The quick EXAFS setup at beamline P64 at PETRA III for up to 200 spectra per second

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The quick scanning EXAFS (QEXAFS) setup at the undulator beamline P64 at the high brilliance source PETRA III (DESY, Germany) is in user operation for about a year and has been optimized continuously. One of its main features is a dedicated cyro-cooled monochromator which is driven by a direct drive torque motor inside a goniometer, covering X-ray energies from 4.5 keV to 44 keV [1, 2]. The maximum oscillation frequency of the channel-cut Si(111) and Si(311) crystals has been increased to 100 Hz which corresponds to a time of 5 ms per spectrum. The improved electrical drive decreases the heat load on the motor and suppresses electrical resonances. In addition, much slower scans up to 60 s/spectrum for slower detection methods become possible, closing the gap to conventional EXAFS measurements. The influence of tapering the undulator on different harmonics to obtain the required energy range for the spectra will be discussed.

For detection gridded ionization chambers and fast current amplifiers with rise times of a few microseconds [3] are installed in the experimental hutch which allow to resolve high quality XAFS spectra even at the highest repetition rates. The signal to noise ratio has been increased by a factor of about 4 by further optimizing the current amplifiers and readout of the input voltage of the 2 MHz 16 bit ADC. The data acquisition and analysis is accomplished with dedicated software packages and National Instruments hardware to handle the large amounts of data, which are typically collected in experiments lasting up to a few hours. The effects of averaging on the highly oversampled spectra will be shown.

For surface sensitivity and samples which do not allow measurements in transmission mode a fast setup for fluorescence detection with a PIPS detector with matched amplifiers for faster response times and a 2-circle goniometer setup for reflectivity measurements have been added. First user experiments included in-situ and operando catalysis for various applications as well as surface sensitive measurements of the reduction of heated steel surfaces in different gas atmospheres for brazing applications in fluorescence and reflection mode.

The optimization is ongoing and the system is open for beamtime applications. The performance of the system will be discussed in detail and typical scientific results will be presented. The project is supported by BMBF, grant numbers 05K13PX1 and 05K10PX1.

References

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