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Instrumentation for time resolved X-ray absorption spectroscopy at PETRA III

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After its transformation into a dedicated high brilliance synchrotron source, several efforts have been made to implement the opportunity of time-resolved X-ray absorption spectroscopy (XAS). Thanks to the intense photon beam delivered by a tapered undulator in a wide energy range from about 4-40 keV, a time resolution in the millisecond range appears feasible from theory, needing however dedicated equipment to achieve this challenge. In this presentation, we will summarize the related activities from the past few years. Since the achievable temporal resolution of XAS is limited by the mechanical stability of the monochromator, a design with channel-cut crystals was employed, due to the positive experience with fast-oscillating double-crystal monochromators. The oscillating movement was realized by implementing a direct drive torque motor here, instead of a purely mechanically driven system. The actual Bragg-angle of the monochromator was measured by angular encoders, and in order to cope with the high heat load of the undulator, cryogenic cooling using liquid nitrogen is mandatory. Furthermore, fast detection systems comprising the detector, the read-out electronics as well as spectroscopic amplifiers with a response time in the microsecond range have been developed. Finally, software for data recording and analysis of several thousand EXAFS spectra has been realized.

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