Institute of Magnetism of the NAS of Ukraine and MES of Ukraine

COMBINED TEMPERATURE AND ELECTRICALLY CONTROLLED MAGNETIC NANOSTRUCTURES FOR SPINTRONICS AND MAGNONICS

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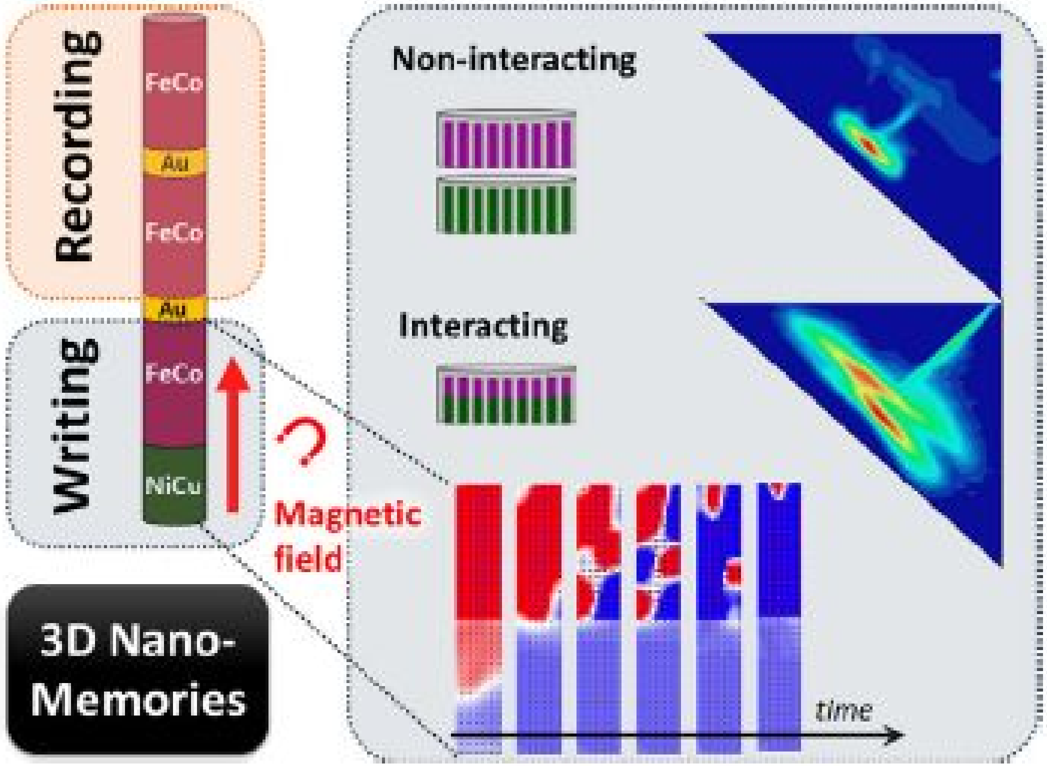
Targeted and competitive program of the NAS of Ukraine, call for projects under the budget program "Support for the development of priority areas of scientific research" (Budget Program Classification Code 6541230)

OBJECTIVES

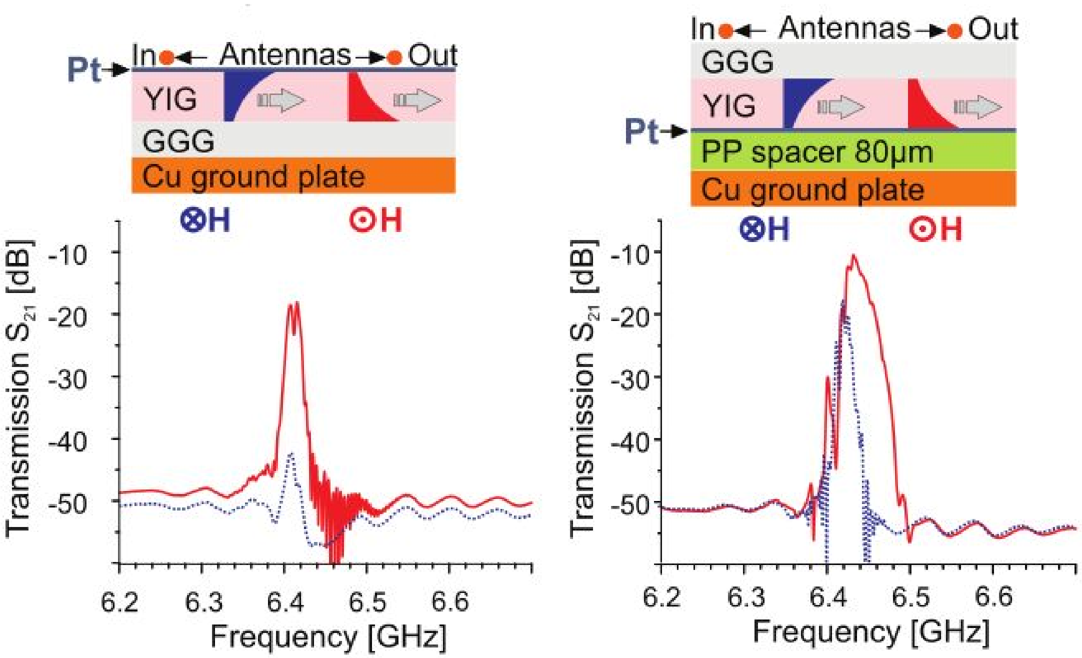
The goal of the project is the development of physical principles as for static and dynamic processes in one- and multicomponent nanoscale magnetic heterostructures with interactions that can be controlled by the influence of external factors (temperature, electricity, etc.), and to elaborate methods to improve existing energy efficient devices for magnonics and spintronics applications and to discover ways to create new ones.

