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XMCD/XLD Study of the Magnetoelectric Coupling Mechanism in the Multiferroic Composite Co/PMN-PT(011)

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Multiferroic composites are promising candidates amongst the strategies to achieve electric field control of magnetism. In compounds consisting of ferromagnetic and ferroelectric (FE) layers strain can couple the FE phase via the piezoelectric effect to the magnetic phase employing magnetostriction.
Pb(Mg1/3Nb2/3)O3-[PbTiO3]x (PMN-PT) is a relaxor FE with strong piezoelectric properties near the morphotrophic phase boundary x=0.3 [1] - Wu et al. reported on a remanent in-plane FE polarization for PMN-PT (011) in addition to the two out-of- plane polarization directions [2]. The impact of the FE order of PMN-PT (011) on the electronic and atomic structure of a Co top layer is studied using X-ray magnetic circular dichroism (XMCD) and X-ray linear dichrosim (XLD) for Co and Ti respectively. We observe the development of a magnetic easy axis upon rotating the FE polarization to in-plane due to strain-mediated coupling (see Fig. 1, red curve). The data suggest an additional charge driven magnetoelectric coupling due to electron accumulation/depletion at the Co/PMN-PT interface(Fig. 1,green and blue curve). Moreover, the Ti data shows a change in the spectrum with applied voltage which is described with the help of multiplet calculations.

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