

Magneto-Optic Effects and Domain Imaging in EuO film and EuO/Co Heterostructure

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Ferromagnetic semiconductors and stable half-metallic ferromagnets with Curie temperatures (T_c) equal to or more than room temperature have been sought for their applications in novel spintronic devices [1-4]. Europium oxide (EuO) is one of the potential candidates as it possesses strong ferromagnetism (FM) of $7\mu_B/\text{Eu}$ atom with a T_c of 69 K [1,2]. With vast literature on the electronic and magnetic properties of EuO, the magneto-optic-effect-based domain structure, evolution and dynamics have not been explored yet. Along with this, the integration of EuO layers with layers such as Graphene or metallic FM leads to fluctuations at the interface, bringing fundamental changes in the physical properties [3]. Such integration and exploring novel physical properties in Eu-based compounds have been explored recently [4]. The present work focuses on the magnetization reversal mechanisms and domain images in EuO and EuO/FM-based heterostructures probed using magneto-optic Kerr microscopy.

Using different approaches, we synthesized EuO films and EuO/Co heterostructure samples using molecular beam epitaxy on Nb-doped SrTiO₃ substrates [5]. In order to investigate the magnetic domains and their evolution, we carried out Kerr microscopy measurements. We observed the differences in the domain saturation behavior as well as the Kerr rotation below T_c depending on film thickness and interface with Co. This was performed by magnetic hysteresis measurement and simultaneous domain imaging using a Kerr microscope. We measured hysteresis at various temperatures below and above T_c to explore the temperature-dependent magneto-optic effects in EuO/Co heterostructure. The magnetic proximity effect leads to fluctuations in magnetic domains in the EuO/Co sample as compared to the EuO film. This study of proximity effect-induced changes in magnetic domains in EuO due to the Co layer can be helpful in the T_c enhancement and provide insights into achieving room-temperature FM in EuO films.

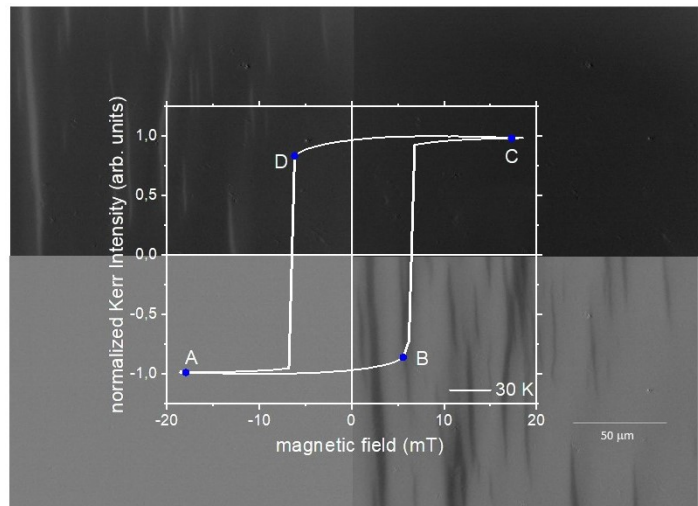


Fig. 1: Domain images shown below different points of the hysteresis loops (A-D) showing ferromagnetic domain evolution in image B and D in EuO films at 30 K.

References:

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