SPIN-DEPENDENT TRANSPORT IN F/S/F STRUCTURES

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Spin dependent transport in magnetic nanostructurized devices has received much attention nowadays. It is particularly interesting in heterostructures based on oxide superconductors (S) and ferromagnets (F), because of interplay between ferromagnetism and superconductivity.

Our samples were grown by dc high pressure sputtering method from stoichiometric targets on (100) LSAT substrate. The trilayer F/S/F structure consists of highly spin polarized half metallic ferromagnet - $La_{0.7}Sr_{0.3}MnO_3$ and unconventionally paired (d-wave symmetry) high T_c superconductor $YBa_2Cu_3O_7$. The step like design of the structure with bottom F layer only partially covered enabled us to perform transport measurements not only in current-in-plane (CIP) but also in quasi-current – perpendicular-to-plane (CPP) geometry.

The low field magnetoresistance was measured at temperatures well above and along the superconducting transition ($T_{C\ onset}$ = 72 K). The magnetoresistive effects are of the order of 1% when YBCO remains in normal state. For temperatures below T_c the MR defined as $(R_{max} - R_{min})/R_{min}*100\%$ gets amplified, reaching 2500% in CIP and 50% in CPP configurations. The magnetoresistance curves reveal three regions: a peak coinciding with coercive field , a minimum and positive part. We identify this behavior with two competing mechanisms of spin polarized transport: crossed Andreev reflection and elastic co-tunneling. The crossed Andreev reflection is favored for antiparallel alignment of two ferromagnetic layers, while elastic co-tunneling for parallel alignment. Moreover, both mechanisms lead to the opposite sign of magnetoresistance.

Our hypothesis has been confirmed indirectly by the conductance spectroscopy which revealed characteristic for crossed Andreev reflection zero bias conductance peak. The additional proof we have got by measuring the resistive transition in various external magnetic fields, which demonstrated spin switch effect.