NANOSCIENCE COLLOQUIUM

Using time-resolved X-ray spectroscopy to probe ultrafast charge carrier dynamics in functional materials

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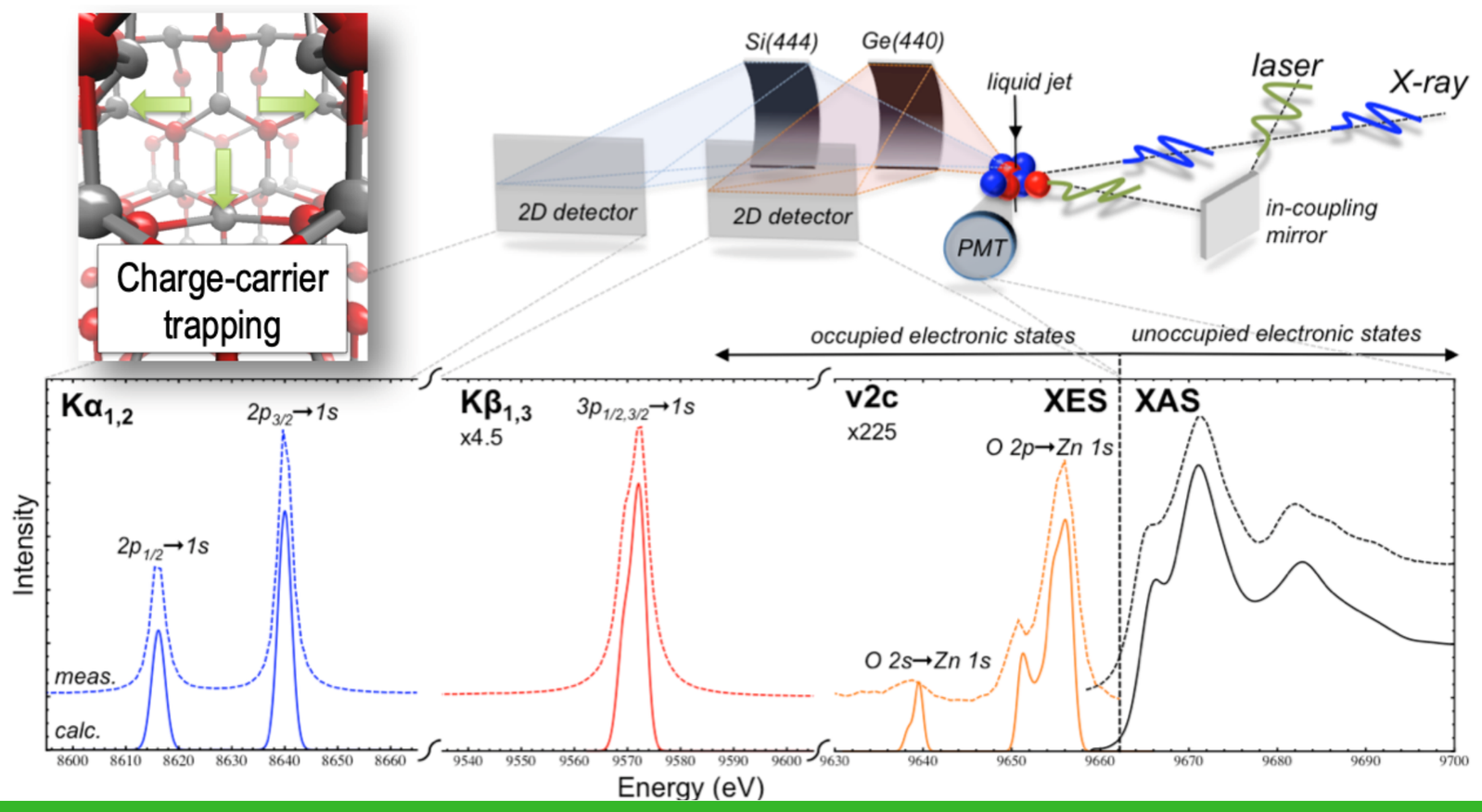
Abstract: X-ray spectroscopy allows a unique combination of electronic and structural information to be obtained from a variety of different types of samples (solid, liquid, gas). The extension of these methods into the time domain has allowed measurement of dynamic processes, for example the catalysis of a chemical reaction in situ. In recent years X-rays have started to become routinely used to measure light-activated processes using a pump-probe scheme, where the sample is photoexcited with light and then probed after a variable time delay using an X-ray pulse. These methods can measure dynamics over a broad range of timescales, allowing them to probe everything from slow protein dynamics to ultrafast charge carrier relaxation in functional materials. With the recent introduction of X-ray free electron lasers (XFELs), time-resolved X-ray techniques have moved into the ultrafast regime, where the timescales of electron and nuclear motion can be accessed using the femtosecond X-ray pulses available from these facilities. This talk will present an overview of the information that can be obtained using X-ray spectroscopy and present an example of using X-ray spectroscopy to probe charge carrier dynamics in metal-oxide nanostructures using both 'slow' storage ring X-ray pulse and 'fast' XFEL X-ray pulses. These measurements on ZnO allowed the identification of the structural defect that is responsible for both the photoluminescent and photocatalytically active properties of the material. Finally the talk will introduce the European XFEL, a brand-new, high-repetition rate XFEL facility located in Schenefeld, just north of Hamburg, and will present some examples of the types of measurements the facility can perform and the scientific questions that can be answered using X-ray techniques



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12.10.2021
1:15 pm | Zoom

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