OPTIMUS 2

Augmented On-Axis TKD in the SEM

TKD

Innovation with Integrity

Unmatched Solution for Nanomaterials Characterization in the SEM

OPTIMUS 2 is an add-on option of the e-Flash EBSD detectors which makes the on-axis Transmission Kikuchi Diffraction (TKD) technique possible as well as STEM-like imaging on electron transparent samples in the SEM. Building on its predecessor's unrivalled performance, OPTIMUS 2 brings new analytical capabilities for in-situ experiments, vastly improved spatial resolution, data quality and data integrity.

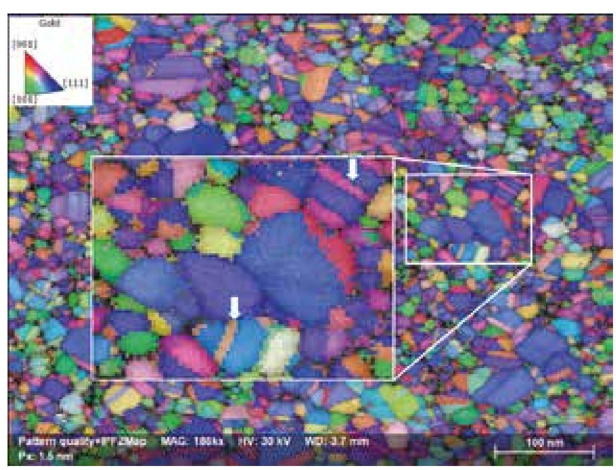
New features of OPTIMUS 2

- OPTIMUS Vue screen with silicon diode at its center for Bright Field (BF) STEM-like imaging
- Advanced alloys for minimized interference with e-beam
- Additional new thin film in the screen active layer structure for improved signal quality
- Optimized screen frame design for an improved user experience

Enabling nanoscale TKD mapping in the SEM

Available since 2015, on-axis TKD has offered the best spatial resolution capabilities during orientation mapping in a SEM. Bruker's latest TKD solution brings significant technology advances to push the limits of spatial resolution even further:

- **OPTIMUS Vue** screen provides the ideal conditions for optimizing beam focus and astigmatism to obtain the best spatial resolution settings before acquiring a TKD map.
- The new **ESPRIT FIL TKD** software feature combined with on-axis TKD enables - for the first time ever - orientation mapping in ultra-high resolution (UHR) mode of SEMs with electron columns using full immersion lens (FIL) technology.



4 nm wide annealing twins resolved in a raw orientation map acquired from a gold thin film. Scale bar represents 100 nm.

Fastest simultaneous TKD & EDS measurements on nanomaterials

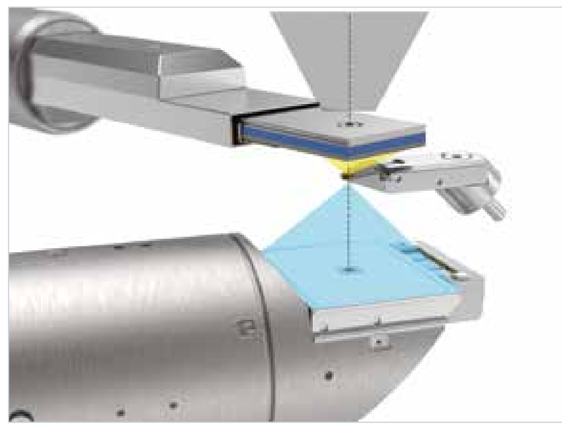
Bruker's unique XFlash® FlatQUAD EDS detector with its ultra-high solid angle of up to 1.1 sr is the ideal low-kV EDS solution for characterizing nanoparticles or nanostructures in electron transparent samples. Unmatched spatial resolution and speed are achieved using the XFlash® FlatQUAD simultaneously with OPTIMUS 2 for the acquisition of maps containing elemental and crystal orientation data from electron transparent samples.

Accurate quantitative EDS analysis can be performed using methods designed for electron transparent samples:

- Cliff-Lorimer-factor method
- Zeta-factor method.

