FERROMAGNETIC RESONANCE: APPLICATION FOR STUDY OF MAGNETIC SHAPE MEMORY ALLOYS

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In spite of a big progress in modernization of conventional magnetic measurements techniques such as VSM and SQUID magnetometries ferromagnetic resonance (FMR) is widely used for investigation and characterization of different magnetic materials. This is connected with the following advantages of FMR technique: high sensitivity, possibility to separate contribution from different magnetic phases and magnetic structure units, absence of an influence of diamagnetic subsystems, possibility to obtain data about exchange interaction inside magnetic materials or between magnetic components of magnetic materials, power of FMR technique for a saturation magnetization, magnetic anisotropy and magnetostatic interaction investigation.

This presentation is devoted to show a power of FMR technique to study structural, magnetic and resonance properties of thin epitaxial films of ferromagnetic shape memory alloys (FSMA). The influence of the phase transitions on magnetic properties of FSMA films will be discussed. It will be also shown that the elastic interaction between film and substrate determines the microstructure of FSMA films resulting to the dramatic change of their structure and magnetic parameters. This interaction suppresses the martensitic transformation for thin films while for the thick films it leads to formation of periodic twin structures. A formation of stress induced two-fold and four-fold magnetic anisotropy will be discussed in detail.

A lot of attention will be paid to the influence mesoscale twin structure on magnetic parameters of FSMA films. Modification of magnetic properties in periodic mesoscale twin structures in the case of ferromagnetic and antiferromagnetic exchange on twin boundaries will be demonstrated for epitaxial Ni-Mn-Ga and Ni-Mn-Sn films.

Rare example of nanomesh surface self-patterning for the films deposited by conventional magnetron sputtering method on single-crystalline substrates will be presented here. Natural selforganized morphology being formed by the elongated bar-like shaped crystals will be demonstrated for epitaxial Ni-Mn-Ga thin films deposited on MgO (001) substrate and will be discussed in terms of surface stress relaxation. These films have well defined crystalline and magnetic structure. They show unusual magnetic properties properties to be considered as systems interesting for possible smart nanoscale applications.

Some new possible applications of FSMA films such as magnonic and photonic crystals fabrication will be discussed. The resent results on the observation of giant magnetoresistance in epitaxial films will be also shown.