HARMONY-X

HARMONY-X aims at yielding a full understanding of electrochemical devices (batteries, electrocatalysts, …) – from surface chemistry to bulk structure. For this purpose, a large energy range is covered (soft-to-tender to slightly hard X-rays) and multiple techniques will be combined: spectroscopy, spectral imaging and scattering. The instrument will enable quantitative studies, leveraged by a collaboration with PTB, as well as long-term *operando* studies, supported by specialised sample environment (battery hotel with automated sample changes). HARMONY-X will benefit from BESSY III's high brilliance in two ways: for high-throughput measurements at the microfocus branch and for high spatial resolution experiments at the nanofocus branch. It will connect to experiments on campus for battery synthesis and characterisation, including industrial collaborations.

Instrument	HARMONY-X *(High-throughput Analysis with Range-bridging Multimodal Operando Nano-spectroscopY with X-rays)*
Contact	Sebastian Risse (sebastian.risse@helmholtz-berlin.de) Philipp Hönicke (philipp.hoenicke@helmholtz-berlin.de)
Source(s)	Undulator IVU28 (500 – 8000 eV, linear polarisation)
Beamline capabilities	Microfocus branch: • Energy range: 500-8000 eV • Resolving Power: > 6000 • Focus Size: 3x3 μm^2 • Flux: 10^{12} ph/s Nanofocus Branch: • Energy range: 500-8000 eV • Resolving Power: > 6000 • Focus Size: 300x300 nm^2 • Flux: 10^{10} ph/s
Techniques	At both branches: • quantitative XAS/XRF • *operando* XRD and ptychography • *operando* transmission EXAFS • spectromicroscopy (*operando* capable) • XES or RIXS (*operando* capable)
Sample environment	• Sample hotel at microfocus branch (automated sample changer, *operando* capabilities, enabling long-term measurements) • Sample tray with ≈8 samples at both branches (*operando* capabilities) • Temperature range: ~20°C – 80°C at microfocus branch, extended range at nanofocus branch • Adaptable soft-X-ray sample cells for batteries and other electrochemical devices