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Probing Ultrafast Electron Dynamics at Surfaces Using Soft X-Ray Transient Reflectivity Spectroscopy L. ROBERT BAKER, JAKUB HUSEK, SOMNATH BISWAS, ANTHONY CIRRI, Ohio State Univ - Columbus — The ability to probe electron dynamics with surface sensitivity on the ultrafast time scale is critical for understanding processes such as charge separation, injection, and surface trapping that mediate efficiency in catalytic and energy conversion materials. Toward this goal, we have developed a high harmonic generation (HHG) light source for femtosecond soft x-ray reflectivity. Using this light source we investigated the ultrafast carrier dynamics at the surface of single crystalline α-Fe_2O_3, polycrystalline α-Fe_2O_3, and the mixed metal oxide, $CuFeO_2$. We have recently demonstrated that $CuFeO_2$ in particular is a selective catalyst for photo-electrochemical CO_2 reduction to acetate; however, the role of electronic structure and charge carrier dynamics in mediating catalytic selectivity has not been well understood. Soft x-ray reflectivity measurements probe the $M_{2,3}$ edges of the *3d* transition metals, which provide oxidation and spin state resolution with element specificity. In addition to chemical state specificity, these measurements are also surface sensitive, and by independently simulating the contributions of the real and imaginary components of the complex refractive index, we can differentiate between surface and sub-surface contributions to the excited state spectrum. Accordingly, this work demonstrates the ability to probe ultrafast carrier dynamics in catalytic materials with element and chemical state specificity and with surface sensitivity.

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