# Time resolved photoelectron imaging with an XUV high harmonic source

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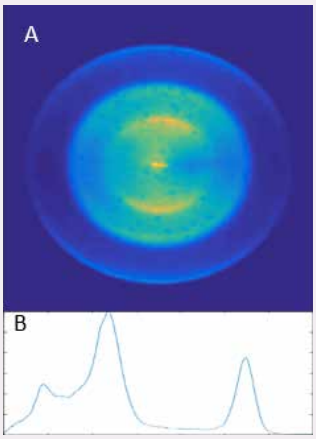
We have performed a UV pump-VUV probe photoelectron imaging experiment on the photodissociation dynamics of CS2. The dynamics in the $CS_2$ molecule is initiated using a 70 fs 200 nm pump that populates the $S_2$ excited state of the molecule. Once in the excited state the molecule dissociates on a sub picosecond timescale leading to the formation of CS and S. The dynamics are probed by a delayed VUV probe at 15.5 eV. The probe is generated using high harmonic generation with a driving 400 nm pulse. The 15.5 eV harmonic is then separated from the other harmonic frequencies in a time preserving monochromator. The probe is then used to ionise both the excited state and remaining ground state population. Analysis of the changes in the resulting photoelectron images show features that correspond to ground state depletion and the delayed formation of the dissociation products.




*Photoelectron image (A) and spectrum (B) of $CS_2$ following excitation with UV (6.2 eV) and probing with XUV (15.5 eV) light.*

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# Decay dynamics of conduction band electrons on hydroxylated $TiO_2$

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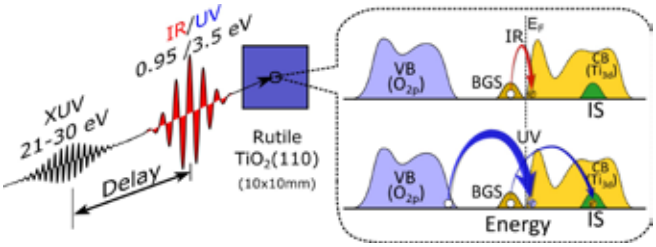
We performed IR/UV-pump XUV probe experiments on a rutile $TiO_2$(110) surface. The pump energies, either larger or smaller than the band gap of rutile $TiO_2$, are chosen to distinguish the dynamics of different charge carriers. A trapping time of ~50 fs of electrons at the bottom of the conduction band is observed in the IR-pump XUV-probe measurements. In the UV-pumped measurements, the fast electron dynamics will also arise from electron trapping as it lies in a similar time scale. In addition, slow processes with lifetimes extending up to picoseconds can be understood under the scheme of trap-assisted recombination. This observation confirms the critical role of the band gap states to the annihilation of electrons and holes under low illumination conditions, which has long been proposed in photochemistry studies of $TiO_2$.




*Schematic of the IR-/UV-pump XUV-probe experiments. The pump pulses are either 1300 nm (0.95 eV) or 350 nm (3.5 eV), which are followed by an XUV (21 and 30 eV, respectively) pulse with a controlled delay time. The IR pulse can create excitations from the BGS to the CB bottom, while UV can create excitations from the VB to CB bottom (big arrow) and from the BGS to a resonant intermediate state (IS) in the CB manifold (small arrow).*

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