Design of Magnonic Waveguides Using Surface Anisotropy-Induced Bragg Mirror

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Magnonics offers a promising pathway toward energy-efficient data processing [1]. A key challenge in developing magnonic circuits [2] is the design of effective waveguides [3] for spin wave propagation. In this study, we propose a magnonic waveguide based on Bragg mirror principles, enabling spin wave confinement within a uniform CoFeB thin film [4]. The waveguide design incorporates periodic surface anisotropy patterns applied to both surfaces of the magnetic layer using non-magnetic materials. These patterns function as one-dimensional magnonic crystals positioned on either side of the waveguide. Spin wave confinement is achieved through Bragg scattering, which creates magnonic band gaps. To ensure sufficient spin wave propagation velocity, we applied an external magnetic field perpendicular to the waveguide axis (Damon-Eshbach geometry) and selected an appropriate layer thickness. The proposed design presents two key advantages: first, it requires only a uniform low-damping ferromagnetic layer with patterned non-magnetic overlayers; second, it avoids issues related to static demagnetizing fields and edge modes typically present in conventional waveguide designs.

References:

[1] A. V. Chumak and et al., IEEE Trans. Magn. 58, (2022), 1
[2] A. Khitun and K. L. Wang, Superlattice. Microst. 38, (2005), 184
[3] L. Zheng, and et al., J. Phys. D: Appl. Phys. 55, (2022), 263002.
[4] G. Centała, J. W. Kłos, Appl. Phys. Lett (2026) – accepted

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