THE JOINT EUROPEAN MAGNETIC SYMPOSIA

HYBRID CONFERENCE

JULY 24–29, 2022

WARSAW, POLAND

BOOK OF ABSTRACTS

Magnetoelastic interactions between surface acoustic waves and spin waves in nanopatterned structure

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In the system where the magnetostrictive layer is deposited on non-magnetic substrate, the spin waves (SWs) can interact with surface acoustic waves (SAWs) in a strongly anisotropic manner [1]. This interaction depends both on the direction of the applied magnetic field and the polarisation of SAW [2]. The matching between the wave vectors of SAW and SW is necessary to avoid the spatial averaging of the dynamic interaction for propagating plane waves and observe the coupling between them [2]. This picture is more complicated for the SWs propagating in the nanostructures.

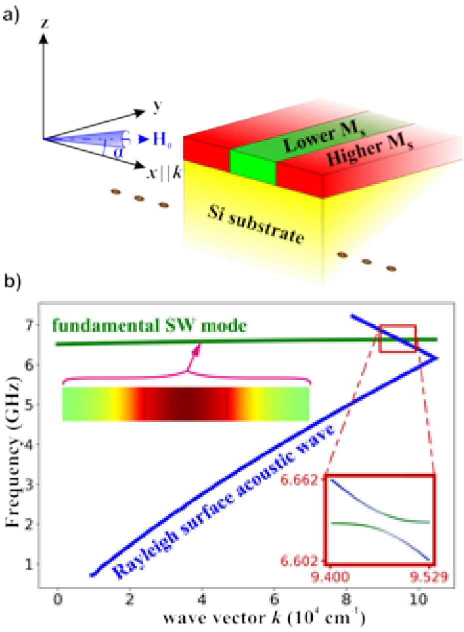

Figure 1: (a) The unit cell of considered system. External magnetic field H_0 is applied at oblige angle to the wave vector k (for SAWs and SWs). (b) The dispersion relation of SAW (Rayleigh wave) and SW with interaction magnified in the red box (for magnetoelastic coupling constants $b_1 = 4.39 \times 10^5 \frac{J}{m^3}$, $b_2 = 8.77 \times 10^5 \frac{J}{m^3}$). Marked with pink arrow: the profile of the in-plane dynamic magnetization.

We extended our previous work [1] and considered the impact of the patterning on magnetoelastic interactions. Using the finite element method, we calculated the magnetoelastic dispersion relation for an array of thin (30 nm) stripes (of the width 200 nm or 100 nm) differing in saturation magnetization ($M_S = 475$ or 95 $\frac{kA}{m}$, respectively) but identical in terms of elastic properties (c_{11}=260 GPa, c_{12}=176 GPa, c_{44}=39 GPa, ρ=11535 $\frac{kg}{m^3}$).

We investigated the SAWs and SWs propagating in the direction of periodicity, which causes the folding of magnetoelastic dispersion relation into the first Brillouin zone. The magnetic field is applied in-plane at the angle 45° to the k-vector, to make the interaction between Rayleigh SAWs and SWs possible.

Our main findings are: (i) the higher SAW dispersion branches are exhibited only due to the magnetoelastic interactions, (ii) the partial confinement of SWs within the stripes and nonuniform changes of SWs' phase affect their coupling with freely propagating SAWs.

G.C. would like to acknowledge the support from the National Science Center – Poland (grant No. 2020/39/O/ST5/02110)

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