Hysteresis of the frequency spin wave excitations in Ir/Co/Pt mutlilayers with Dzyaloshinskii-Moriya interaction

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Multilayered systems consisting of ferromagnetic layers alternating with non-magnetic heavy metal layers exhibiting perpendicular magnetic anisotropy (**PMA**) and Dzyaloshinskii-Moriya Interaction (**DMI**) are now intensively studied because of interesting physics and potential applications e.g. skyrmion-hosting systems [1]. The evolution of topological skyrmions as a function of Co thickness d has been recently studied across the Spin Reorientation Transition (**SRT**) in $(\mathrm{Pt/Co}(d)/\mathrm{Ta})_N$ (N – number of repetitions) multilayers using Lorentz Transmission Electron Microscopy [2]. Close to the **SRT**, it is possible to perform Brillouin Light Scattering (**BLS**) studies of spin wave excitations even without applying external magnetic fields H. In the present work, we investigated $(\mathrm{Ir/Co}(d)/\mathrm{Pt})_N$ multilayers with negative effective uniaxial anisotropy and large **DMI**. The samples were deposited by magnetron sputtering with N=1 or N= 6. Using Longitudinal Magneto Optical Kerr Effect (**LMOKE**) and magnetic force microscopies we determined the following magnetization configuration: large macrodomains (several dozen micrometers size) with in-plane "core" magnetization which are modulated by small nanodomains (about 100 nm size) differentiated by out-of-plane magnetization. Using **BLS** spectrometer, the hysteresis behaviors of the **DMI** sensitive: Stokes f_S and anti-Stokes f_{AS} frequencies as well as their frequencies difference Δf as the functions of the in-plane magnetic field were observed. The **BLS** signal is related to the in-plane "core" magnetization component of domains. The hysteresis of $\Delta f(H)$ is correlated with the switching of the large macrodomains observed with **LMOKE**. These experimental results are supported by micromagnetic simulations.

References:

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Supported by Polish National Science Center projects: DEC-2016/23/G/ST3/04196 Beethoven and UMO-2018/28/C/ST5/00308 SONATINA.