Spin-orbit torque mediated coupling of terahertz light with nanometer-wavelength magnon modes

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Nonvolatile and energy-efficient spin-based technologies call for new prospects to realize computation and communication devices that are able to operate at terahertz (THz) frequencies [1-3]. In particular, the coupling of electro-magnetic radiation to a spin system is a general requirement for future communication units and sensors. Here we propose a layered metallic system, based on a ferromagnetic film sandwiched in between two heavy metals that allows a highly effective coupling of millimeter wavelength THz light to nanometer-wavelength magnon modes. Using single-cycle broadband THz radiation we are able to excite spin-wave modes with a frequency of up to 0.6 THz and a wavelength as short as 6 nm. Our experimental and theoretical studies demonstrate that the coupling originates solely from interfacial spin-orbit torques [4]. These results are of general applicability to magnetic multilayered structures, and offer the perspective of coherent THz excitation of exchange-dominated nanoscopic magnon modes.

References

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