

## OBSERVING TRANSIENT MAGNETIC OXIDATION STATES WITH MAGNETIC CIRCULAR DICHROISM SPECTROSCOPY

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Electron transfer induced by the optical pumping of systems leads to the formation of transient species that can be observed by time-resolved optical spectroscopy. However traditional linear spectroscopy cannot detect the formation of transient magnetic species formed by spin-polarized pump excitation of electrons. These transient magnetic species can be long-lived and have a wide variety of applications in spintronics and photocatalysis.

In this talk, we utilize time-resolved XUV magnetic circular dichroism spectroscopy to detect transient magnetic states in Yttrium Iron Garnet ( $\text{Y}_3\text{Fe}_5\text{O}_{12}$ , YIG). This method provides direct observation of electron dynamics at the surfaces with element and spin state resolution. YIG is a ferrimagnetic semiconductor with two different lattices of tetrahedral and octahedral Fe(III) atoms with opposite spins. The measurements on YIG show lattice-dependent electron dynamics upon photoexcitation. When excited above the bandgap, a charge transfer occurs from oxygen to iron atoms. Depending on the lattice of iron where the electron is excited, the dynamics of these charge transfer electron varies. The electrons in the octahedral iron form a small polaron at the surface. The tetrahedral electrons are more mobile and diffuse from surface to bulk forming a natural spin filter. This filtering of spin depending on the lattice causes the surface to be spin-polarized. This spin-polarized electron localizes in the oxygen and octahedral iron atoms on the surface due to exchange interaction and can be observed with XUV-MCD Spectroscopy.