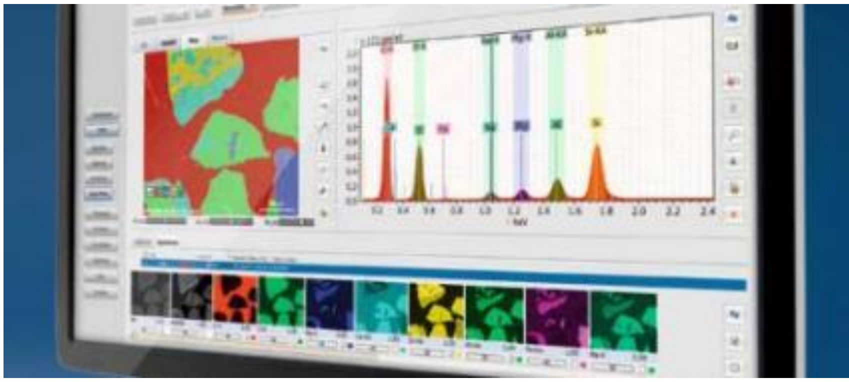

Microanalysis News
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Transmission Kikuchi Diffraction in SEM *By Stefan Langner, Bruker Nano GmbH, Berlin, Germany*

The Transmission Kikuchi Diffraction (TKD) technique has been recently introduced as an SEM-based method capable of delivering the same type of results as Electron Backscatter Diffraction (EBSD) but with a spatial resolution improved by up to one order of magnitude. The technique uses existing EBSD hardware and software, but requires electron-transparent samples, such as TEM lamella, free-standing films and crystalline nanoparticles.

Recognizing the potential of this new technique Bruker decided to integrate it into the QUANTAX EBSD system. The TKD mode in QUANTAX EBSD is designed to be user friendly and allow the acquisition of high quality data regardless of the users' experience level. TKD analyses with QUANTAX EBSD also can be combined with EDS analyses, thanks to a special sample holder designed by Bruker.

The TKD Professional Toolkit

Bruker's TKD Professional Toolkit allows you to combine TKD analyses with EDS measurements. The core piece of this toolkit is the special-design TKD sample holder, which allows easy handling of any type of thin sample prepared on a TEM grid and permits measurements even at 3-mm working distance.

The clamp design of the sample holder makes it easier to fix and handle fragile objects, i.e. thin samples. Figure 1 shows the clamp in its "open" position; Figure 2 shows it in its "closed" position.

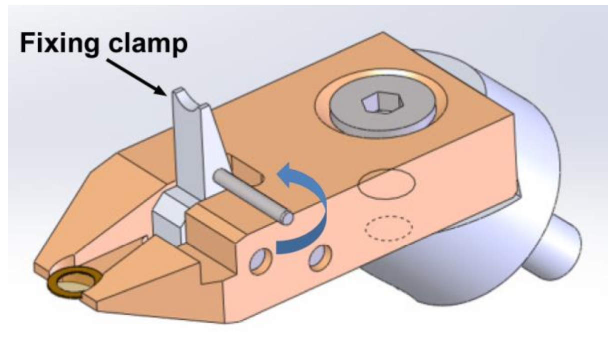

Figure 1. TKD sample holder with open clamp.

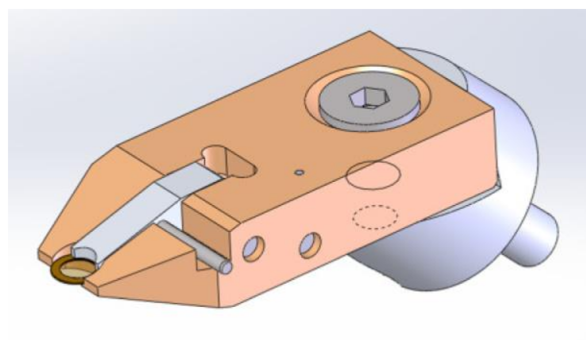

Figure 2. TKD sample holder with closed clamp.

Its special design ensures combined TKD/EDS measurements without shadowing effects and avoids collision risks even when operating at very low sample-to-detector distances.

TKD Optimized Calibration Assistant

The pattern center calibration algorithm has been adapted to function optimally in the TKD geometry, i.e. with the pattern center having PCy coordinate values much closer to zero or even negative. The pattern center calibration procedure is fully automatic.

