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Full-switching FSF-type superconducting spin-triplet magnetic random access memory element

Lenk D., Morari R., Zdravkov V. I., Ullrich A., Khaydukov Yu., Obermeier G., Müller C., Sidorenko A. S., von Nidda H.-A. Krug, Horn S., Tagirov L. R., Tidecks R.

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Abstract

In the present work a superconducting $Co/CoO_x/Cu_{41}Ni_{59}/Nb/Cu_{41}Ni_{59}$ nanoscale thin film heterostructure is investigated, which exhibits a superconducting transition temperature, Tc, depending on the history of magnetic field applied parallel to the film plane. In more detail, around zero applied field, Tc is lower when the field is changed from negative to positive polarity (with respect to the cooling field), compared to the opposite case. We interpret this finding as the result of the generation of the odd-in-frequency triplet component of superconductivity arising at noncollinear orientation of the magnetizations in the $Cu_{41}Ni_{59}$ layer adjacent to the CoO_x layer. This interpretation is supported by superconducting quantum interference device magnetometry, which revealed a correlation between details of the magnetic structure and the observed superconducting spin-valve effects. Readout of information is possible at zero applied field and, thus, no permanent field is required to stabilize both states. Consequently, this system represents a superconducting magnetic random access memory element for superconducting electronics. By applying increased transport currents, the system can be driven to the full switching mode between the completely superconducting and the normal state.