The substitution of S for Se keeping the constant tellurium concentrations $y = 0.3$, 0.4, 0.5, 0.6 in $Fe_{1.02}T_ySe_{1-y-x}S_x$ was found to expand the crystal lattice in all samples despite the lower ionic radius of sulfur in comparison with selenium [3]. The expansion of the unit cell with increasing sulfur content may be ascribed to the softening of the lattice due to the growing amount of more ionic Fe-S bonds and weakening of the van der Waals interactions between chalcogen layers. Together with the lattice expansion the substitution is observed to reduce the critical temperature of superconductivity in all series (Fig. 1). The results of the magnetization measurements have shown that the materials exhibit bulk superconductivity and the shielding volume fractions for all the samples decreases with increasing sulfur content. The results obtained in the present work show that the variation of S, Se and Te concentrations in the ternary chalcogen mixture can be used to control the lattice, superconducting and magnetic properties of iron-chalcogen based superconductors.

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MAGNETIC AND MAGNETORESISTIVE PROPERTIES OF $FeMn/FeNi/Co\text{-}Al_2O_3/FeNi$ FILMS

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Magnetic films containing exchange-coupled antiferromagnetic and ferromagnetic layers have been a subject of many studies devoted to the development of magnetic sensors [1]. The present research is aimed to develop a medium with optimal values of the anisotropic magnetoresistance (AMR), internal magnetic bias and high sensitivity to external magnetic field. For this purpose, multilayered FeMn/FeNi films were used. In order to reduce the exchange bias field and, consequently, increase the sensitivity granular interlayer was introduced into the permalloy layer. Thus the objects of the study were $Ta(5)/Fe_{20}Ni_{80}(5)/Fe_{50}Mn_{50}(20)/Fe_{20}Ni_{80}(5)/Co_{40}\text{-}(Al_2O_3)_{60}(L)/Fe_{20}Ni_{80}(40)/Ta(5)$ (in parentheses thickness in nm is specified) planar structures.

Two series of the samples were obtained by magnetron sputtering of one-component and alloyed targets onto glass substrates at presence of the external magnetic field oriented parallel to the films surface. Samples of the first one were as-deposited (A-samples), whereas samples of the second series (B-samples) were subjected to annealing at 350 °C. For both series the thickness L of the $Co_{40}-(Al_2O_3)_{60}$ layer was varied (0÷6 and 0÷4 nm, respectively). Magnetic measurements were carried out using magneto-optical and VSM magnetometry. Magnetoresistance was measured by four-point probe method.

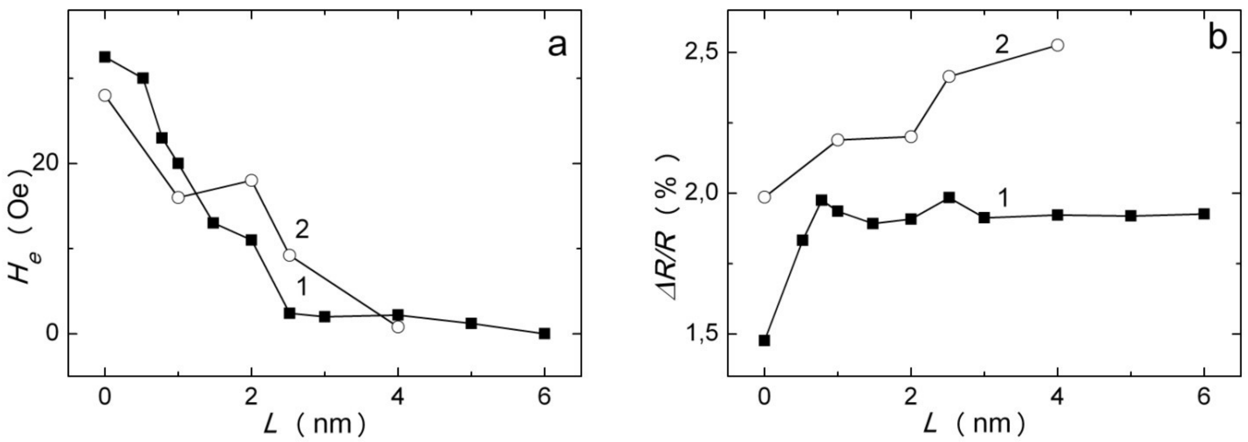

Fig. 1. Dependencies of the exchange bias field H_e (a) and anisotropic magnetoresistance $\Delta R/R$ (b) of the permalloy layer on the thickness of $Co_{40}-(Al_2O_3)_{60}$ layer L measured for samples of series A (1) and B (2)

The dependencies of the exchange bias field H_e and magnetoresistance $\Delta R/R$ of the functional layer FeNi(40) on the thickness of the granular layer are presented in fig. 1. The observed reduction of H_e with L increasing can be explained by the decrease in the effective contact area of the separated FeNi ferromagnetic layers. As expected, the annealing improved the properties of the studied samples causing the increase in the FeNi crystallite size and, as a result, magnetoresistance. Therefore it can be employed as an important technological step in sensors production. In general, it was found that usage of the $Co_{40}-(Al_2O_3)_{60}$ spacer in the permalloy layer leads to the decrease in the exchange coupling and reduces the shunting effect of the bottom layers. Thus it allowed us to optimize values of H_e and $\Delta R/R$. Comparison of the data obtained for samples with Al_2O_3 and $Co_{40}-(Al_2O_3)_{60}$ spacer shown that for the last one the FeNi properties are less sensitive to interlayer thickness, consequently, this material is more suitable for applications in magnetoresistive medium. Basing on the studied annealed multilayered structure with L = 2.5 nm, $H_e \sim 10$ Oe sensor sample was fabricated.

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