Enhancing magneto-optic effects in two-dimensional magnets by thin-film interference

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Magneto-optics plays a key role in the study of two-dimensional (2D) magnetic materials and their van der Waals heterostructures. However, thin-film interference that occurs in these layered structures is often not fully taken into account during the experiment design, even though it can greatly affect the magneto-optical signals. Here, we show that the magneto-optical signals can be optimized by carefully designing the sample to exploit thin-film interference, taking into account the wavelength, the SiO_2/Si substrate, the 2D magnet thickness, and encapsulation in hexagonal boron nitride (hBN). We do this by using the transfer matrix method to analyze the magneto-optical signals from realistic systems composed of van der Waals heterostructures on SiO_2/Si substrates, using CrI_3 as a prototypical 2D magnet. The subsequent improvement of the signal-to-noise ratio will help improve optical studies of low-dimensional, non-trivial magnetic textures such as skyrmions and chiral domain walls.

References

[1] F. Hendriks and M. H. D. Guimarães, "Enhancing magneto-optic effects in two-dimensional magnets by thin-film interference", AIP Advances, 11 (2021) 035132

Figures

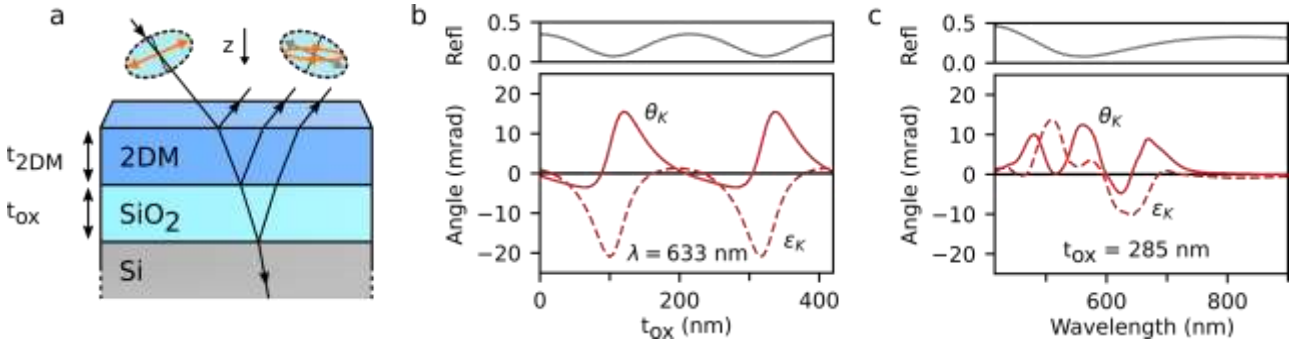

Figure 1: A typical 2D ferromagnet sample displaying MOKE in the presence of thin-film interference. b), c) The calculated Kerr rotation and ellipticity depend heavily on the oxide thickness and wavelength. The maximum signal occurs when the reflectivity is close to its minimum.