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Spectroscopic micro-imaging with off-axis zone plates

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Soft X-ray spectroscopies usually average the observed response of a sample across the entire illuminated area. This restricts the obtainable information, especially if the sample is inhomogeneous (either because of electronic domain formation or patterning on the micro- and nanoscale). Formation of electronically distinct domains has been observed for various quantum materials. A complete understanding thus necessitates a domain-resolved experimental approach.
We demonstrate the implementation of an experimental setup, build around an off-axis Fresnel zone plate, which enables imaging X-ray absorption spectroscopy and resonant inelastic X-ray scattering with a current spatial resolution down to 1.8µm. The zone plate, located between sample and detector, disperses X-rays scattered from the sample and also images the sample along the direction perpendicular to the dispersion. Incident X-rays are focused to a 1mm long line such that excitation spectra from each point along the line are measured in-parallel.
In a microstructured VO2 thin-film, we find that the structure edges undergo the insulator-metal transition earlier than the centers, hinting at facilitated strain release. We believe that the observed effects apply in general to patterned films of quantum materials and provide a tool for adequate experimental studies.
Reference: J.O. Schunck et al. Optica 8(2), 2021

Primary author: SCHUNCK, Jan Oliver (Deutsches Elektronen-Synchrotron DESY)

Co-authors: Dr DÖRING, Florian (Paul Scherrer Institut, Villigen PSI, Switzerland); Dr RÖSNER, Benedikt (Paul Scherrer Institut, Villigen PSI, Switzerland); Dr BUCK, Jens (Institut für Experimentelle und Angewandte Physik, Kiel University, Kiel, Germany); Mr ENGEL, Robin (Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany); Dr MIEDEMA, Piter (Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany); Dr MAHATHA, Sanjoy Kr (Ruprecht Haensel Laboratory, Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany); HOESCH, Moritz (DESY Photon Science); Dr PETRARU, Adrian (Nanoelektronik, Technische Fakultät, Kiel University, Kiel, Germany); Prof. KOHLSTEDT, Hermann (Nanoelektronik, Technische Fakultät, Kiel University, Kiel, Germany); Dr SCHÜSSLER-LANGEHEINE, Christian (Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Germany); ROSSNAGEL, Kai (DESY / CAU Kiel); DAVID, Christian; BEYE, Martin (DESY)

Presenter: SCHUNCK, Jan Oliver (Deutsches Elektronen-Synchrotron DESY)