Seminar announcement

Tuesday, May 9, 2023
1:30 pm
WSI, Seminar room S 101

"Visualizing electron dynamics at interfaces using XUV light"

Electron dynamics at surfaces mediates the efficiency of numerous processes from solar energy conversion to ultrafast information processing. Toward the goal of understanding these dynamics, we have developed extreme ultraviolet reflection-absorption (XUV-RA) spectroscopy. This method combines the benefits of X-ray absorption spectroscopy, including element, oxidation, and spin state resolution, with surface sensitivity and ultrafast time resolution. This technique now enables direct observation of charge and spin dynamics in materials with applications ranging from ultrafast spin crossover in magnetic semiconductors to electron dynamics at photochemical interfaces. As a recent example, we perform a detailed investigation of the electron dynamics in yttrium iron garnet ($Y_3Fe_5O_{12}$, YIG). YIG is a ferrimagnetic semiconductor, consisting of two sub-lattices based on octahedrally and tetrahedrally coordinated Fe(III) centers. Despite the similar electronic structures of YIG and hematite (α-Fe_2O_3), YIG significantly outperforms hematite as a water oxidation catalyst, displaying an order of magnitude increase in photocurrent density and a factor of two increase in Faradaic efficiency for H_2O over H_2O_2. Probing the charge and spin dynamics by surface sensitive XUV spectroscopy reveals that the enhanced performance arises from 1) reduced polaron formation in YIG compared to hematite and 2) intrinsic spin polarization of catalytic photocurrents in YIG. Finally, I will highlight new capabilities for that will soon become available at the National eXtreme Ultrafast Science Facility (NeXUS). NeXUS is an open access user facility under development at Ohio State University, which will enable studies of electron dynamics in molecules and materials with femtosecond to attosecond time resolution.

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