MAIN RESULTS



It has been shown that ***interacting double-layer magnetic systems consisting of NiCu/FeCo nanowire arrays*** can be considered as potential candidates for application as recording components in 3D track memory devices. FORC diagrams and micromagnetic simulations confirmed the multi-step magnetization reversal process due to the strong interaction on the interface between soft and hard magnetic materials. This opens a new way for the fabrication of ***3D track memory devices with integrated heads for recording along the track***.

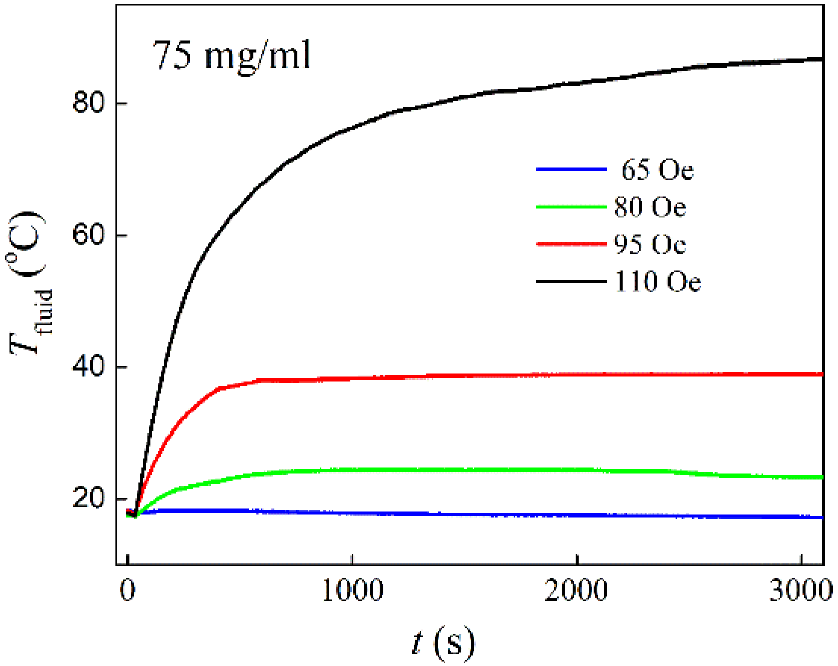
MAIN RESULTS



Transmission characteristic of spin waves in an iron-yttrium garnet (6.7 μm)/platinum (10 nm) structure without grounding (left) and with grounding (right)

A method for ***reducing eddy currents and corresponding losses in spin wave propagation in spintronic devices*** based on magnetic dielectric films/waveguides covered with a layer of platinum (which is necessary for the realization of direct and inverse spin Hall effects) has been demonstrated. The method is based on grounding a thin layer of platinum with a metal plate with good conductivity. Importantly, direct contact between the platinum and the grounding plate is not necessary – there can be a dielectric layer up to a hundred microns thick between them, which ***allows the platinum layer to be isolated in a direct current circuit***.

MAIN RESULTS



Time dependence $T_{fluid}(t)$ of the fluid temperature at heating by alternative magnetic field of different amplitude.

A comprehensive magnetic and calorimetry study of $NaFeO_2$ nanoparticles and magnetic liquids based on them revealed a strong relation between the magnetic characteristics of nanoparticles and their heating characteristics in liquids. It has been shown that ***$NaFeO_2$* nanoparticles can be effectively used for magnetic hyperthermia and remote temperature control**. The specific power loss has a threshold character, due to the domination of hysteresis mechanism of magnetic losses in such particles. Thus, it is possible to achieve ***efficient heating of magnetic fluids by an alternating magnetic field of small amplitude*** using hysteretic magnetization reversal of nanoparticles. The heating efficiency rapidly increases with the amplitude threshold overcoming.

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