Magneto-optical Characterization of Two-Dimensional Ferromagnetic FGT and CGT

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Since the exfoliation of graphene in 2004 [1], there has been a still growing pool of two-dimensional (2D) materials. In recent years, thin films of magnetic van der Waals materials have gained increasing interest due to their potential applications in spintronics and magnetic storage devices. To this end, various ferromagnet/semiconductor heterostructures have been studied. For instance, heterostructures consisting of insulating ferromagnetic CRI_3 and a semiconducting WSe_2 monolayer have demonstrated the existence of magnetic proximity effects, manifesting in the lifting of WSe_2 valley degeneracy as well as helicity-dependent photoluminescence emission of the WSe_2 monolayer in proximity to the 2D ferromagnet [2,3].

Given the complex changeover from ferromagnetism to anti-ferromagnetism depending on layer thickness in CrI_3 and its pronounced lack of environmental stability [4], (i) metallic Fe_3GeTe_2 (FGT) and (ii) semiconducting $CrGeTe_3$ (CGT) are more robust, attractive alternatives for the integration of layered ferromagnetic materials into heterostructures.

Here, we present a magneto-optical characterization of atomically thin FGT and CGT flakes obtained by mechanical exfoliation in a nitrogen-filled glovebox. Taking advantage of their out-of-plane easy axis, the magnetic properties of both materials are accessible through the (polar) magneto-optical Kerr effect (MOKE). We perform micro-MOKE measurements with micron resolution, allowing us to access individual regions of different thickness on our samples. Temperature dependencies and characteristic hysteresis features such as coercive field and magnetic remanence are discussed with respect to the materials' potential for the construction of (i) metal/semiconductor or (ii) semiconductor/semiconductor heterostructures in combination with transition metal dichalcogenide monolayers.

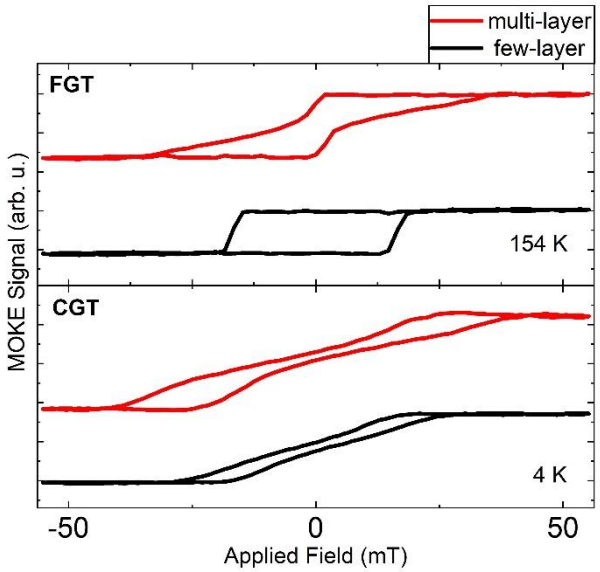

Fig. 1. FGT and CGT hysteresis loops for flakes with different layer thicknesses measured at two different temperatures

References

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[3] D. Zhong et al., Nat. Nanotechnol. **15**, 187 (2020).
[4] B. Huang et al., Nature **546**, 270 (2017).