Experimental investigation of bi-layered CoFeB/Au structures with perpendicular magnetic anisotrop

S. Janardhanan,[1] A. V. Achuthan,[1] P. Kuświk,[2] and A. Trzaskowska[1]

[1]*Institute of Spintronics and Quantum Information, Faculty of Physics and Astronomy, Adam Mickiewicz University, 61-614 Poznan, Poland*

[2]*Institute of Molecular Physics of the Polish Academy of Sciences ul. M. Smoluchowskiego 17, 60-179 Poznan, Poland*

Bi-layered ferromagnetic systems with perpendicular magnetic anisotropy are currently among the most intensively studied materials in spintronics and magnonics. Despite extensive research, the role of interlayer interactions in such systems, particularly the Ruderman–Kittel–Kasuya–Yosida (RKKY) exchange coupling and the Dzyaloshinskii–Moriya interaction (DMI), is still not fully understood. In particular, systematic investigations of spin-wave dynamics in CoFeB-based bilayers separated by a gold spacer, where controlled manipulation of in-plane and out-of-plane magnetic anisotropy is possible, remain scarce. In this work, bi-layered CoFeB/Au/CoFeB thin-film systems exhibiting pronounced interfacial effects and perpendicular magnetic anisotropy were investigated experimentally. The evolution of spin-wave modes was analyzed as a function of the Au spacer and CoFeB layer thicknesses using Brillouin light scattering, ferromagnetic resonance, and polar magneto-optical Kerr effect techniques. A clear nonreciprocity of spin-wave frequencies was observed, displaying an oscillatory dependence on the Au spacer thickness. Symmetric CoFeB bilayers exhibit a single spin-wave mode, whereas asymmetric structures reveal two distinct modes with contrasting frequency shifts and linewidth evolution, arising from the coexistence of perpendicular and in-plane magnetic anisotropies in the individual layers. Dispersion analysis indicates a significant contribution of oscillatory interlayer Dzyaloshinskii–Moriya interaction, closely linked to an RKKY-type exchange mechanism. These results demonstrate that spin-wave dynamics in CoFeB/Au/CoFeB bilayers can be precisely tailored through engineering of the spacer and ferromagnetic layer thicknesses. The presented findings provide important insight into the interplay between interlayer exchange coupling, perpendicular magnetic anisotropy, and chiral interactions, highlighting the potential of such multilayer systems for the design of reconfigurable magnonic architectures and chiral spintronic devices.

This work was supported by the Polish National Science Centre under grant no. UMO - 2020/37/B/ST3/03936