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INFLUENCE OF THE MAGNETORESISTIVE ELEMENTS TOPOLOGY ON THE MAGNETIC MEMS FUNCTIONAL CHARACTERISTICS

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The development of the micromagnetic theory has given the impetus to the development of various magnetic sensors, perspective, in particular, for the MEMS applications [1]. The improvement of sensitivity, thermal stability and miniaturization is the main objective of the development of magnetic sensitive devices and transducers based on the magnetoresistive microsystems. The magnetic MEMS sensitivity enhancement is possible by choosing an appropriate geometric shape and topology of the magnetosensitive elements. Variation of shape and elements sizes affects the magnetization distribution, hysteresis and sensitivity range. This is important for the local magnetic stray fields detection.

In this work the analysis of magnetoelectric characteristics, based on the numerical simulation of micromagnetic configurations in the magnetoresistive elements, depending on the topology was carried out. This microsystem design based on the ”barber-pole” structure. This allows to reduce the magnetization hysteresis to a minimum. The analysis of the magnetization distribution based on the micromagnetic model give the distribution close to uniform. However, if we assume the shape of the magnetic element follows the shape lying on the shunt, the distribution becomes significantly non-uniform [2]. This design feature (shape-coupled microsystems) can significantly improve the sensitivity of the magnetic MEMS (Fig. 1) [3].

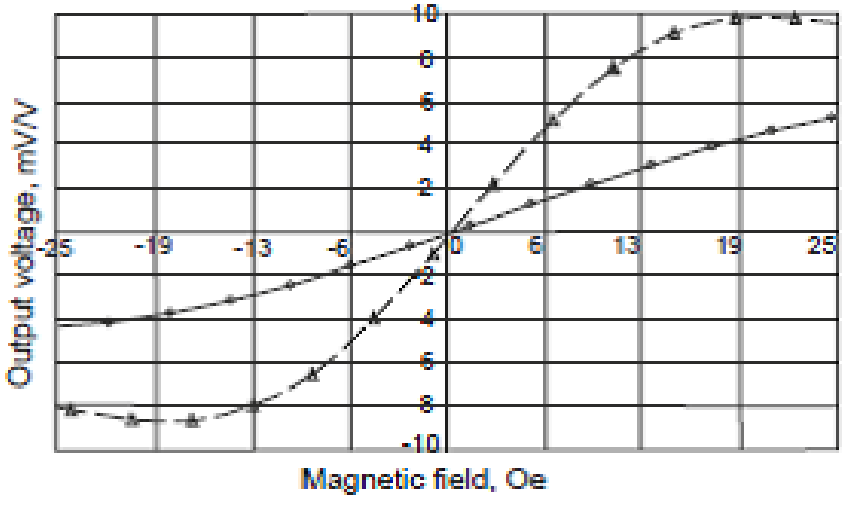

Figure 1. Calculated transfer characteristic of MEMS: solid line — the sensitivity of 0.78 (mV/V)/Oe (W = 10 μm, a = 15 μm, s = 6 μm); dotted line — 1.90 Sensitivity (mV/V)/Oe (W = 40 μm, a = 6 μm, s = 6 μm), where W, a, s — topology parameters

This work demonstrated the possibility of significantly increasing the sensitivity of magnetic MEMS by using shape-coupled structures. The results of micromagnetic modeling confirmed that there was an about 70% increase in the sensitivity of shape-coupled microsystems compared to classical magnetoresistors.

The work was supported by the Minobrnauki RF (Goszadanie No. 16.2475.2017/4.6) and conducted using the equipment of Multi-access center «Microsystem technics and electronic component base» MIET.

1. N.A. Djuzhev, A.S. Yurov, R.Yu. Preobrazhensky, N.S. Mazurkin, M.Yu. Chinenkov. Surface investigation. X-ray, synchrotron and neutron techniques. **10**, 2, 307–311 (2016).