

DETERMINING THE PRESENCE OF SPIN DYNAMICS IN COBALT FERRITE THIN FILMS USING XUV-RA SPECTROSCOPY

STEPHEN LONDO, SOMNATH BISWAS, JAKUB HUSEK, ROBERT BAKER, *Department of Chemistry and Biochemistry, The Ohio State University, Columbus, OH, USA.*

Spin crossover (SCO) metal-organic complexes have seen recent advances for their applicability in spintronic devices by exhibiting bidirectional stability between high-spin (HS) and low-spin (LS) states upon application of external stimuli. However, adsorbing these molecular complexes onto surfaces can dramatically change their SCO characteristics so alternative materials are being explored. Cobalt ferrite (CFO, CoFe_2O_4) thin films are presently studied for their ability to induce magnetism but may exhibit SCO the same way Fe/Co Prussian Blue molecular analogs SCO after photoexcitation. To investigate the potential SCO dynamics of CFO, we employ reflection-absorption extreme ultraviolet (XUV-RA) spectroscopy which is element and oxidation state specific and sensitive to changes in the local geometry and spin state. Photoexciting CFO initiates an electron transfer from Co^{2+} to Fe^{3+} , reducing iron and oxidizing cobalt. By comparing time-averaged experimental spectra to charge-transfer multiplet simulations, we find excellent agreement with LS Co^{3+} CFO indicating a SCO from native HS Co^{2+} after photoexcitation. Kinetic analysis using a two-state sequential model produces a SCO time constant of 245 ± 30 fs and the initial and final state solutions agree well with simulated HS and LS Co^{3+} CFO spectra respectively. The driving mechanism for SCO is small hole polaron formation evident by changes in the oxygen L_1 -edge signature. Hole polarons compress the oxygen lattice around photoexcited Co^{3+} increasing the crystal field splitting of hybrid Co^{3+} $3d$ orbitals and enabling the initially blocked oxygen $2s \rightarrow 2p$ transition. These results demonstrate the ability of XUV-RA to capture the femtosecond spin dynamics of metal oxide materials and provides insight into the SCO characteristics of CFO for use in spintronic devices.