Spin-wave dynamics in the magnetic heterostructures with regular stripe-domain texture

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Periodic magnetic structures, called magnonic crystals, allows the control of the spin-wave (SW) propagation. A standard way to introduce the periodicity is to artificially implement a structural modification of the magnetic material. Recently, magnetic materials based on rare-earth metals having a perpendicular magnetic anisotropy (PMA) which allows to stabilize a domain texture have been proposed as an alternative to manipulate SW propagation [1]. However, they are characterized by strong damping, making them inefficient for magnonic applications.

We present a magnetic multilayer structure consisting of 64-nm-thick NdCo layer and 10-nm-thick soft ferromagnetic layer (NiFe, Co/NiFe, NiFe/Co) separated by Al layer [2]. NdCo has a weak PMA allowing the stabilization of a regular stripe-domain texture. Due to the dipolar interaction between the layers, the domain pattern of NdCo is imprinted in the soft magnetic layer, which can serve as a conduit for the SWs. Due to different coercivity of the magnetic films, the magnetization orientation in the soft layer can be switched using a small external magnetic field of 20-30 mT without changing the domain structure of NdCo layer. Interestingly, this process is fully reversible. Brillouin light scattering (BLS) spectroscopy was used to analyse SWs propagating in the direction perpendicular to the stripe domains. SW dispersion was found to significantly differ in two configurations. BLS spectra show a few modes which exhibit strong asymmetrical behaviour. Numerical simulations indicate the source of the asymmetry in both static configuration and dynamic coupling. Moreover, they show that the BLS spectra contain fundamental soft layer mode branches coming from different Brillouin zones, a typical feature of magnonic crystals.

References:

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