Voltage-induced magnetic anisotropy change in Fe|MgO tunnel junctions investigated by x-ray absorption spectroscopy

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Voltage-induced magnetic anisotropy change has attracted great attentions as a low energy magnetization control methods for spintronics devices. One possible origin of the anisotropy change is modulation of the electron filling at the surface of ferromagnets.[1] In addition, voltage-induced surface oxidation/reduction [2,3] may influence the interfacial magnetic anisotropy. To discuss in detail, in this study, we have prepared Fe/MgO tunnel junctions and have performed x-ray absorption spectroscopy (XAS) under external voltage.

MgO(100)substrate| MgO(5 nm)| V(30 nm)| Fe(0.65 nm)| MgO(2 nm) multilayer was fabricated by molecular beam epitaxy methods.(Fig.1) After breaking vacuum, we deposited SiO_2(5 nm) by sputtering and Cr(2 nm)| Au(5 nm) by electron beam deposition. The film was patterned into tunnel junctions of 80 μm in diameter by using photolithography and Ar ion milling. Fig.2 shows XAS spectra. The XAS was conducted at BL25SU beamline of SPring-8. We measured fluorescence yield using silicon drift detector (SDD). Magnetic field was applied tilted 30 degrees from out-of-plane. As shown in Fig.2, spectrum shape of Fe L_2, L_3 edges were unchanged with changing the polarity of voltage ($\pm$4 V). This result indicates that voltage-induced anisotropy change in the Fe|MgO tunnel junction was independent of voltage driven surface oxidization/reduction at the Fe/MgO interface.

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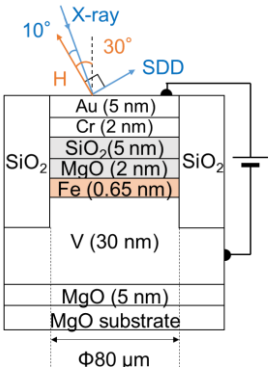

Fig.1 Sample structure

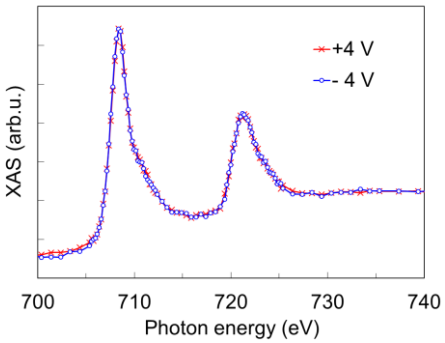

Fig.2 XAS spectrum

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