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STRUCTURE AND MAGNETISM IN MULTILAYER Fe/MgO/Cr/MgO/Fe NANOSYSTEMS

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Layered Fe/MgO/Cr/MgO/Fe nanostructures are an artificial ferromagnetic material in which the exchange interaction of magnetic moments of Fe layers through intermediate dielectric and metal layers can lead to magnetic configurations that are not realized in the well-studied Fe/MgO/Fe and Fe/Cr/Fe systems. The correlation between the structural and magnetic properties of layered Fe(10 nm)/MgO(1.5 nm)/Cr(t)/MgO(1.5 nm)/Fe(7 nm) (t = 0.9 and 1.8 nm) nanoheterostructures was studied. X-ray diffractometry and high-resolution reflectometry data confirmed the formation of an epitaxial crystal structure and revealed its well-defined layered nature with sharp interlayer boundaries. Vibration magnetometry did not reveal significant differences in the hysteresis loops of a characteristic stepped shape. Reflectometry of polarized neutrons made it possible to establish that the processes of magnetization reversal in these samples occured in different ways at the level of individual Fe layers. In the sample with a 0.9 nm thick Cr interlayer, the Fe layers were exchange-coupled through the MgO/Cr/MgO interlayer, and their rotation was correlated with the application of a magnetic field. In the sample with a 1.8 nm thick Cr interlayer, the Fe layers were not exchange-coupled and magnetized independently of each other. It was found that the magnetization reversal of the Fe/MgO/Cr/MgO/Fe systems was characterized by an intermediate state, which could be controlled using a small external field of several tens of oersted and a change in the orientation of the sample, as well as by varying the thickness of the MgO layer.

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