

MS39-O5 X-ray study of femtosecond structural dynamics of the charge-density wave compound 1T-TaS₂

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1T-TaS₂ is a 2D metallic compound which undergoes a series of electronically driven phase transitions toward charge density wave (CDW) and Mott phases. In this paper, we present femtosecond pump-probe X-ray diffraction experiments, carried out at the X05LA beamline of the Swiss Light Source in two of the low-temperature phases of 1T-TaS₂.

In the low temperature Mott phase, we study the coherent phonon induced by the infrared 800 nm laser pulse, while in the so-called near-commensurate CDW phase, we have studied the mechanism of the phase induced phase transition toward another incommensurate phase, where a fast coarsening process is clearly observed.

Keywords: ultra-fast , diffraction , charge-density wave

MS40 New detectors for high energy x-ray applications

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MS40-O1 Hard X-ray photon counting with "LAMBDA" high-Z detectors

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Photon-counting hybrid pixel detectors are now the technology of choice for a wide range of X-ray scattering experiments, due to their excellent signal-to-noise ratio and high speed. However, most photon-counting detectors use silicon as a sensor material, limiting their detection efficiency in hard X-ray experiments. By replacing the silicon sensor with a "high-Z" (high atomic number) semiconductor, these detectors can also be applied to hard X-rays.

"LAMBDA" is a photon-counting hybrid pixel detector with a relatively small pixel size (55µm), high-speed readout at 2000 fps (deadtime-free), and a modular design that makes it possible to build large detector areas. Prototype LAMBDA systems using different high-Z semiconductors – GaAs, CdTe and Ge – have been built and tested to compare their performance. GaAs and CdTe both show some nonuniformities, but display sufficiently good performance for some experiments; in particular, GaAs shows good stability with time and irradiation, and good image quality after flat-field correction. Ge is at an earlier stage in development, but shows improved image quality.

A 2-megapixel LAMBDA system for hard X-ray detection has been built using GaAs sensors. This system has been used at the PETRA-III synchrotron to perform high-speed diffraction experiments, demonstrating a combination of high speed and sensitivity. For example, in experiments studying compression of Bi during rapid compression in a diamond anvil cell, it was possible to observe changes of phase on sub-millisecond timescales.

Keywords: pixel detector, high energy, photon counting