

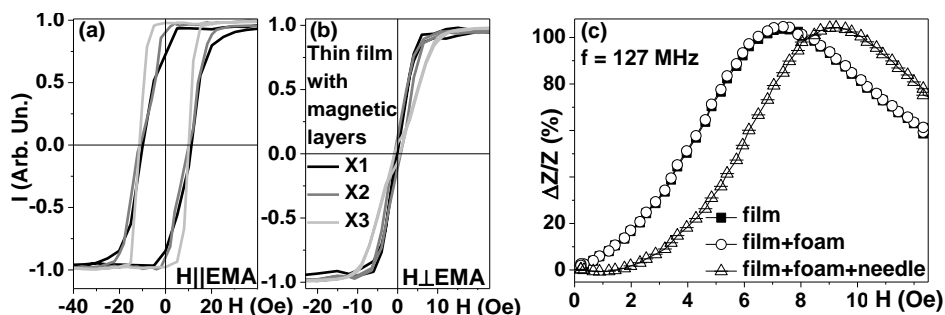
PERMALLOY-BASED MULTILAYERED STRUCTURES FOR NON-DESTRUCTIVE TESTING

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Multilayered structures are successfully used in sensors of weak magnetic fields based on the giant magnetoimpedance effect. Such sensors have a very high sensitivity with respect to external magnetic field. MI is therefore a suitable effect for the devices with aim to determine the presence and concentration of metal objects at a certain distance. A comparative analysis of several multilayered structures, as well as their application in an experiment to detect a ferromagnetic needle were carried out in this work. Multilayered structures $[\text{Cu}(3\text{nm})/\text{Fe}_{22}\text{Ni}_{78}(\text{XN})]_Y/\text{Cu}(500\text{nm})/[\text{Fe}_{22}\text{Ni}_{78}(\text{XN})/\text{Cu}(3\text{nm})]_Y$, where $X1=170$ nm ($Y1=3$), $X2=100$ nm ($Y2=5$), $X3=50$ nm ($Y3=10$) were prepared by magnetron sputtering onto glass substrates. The structure and magnetic properties of multilayers were investigated. All structures were soft ferromagnets with well defined uniaxial anisotropy (see Figure a, b).



Hysteresis loops of different structures were measured by Kerr-microscope, external magnetic field was applied parallel (a) and perpendicular (b) to the easy magnetization axis (EMA). Field dependencies of magnetoimpedance ratio of total impedance of thin film based on X2 without and with needle above it (c).

Ferromagnetic needle was placed into non-magnetic foam to mimic typical damage of the body. The presence of the foam did not change the MI ratio during the experiment (Fig. 1c). A significant change in the peak position of the MI ratio $\Delta Z/Z = (Z(H_{\max}) - Z(H)) / Z(H_{\max})$ from 7 to 9 Oe was observed when the needle was inside of the foam above the film at a distance of 0.5 mm. It was found that MI element can be used to detect the position of the needle. The dependence of the magnetoimpedance ratio $\Delta Z/Z$ on the position of the needle in foam rubber will be presented in the report for a set of multilayered structures with varying thickness and number of magnetic layers.

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