Development of a laboratory based quick X-ray absorption and emission spectrometer in a Von Hamos geometry

P. Tack, L. Vincze

X-ray Micro-spectroscopy and Imaging group, Ghent University, Krijgslaan 281 S12, 9000 Ghent, Belgium, **Pieter.Tack@UGent.be**

Currently, the application of X-ray absorption spectroscopy (XAS) and X-ray emission spectroscopy (XES) is mainly reserved for synchrotron radiation facilities due to the need for an intense, energy tuneable, narrow bandwidth X-ray beam. However, due to the high demand for measurement time at these facilities and their limited accessibility, experiments are usually granted through a highly competitive peer-reviewed proposal process, and are usually limited to a few days of available 'beam time' per year.

The development of a laboratory based XAS/XES spectrometer will provide an alternative for experiments that do not necessarily require e.g. highly focussed X-ray beams or very fast acquisition speeds. In addition, the laboratory based spectrometer can improve experiments that are currently performed at synchrotron radiation facilities by performing initial tests, pre-characterization and identification of samples of interest, resulting in more streamlined and efficient synchrotron experiments.

One typical drawback of laboratory based XAS/XES spectrometers is the significantly reduced photon flux with respect to synchrotron radiation facilities, and thus reduced data statistics and increased measurement times[1]. The proposed device will resolve these matters in several ways: i) the spectrometer makes use of a 80 W X-ray tube, providing an integrated photon flux in the order of 10^{10} ph/s. The absorbed or emitted X-rays are detected by a position sensitive energy dispersive CCD detector (SLcam, Colour X-ray Camera)[2] in a quick-XAS/XES geometry, which allows for the detection of a full XANES/XES spectrum without the need for scanning by the monochromator crystal. ii) Additionally, the SLcam's energy dispersive properties will result in an improved signal-to-background ratio as a X-ray photon energy region of interest can be monitored selectively, without interference of other fluorescent, scattered or higher order diffracted radiation. In XAS, this approach has also been shown to partially improve the spectral energy resolution[3].

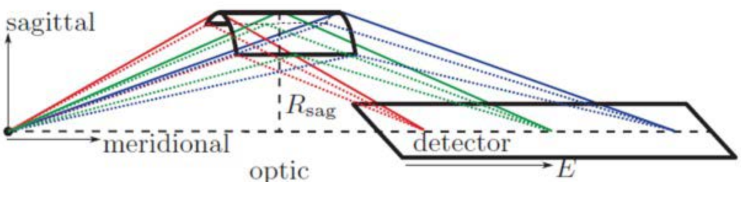

Figure 1: Schematic overview of the Von Hamos geometry for a XAS/XES spectrometer. Figure adapted from Anklamm et al.[1b]

References

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