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Magnetoresistive Properties of Py/Ag/Co Pseudo Spin-valves

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The pseudo spin-valve (PSV) structures based on soft magnetic permalloy $Ni_{80}Fe_{20}$ (Py) and hard magnetic Co, separated by a layer of nonmagnetic material (Ag) belong to the pseudo spin-valve structures, in which independent magnetization reversal of magnetic layers is gained by diverse coercive forces of magnetic layers. It is known that well-designed structure, optimized sample size and sputtering parameters are the key factor to fabricate high-performance magnetoresistance (MR) sensors that based on pseudo spin-valves. So, the following stages of the work were defined: analysis the crystal structure and phase state of the film systems that were annealed to different temperatures (temperature range is 300-750 K) and establishing the correlation between the change in magnetoresistive properties of pseudo spin-valves based on Py, Co and Ag, phase state, annealing temperature and thickness of a nonmagnetic layer (d_{Ag} = 3-15 nm).

The samples were prepared layer-by-layer by electron-beam sputtering in a vacuum chamber VUP-5M with a base pressure of 10^{-4} Pa on an amorphous glass-ceramic substrates with the temperature T_S = 400 K and size 10×10 mm, and copper grids with predeposited layer of carbon. Two series of samples were obtained: type A – Co(5)/Ag(d_{Ag})/Py(30)/S (S – glass-ceramic substrate, d_{Ag} = 3-15 nm) and type B – Co(30)/Ag(d_{Ag})/Py(5)/S. The maximum value of MR is obtained after annealing to 750 K for samples of type A at d_{Ag} = 15 nm in the parallel orientation (1.10%, overtake three times as-deposited one). Whereas, the systems of A and B types at d_{Ag} = 6 nm are the most stable in terms of temperature influence on the value of B_C, which vary in ranges 7-10 mT and 7-17 mT, respectively, in temperature range 300-750 K.

Practical value is that magnetic field detectors of various applications can be produced on the basis of investigated film systems. In order to create thermostable detectors, the systems Py/Ag/Co must be annealed at high temperatures (750 K).

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