New von Hamos-type spectrometer at PETRA III P64 beamline

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In recent years von Hamos-type spectrometers became popular at synchrotron and x-ray free electron laser facilities because of extremely high photon flux available at these machines. The advantage of the von Hamos geometry is the ability to disperse emitted x-rays and at the same time to focus them. That allows getting complete element characteristic emission line or lines on the 2D detector without any mechanical movements and at the same time maintaining high energy resolution. However, the efficiency of such spectrometer is rather low due to limited analyzer crystal area which is utilized to disperse emitted x-rays. To overcome this drawback and to improve signal-to-noise ratio or to reduce measurement time, multi crystals von Hamos-type spectrometer was introduced.

During this work multi crystal and multi detector von Hamos-type spectrometer was designed and implemented at PETRA III P64 beamline. In the design phase x-ray tracing procedure, based on XRT x-ray tracing code, was performed to optimize the configuration and to evaluate expected performance of the spectrometer. All mechanical parts, such as crystal holder array, crystal holders and detectors positioning system were designed to fulfill all requirement 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. This feature is especially useful while studying multi component systems. One of the main applications of the spectrometer is to study 3d metal containing catalysts by measuring Kβ main lines and its satellites - Kβ1,3 and Kβ2,5 during chemical reactions or catalytic processes using custom made setup for photocatalytic experiments. It should be noted that the spectrometer can be used with other sample environments, for example liquid jets, liquid He cryostat, etc.

In this presentation I will guide you through the design and development process of the spectrometer and mention difficulties and challenge. I will present comparison of the calculated versus real performance of the spectrometer. And finally, I will describe typical applications of the spectrometer and present recent experimental highlights achieved using the spectrometer.