = 35$ - $800\,nm$, and $d_{Fe} = 40\,nm$) epitaxially grown on sapphire $(11\bar{2}0)$ is studied in parallel magnetic fields B between temperatures of $T = 0.06$ - $10\,K$. Below the superconducting phase transition of Nb a further diamagnetic signal occurs at a temperature $T^\star$ due to screening currents in Ag induced by the proximity effect. In contact with an additional Fe layer the proximity effect vanishes for thick Ag layers ($d_{Ag} \geq 200\,nm$). Surprisingly the diamagnetic transition at $T^\star$ reappears in Nb/Ag/Fe triple layers with a thickness of 20 - 35 nm. Furthermore, we investigate the effect of an additional SiO_2 spacer layer of thickness $d_{SiO_2} = 1$ - $5\,nm$, separating the Ag and Fe film, on the diamagnetic phase diagram. We propose the realization of a tunable π-contact using weak ferromagnets.

TT 26.5 Di 11:15 TU H3027

Switching superconductivity in S/F bilayers by multiple-domain structures — •Thierry Champel and Matthias Eschrig — Institut TFP, Universitaet Karlsruhe, 76128 Karlsruhe, GERMANY

We consider the effect of a multiple magnetic domain structure in a superconductor/ferromagnet bilayer, modeled by a ferromagnetic layer with a rotating magnetic moment. The domain walls in this model are of equal size as the domains, and are of Néel type. We study the superconducting critical temperature as a function of the rotation wavelength of the magnetic moment. The critical temperature of the bilayer is found to be always enhanced by the domain structure, and exhibits an interesting reentrant behavior. We suggest that this effect can be used for a new device where superconductivity may be controlled by the domain structure of the magnetic layer.

TT 26.6 Di 11:30 TU H3027

Charge Transport in Andreev Billiards with a Superconducting Antidot — •A. Lassl[1], K. Richter[1], P. Schmelcher[2], F. Diakonos[3], M. Scheid[1], and N. Fitas[3] — [1]University of Regensburg — [2]University of Heidelberg — [3]University of Athens

We study the transport properties of a normal conducting electron billiard in contact with a superconductor. In particular we are interested in the magnetic field dependence of the particle and hole transmission and reflection coefficients. For our numerical simulations we chose a Sinai billiard with a superconducting antidot in the center of the quadratic scattering region. The presence of the superconductor changes the dynamics of the system due to Andreevreflection. The results of a purely classical and a quantum mechanical approach are presented and they show to be in very good agreement.