

Combining advanced spectroscopic techniques with operando measurements

X-ray spectroscopy allows studying the electronic structure element-selectively. This is used to great effect in in situ and operando studies that aim to understand the local coordination and electronic structure of the active site. X-ray absorption spectroscopy in the hard X-ray

(>5 keV) range has been combined with in situ studies for decades. Advanced X-ray spectroscopic techniques, that also analyze the emitted or scattered X-rays (photon-in/photon-out spectroscopy) providing significantly more insight, are becoming available at an increasing number of experimental stations at synchrotron radiation sources worldwide. I will give examples for in situ and operando studies in catalysis and battery research using photon-in/photon-out spectroscopy.