Imaging spin-wave using wide-field NV microscopy

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Diamond NV centers have become prominent quantum sensors over the last 15 years due to their sensitivity to both static and dynamic magnetic fields and their atomic size. Via optically detected magnetic resonance, it has been shown that one can image propagating spin-wave at the frequencies of the ms = 0 to ms =+/- 1 transition. Conventional NV imaging techniques are either based on scanning NV magnetometry (using a single diamond at the end of an AFM tip) or confocal microscope (in ensemble of NV centres implanted diamond). Whilst these two techniques are extremely sensitive (in terms of magnetic field sensitivity and spatial resolution), it can require up to a few hours to image area > 10 x 10µm. Following recent development in the field, we develop here a simple widefield microscope setup, and demonstrate that using the same setup it is possible to achieve Kerr imaging of the magnetic domains and image the spin waves spatial profile over an area of 100µmx100µm in a few minutes. For this purpose, we use microwave antennas patterned on YIG films to generate the propagating waves, and an adjustable permanent magnet to tune the static magnetic field orientation and amplitude, which allows us to select the frequency probed by the NV transition. Such experiment can then be used to investigate on the anisotropy of dispersion curve of the spin waves and the properties of the propagating medium. Our results make widefield microscopy a standard technique for fast characterization of spin-wave magnonic devices.