Combined EDS and TKD measurements are ideal for characterizing less-understood samples containing multiple crystallographic phases, e.g. precipitates, inclusions, etc.

The combined dataset can be used for offline phase identification and reanalysis, with great efficiency gains enabled by the ESPRIT 2 capability of indexing up to 60,000 patterns/second.



Geometry setup for simultaneous TKD and EDS measurements with the XFlash® FlatQUAD detector (top), Bruker TKD sample holder (middle) and OPTIMUS 2 detector (bottom).

False-color ARGUS™ image acquired with a pixel size of 1 nm from a gold thin film. Scale bar represents 50 nm.

Ultrafast visualization of electron transparent samples

OPTIMUS 2 has built-in ARGUS™ imaging capabilities:

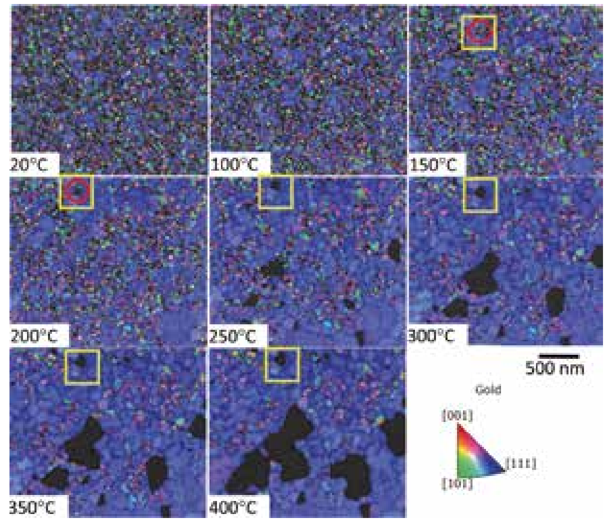
- Three Si diodes for acquiring high quality Dark Field (DF)-like images
- One Si diode at the screen's center to enable Bright Field (BF)-like imaging while in TKD mapping position
- Imaging at speeds of up to 125,000 pixels/second
- Fully automatic signal optimization to create images with unequalled quality and detail.

The new Bright Field (BF)-like imaging capability is particularly useful for drift correction during mapping as well as for near real-time visualization of samples during dynamic experiments like in-situ tensile testing and heating of electron transparent samples.

Time resolved measurements (TRM) during dynamic experiments

OPTIMUS 2, with its new OPTIMUS Vue screen and the new **ESPRIT TRM** feature, represents the perfect, must-have combination of tools for in-situ experiments on electron transparent samples. Acquisition and saving of BF-like images and TKD maps is automatic and repeated for a user-defined duration of time, thus facilitating the capture of all-important microstructural changes happening during very dynamic experiments like in-situ heating and electrical biasing.

The ESPRIT TRM feature is also critically important for capturing changes in the microstructure of electron transparent samples during in-situ tensile testing performed with the Hysitron PI 89 PicoIndenter.



Evolution of microstructure in a gold thin film revealed by a series of 8 orientation maps acquired at various temperatures from the same location on the sample. Results are courtesy of Alice Bastos Fanta, DTU Nanolab in Copenhagen, Denmark (https://doi.org/10.1016/j.matchar.2018.03.026).

Specifications

- Effective spatial resolution down to 1.5 nm (dependent on SEM type, vacuum quality and room environment, e.g. vibrations, acoustics, etc.)
- Mapping speed: up to 630 patterns/second
- 3 + 1 Si diodes for DF-like and BF-like imaging at up to 125,000 pixels/second
- Automatic ARGUS™ signal optimization in ESPRIT 2 software
- Low probe current operation (less than 2 nA even for high-speed mapping)
- Operating beam voltages: 5 kV – 30 kV
- Compatible with all e-Flash detectors
- User replaceable phosphor screens
- High performance phosphor screen optimized for maximum signal efficiency and minimal beam interference
- Seamless combination with Hysitron PI 89 PicoIndenter for observation of electron transparent samples during in-situ tensile testing experiments

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