On-chip emission and detection of short-wave magnons: from conversion to spin textures and grating couplers

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Magnetic nanomaterials play an important role in current technologies ranging from sensing to data storage and processing [1]. To develop novel applications beyond todays information technology [2] the exploration of magnons at 10 GHz and beyond becomes of key importance. At such frequencies they exhibit wavelengths λ of 100 nm and below. To perform experimental studies routinely in the laboratory in this regime relevant instrumentation is still under development. Traditional techniques based on e.g. neutron diffraction, spin-polarized electron loss spectroscopy and light scattering do not allow for studying the tiny volumes foreseen for technological applications, do not provide sufficient frequency resolution and require overcoming the diffraction limit at about 250 nm, respectively. New approaches are needed to obtain experimental data on short-wave magnons and thereby explore both fundamental aspects and possible novel functionalities.

We review approaches realized recently to emit and detect magnons with λ of a few 10 nm on a chip. The approaches include wavelength converters, anisotropic spin textures and grating couplers which incorporate periodic nanomagnet lattices. They are complementary in that they allow for emission in one- and two-dimensional configurations [3,4] as well as emission of multi-directional plane-wave magnons [5,6]. We also discuss our recent experiments performed on aperiodic grating couplers and coplanar waveguides incorporating a ferromagnetic layer which serve as efficient wavelength converters.

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