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Tender X-ray Photon-In/Photon-Out Spectroscopy at ESRF ID26

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The energy range between 1.5 and 4.5 keV (tender X-rays) covers the K-edges of Al, Si, P, S, Cl, K and Ca, the L-edges of 4d transition metals and the M-edges of actinides. 4d transition metals and actinides can also be measured in the hard x-ray range but the smaller lifetime broadening and favorable selection rules to probe the valence orbitals directly make the tender X-ray range interesting also for those elements. X-ray emission spectroscopy (XES) in combination with X-ray absorption spectroscopy (XAS), photon-in/photon-out spectroscopy, can provide sharper spectral features and allows studying the occupied and unoccupied density of electronic states thus providing a wealth of information.
Tender X-ray emission spectrometers have been realized in dispersive and scanning geometries at various synchrotron radiation end-stations and at laboratory X-ray sources. Beamline ID26 at the ESRF features an instrument in non-dispersive, scanning geometry that employs eleven Johansson crystals in combination with a gas proportional counter or a pixel detector [1]. The 80 mm long Si crystal wafers are cylindrically bent to 1m radius in the meridional plane. The sagittal dimension is 25mm requiring a large detector surface of 50 x 25 mm2. The angular range of the instrument is 35 to 85 degrees. This tender X-ray spectrometer (TEXS) is currently by far the most efficient instrument for high-energy-resolution fluorescence-detected (HERFD) XAS studies in the world.
With the energy transition the requests for in situ and operando studies of materials has dramatically grown. Carrying out such studies in the vacuum chamber of the ID26 tender X-ray instrument has thus become a top priority. To this end, an operando cell for catalysis experiments was developed and commissioned [2]. The presentation will present some fundamental considerations for tender X-ray photon-in/photon-out spectroscopy as well as the ID26 spectrometer with the operando cell.
[1] Rovezzi et al. https://doi.org/10.1107/S160057752000243X
[2] Suarez Orduz et al. https://doi.org/10.1002/cmtd.202300044

I plan to submit also conference proceedings

No

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