

Engineering Magnon and Phonon propagation in Co_2FeGe Heusler Thin Films via Buffer-Layer Control

A. V. Achuthan,¹ Andrii Vovk,² Bogdan Postolnyi,² Pavel Štrichovanec,³ Sergey Bunyaev,² Pedro Antonio Algarabel,³ Gleb N. Kakazei,² João Pedro Araujo,² and A. Trzaskowska¹

¹*ISQI, Faculty of Physics and Astronomy,
Adam Mickiewicz University, 61-614 Poznan, Poland*

²*Instituto de Física dos Materiais Avançados,
Nanotecnologia e Fotónica da Universidade do Porto,
Faculdade de Ciências da Universidade do Porto,
Rua do Campo Alegre 687, 4169-007 Porto, Portugal*

³*Instituto de Nanociencia y Materiales de Aragón,
Universidad de Zaragoza-CSIC, Campus Río Ebro, 50018 Zaragoza, Spain*

Magnon, phonon and their interactions play a crucial role in the development of low-power magnonic[1] and spin-acoustic devices[2]. The use of Heusler alloys for this purpose opens new opportunities for exploring and tailoring phonon and magnon behavior[3]. However, the influence of interfaces and buffer layers on the propagation of magnons and phonons remains insufficiently understood. To address this issue, we systematically investigate the propagation of magnons and phonons in Co_2FeGe Heusler alloy thin films grown on MgO substrates with three different buffer configurations: W, Cr, and no buffer layer. Brillouin light scattering (BLS) is employed to measure magnon and surface acoustic wave dispersions at room temperature, while ferromagnetic resonance (FMR), and COMSOL simulations provide complementary insights into magnetic anisotropy, damping, and elastic mode behavior. We find that the buffer layer strongly modifies both magnonic and phononic propagation, significantly affecting mode frequencies, dispersion slopes. These results demonstrate that buffer-layer engineering provides an effective route to tailor phonon and magnon propagation in Heusler alloys, advancing their potential as tunable platforms for next-generation magnonic and spin-acoustic technologies.

References:

- [1] X. Han, H. Wu, and T. Zhang, *Applied Physics Letters* 125 (2024).
- [2] F. Hadj-Larbi and R. Serhane, *Sensors and Actuators A: Physical* 292, 169 (2019).
- [3] B. L. Santos, A. C. Krohling, K. Krambrock, E. C. Passamani, and W. A. Macedo, *Journal of Magnetism and Magnetic Materials* 614, 172691 (2025).

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