Magnetoresistive properties of $[Fe/SiO]_5$ multilayer systems

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INTRODUCTION

Investigation of the physical properties of magneto-heterogeneous nanostructures is relevant at the present stage of the development of science and technology. This is due to both the fundamental problems of magnetism in nanoscale systems and the ability to design various electronic devices based on thin film functional elements. In the case of discontinuous ferromagnetic thin films, their magnetic and magnetoresistive properties can be varied substantially as a result of the realization of different mechanisms of magnetoresistance. The mechanisms of magnetoresistance occurrence in discontinuous systems are complex and not yet fully understood. It can be noted only that the mechanisms of charge and spin transfer play an important role in magnetoresistance formation in these system. s.

RESULTS

This study analyzed the results of experimental investigations of magnetoresistive properties for as-deposited and annealed at 400 and 500 K [Fe/SiO]5/S multilayer systems within the range of effective thickness of d(Fe) = 5-10 nm and d(SiO) = 1-2 nm.

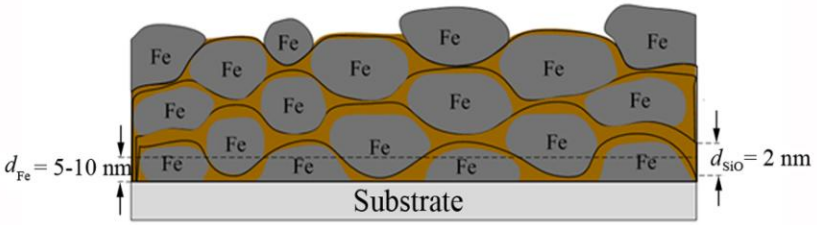

Fig.1. Schematic representation of the structure of $[Fe / SiO]_5$/Sub layered thin-film structure

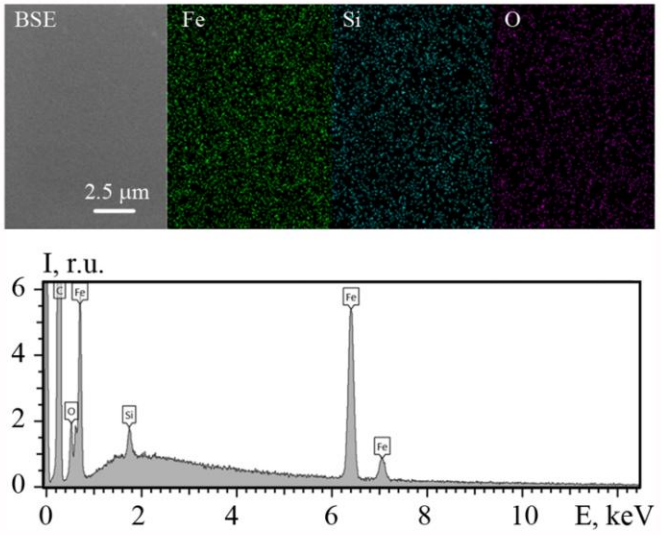

Fig. 2. EDS compositional maps of Al, Cr, Fe, Co, Ni, and Cu elements and EDX spectrum for $[Fe(10)/SiO(2)]_5$/Sub layered thin-film structure after deposition

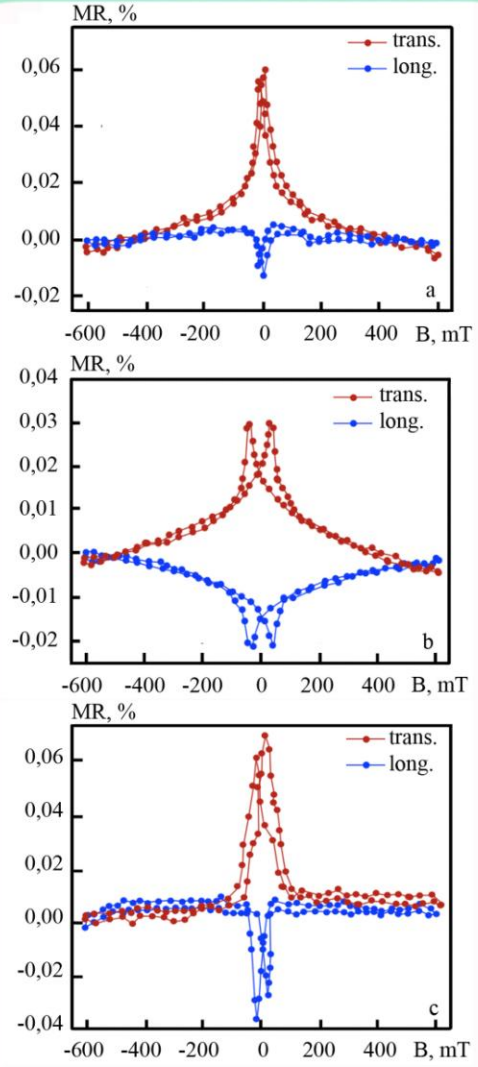

Fig. 3. Field dependences of LMR and TMR for as-deposited (a) and annealed at 500 (b), 600 (b) and 700 K (b) $[Fe(10)/SiO(2)]_5$/Sub layered thin-film structure

CONCLUSION

All investigated systems characterized by anisotropic magnetoresistance before and after annealing. The value of both longitudinal and transverse magnetoresistance in the magnetic field up to 0.6 T does not exceed 0.05 %. In should be noted that ferromagnetic thin films prepared at room temperature and high condensation rates are magnetic, but their magnetization significantly lower than magnetization of bulk metal. In this case, the reduction of magnetization leads to small values of anisotropic magnetoresistance. Besides, in our case, the thickness of the insulator layers is close to 1 nm. At such thickness, the insulator layer can be disconnections. As a result, the formation of ferromagnetic clusters that coincide occurs during the condensation process. Therein the charge transfer through the infinity metal ferromagnetic clusters grows. Therefore the anisotropic magnetoresistance like for homogeneous ferromagnetic metals realized.