

Direct observation of electric field effect on the interface magnetic state of GdO_x/Co thin films by fluorescence-yield depth-resolved soft x-ray absorption spectroscopy

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Electric field-induced modification of magnetism at the interface of GdO_x/Co thin film is investigated by means of soft x-ray absorption spectroscopy (XAS). It is found from x-ray magnetic circular dichroism (XMCD) measurement that remanent magnetization of Co is smaller when the positive electric field is applied to the film, as compared to the film with the negative field. In addition, fluorescence-yield depth-resolved XAS analysis reveals that the interfacial Co layer at the interface is composed of Co oxide when the negative field is applied, while in the case of the positive field, the metallic Co is dominant, as shown in Fig.1. The interfacial Co layer shows no XMCD signal regardless of the electric field, while in the case of the inner layers, enhancement of the orbital magnetic moment is suggested at the negative field. We suppose that the interfacial Co oxide layer is produced by the oxygen migration from the GdO_x layer at the negative field while the interfacial layer shows metallic at the positive field. These interfacial Co layers exist as a magnetically dead layer therefore the field-induced magnetic modification could be attributed to the structural change in the inner layer. We suppose that such structural change modifies the orbital moment which results in change of magnetic anisotropy in Co.

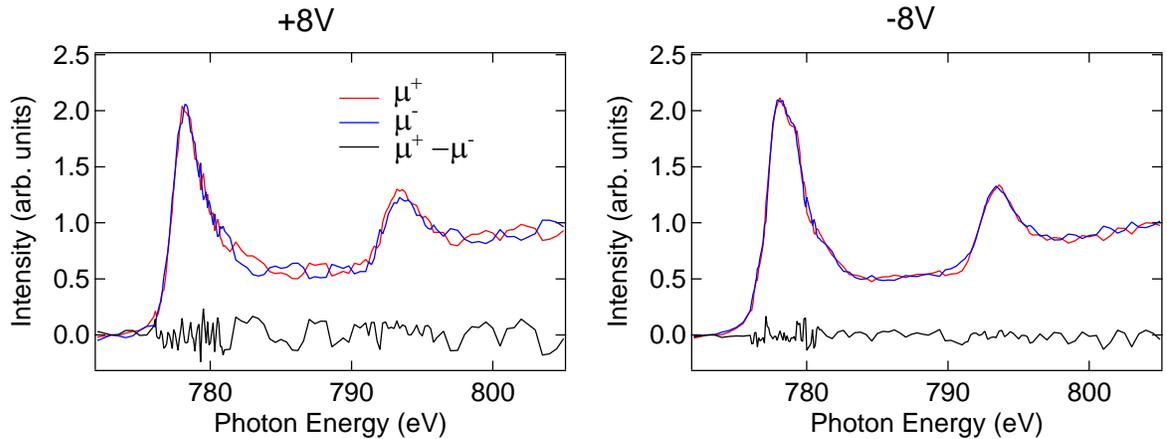


Fig.1: Depth-resolved Co L-edge XAS, μ^+ and μ^- , and XMCD, $\mu^+ - \mu^-$, spectra of GdO_x/Co thin films measured at Photon Factory BL-16A. XAS component of the interfacial Co layer is extracted. Positive (left) and negative (right) electric fields are applied to the film surface.