High-resolution dispersive emission spectrometer at PETRA III XAFS beamline P64

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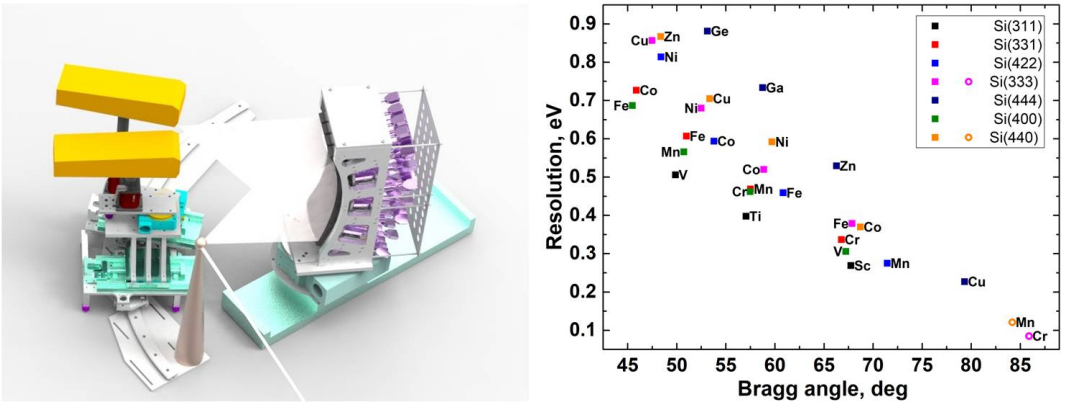
In the present work, we designed and build a dispersive emission spectrometer in von Hamos geometry [1]. It covers an energy range of 4-20 keV with an energy resolution better than 1 eV in all possible configurations. The spectrometer is installed at the high-flux XAFS beamline P64 at PETRA III (DESY, Hamburg, Germany).

In the design phase, x-ray tracing based on the XRT code [2] was performed to optimize the configuration and to evaluate the performance which may be expected. All mechanical parts, such as crystal holder array, crystal holders and detectors positioning system were designed to fulfil all requirements of the spectrometer. Special care was taken to enable so-called "two color" experiments when several emission lines, either from one or two elements, are measured by two detectors simultaneously.

The x-ray emission signal currently is collected by 6 (up to 16 at a later stage) cylindrically curved Si crystals and focused on a 2D detector (XSpectrum Lambda). To reduce x-ray absorption and scattering by air we use a He filled enclosure between sample environment, analyser crystals and detectors. The spectrometer design allows using various sample environments, for example liquid jet, liquid He cryostat, etc. One of the special applications of the spectrometer will be studying chemical reactions and catalytic processes using a custom made setup for photocatalytic experiments.

In this presentation we will describe the design and development process of the spectrometer and also mention difficulties and challenges. The measured performance of the spectrometer will be compared to the simulation. Finally, typical applications of the spectrometer and recently achieved experimental highlights will be presented.



(left panel) Schematic drawing of the spectrometer. (right panel) Estimated resolution of the spectrometer at selected emission lines.

References

[1] L. v. Hamos, Naturwiss. 20, 705, (1932)

[2] K. Klementiev and R. Chernikov, Proc. SPIE 9209, Adv. Comp. Methods for X-Ray Optics III, 92090A