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FM/S/FM/S system as the simplest superlattice logical device with two separating recording channels

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Abstract

We theoretically study the coexistence and mutual influence of magnetism and superconductivity in the ferromagnetic metal/superconductor (FM/S) superlattices (SLs). We found a physically interesting region of the theory parameters, making possible to manage the FM/S SLs superconducting and magnetic properties. We propose the principal scheme of the simplest FM/S/FM/S device which allows one to record information in two *separated* channels (superconducting and magnetic ones) in a common sample. It is shown that the SLs have more logically different variants of data record than the known FM/S/FM trilayer spin switch. © 2002 Elsevier Science B.V. All rights reserved.

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In the ferromagnetic metal/superconductor (FM/S) superlattices (SLs) the mutual influence of superconductivity and ferromagnetism is characterized by the pronounced nonmonotonic dependence of the critical temperature T_c on the thickness of the ferromagnetic layers d_f [1,2]. The existing theories of proximity effect for the FM/S SLs [3–6] relate the $T_c(d_f)$ oscillations to the competition between the 0-phase type and the π-phase type of superconductivity in the neighboring S layers. In the last works [7,8] we have found that in the SLs there is the inverse influence of superconductivity on the magnetism of the FM layers and on the mutual orientation of their magnetizations. The antiferromagnetic superconducting (AFS) states with antiparallel orientation of magnetizations in the adjacent FM layers have higher T_c than ferromagnetic superconducting (FS) states with parallel alignment of the FM layers magnetizations, if the S layers thickness d_s is less than threshold value d_s^{π} [7,8]. In the AFS state the phases of the magnetic order parameter (MOP) in the neighboring FM layers are shifted on π. This essentially attenuates the pair-breaking effect of the exchange field I for the S layers and raises critical temperature of the layered system. This mutual accommodation between the superconducting order parameter (SOP) and the MOP reflects the quantum connection between the boundaries and leads to realization of the π-phase magnetism. The recent theoretical works investigate only part

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