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High-transmission soft x-ray spectroscopy: rRIXS maps with the X-SPEC beamline at the KIT Light Source

Material and device development crucially depend on an in-depth characterization of the electronic and chemical properties of the involved materials and their interfaces. Traditionally, (soft) x-ray spec-troscopy techniques are very powerful and well-established tools for probing the electronic and chem-ical structure. Many instrumental advances have been achieved over the last decades, mostly focusing on high-resolution (and thus unavoidably low-transmission) instruments, which are particularly im-portant for fundamental studies of well-defined systems. In contrast, the investigation of real-world devices requires highly sensitive (high-transmission) probes that are able to measure trace elements, minimize the x-ray dose to prevent beam-induced changes, and are ideally also applicable in an *in situ/operando* environment. At the same time, some of the most relevant materials questions concern the chemical bonding in the materials and how they react to changes in processing or operating condi-tions, which does not require the highest possible energy resolution, but speed and sensitivity. In our efforts at KIT, we focus on developing x-ray spectroscopy techniques and the necessary experimental detection systems for this type of application, which has led to the development of the SALSA (Solid and Liquid Spectroscopic Analysis) experimental station, novel soft x-ray spectrometer concepts, as well as the X-SPEC beamline and its endstations at the KIT Light Source.
This presentation discusses these experimental setups, the methodological advances they enable, and, in particular, the recent development of a high-transmission soft x-ray spectrometer for ultra-fast x-ray emission spectroscopy (XES) and rapid resonant inelastic (soft) x-ray scattering maps (rRIXS maps) as a powerful tool for applied materials research.

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