Application Example – Analysis of a Fine-Grained Silicon Layer

The results shown here were obtained with both techniques from an ultra-fine-grained Si thin film deposited on a glass substrate. The EBSD results were acquired at 7kV EHT using a 30-nm step size, see Figure 3. The TKD results were obtained using a beam acceleration of 30 kV and a step size of 11 nm, see Figure 4. No data cleaning was applied to the results. The difference in resolution and quality of the TKD map is clearly visible.

Figure 3. Standard EBSD orientation map of the Si film.

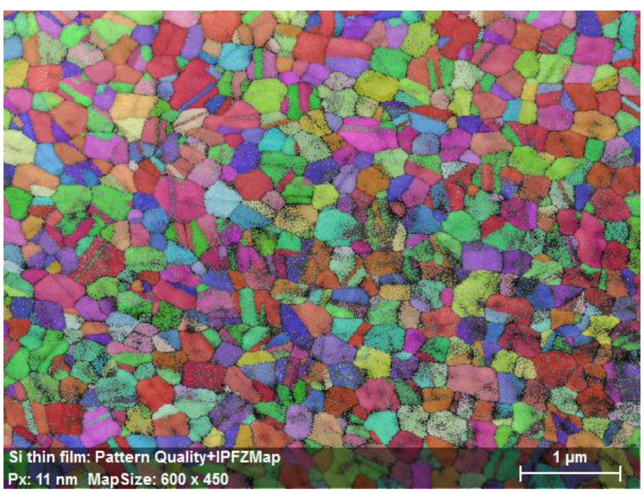

Figure 4. TKD orientation map of the same sample.

FSE Images in Transmission Mode

Similarly, forescattered electron (FSE) images also show a vast resolution improvement, as the images obtained with the ARGUS™ FSE/BSE imaging system of a highly deformed pure aluminum specimen show. Figure 5 displays a number of grains, where a network of dislocation walls, produced through the deformation process, is visible. Figure 6, at even higher magnification, shows single dislocations.

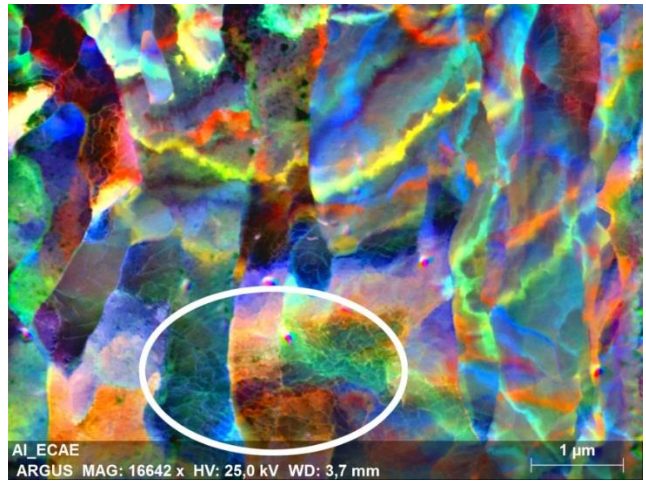

Figure 5. FSE image in transmission mode showing a network of dislocation walls (highlighted).

Figure 6. FSE image acquired in transmission mode with individual dislocations highlighted.

Further Information

A very good introduction by one of the founding fathers of the method can be obtained from this recorded webinar:
http://www.bruker.com/service/education-training/webinars/eds-ebsd-and-micro-ct-for-sem/transmission-kikuchi-diffraction-in-the-sem.html

Ultra-fine-grained silicon application example:
http://www.bruker.com/products/x-ray-diffraction-and-elemental-analysis/eds-wds-ebsd-sem-micro-xrf-and-sem-micro-ct/quantax-ebsd/applications/transmission-kikuchi-diffraction.html

About Bruker Nano Analytics
The companies under Bruker Corporation are globally leading manufacturers of analytical systems for life and materials sciences. The Bruker Nano Analytics (BNA) Division, headquartered at Bruker Nano Analytics GmbH in Berlin, Germany, develops, manufactures and markets X-ray systems and components for elemental and structural analysis on the micro and nano scale, either for electron microscopes or standalone.

BNA's product range of analytical tools for electron microscopes includes:

- Energy-dispersive X-ray spectrometers (EDS) for scanning and transmission electron microscopes
- Wavelength-dispersive X-ray spectrometers (WDS)
- Electron backscatter diffraction (EBSD) systems
- Micro-spot X-ray sources for Micro-XRF on SEM
- Micro computed tomography (Micro-CT) and accessories.

BNA's range of mobile and benchtop micro X-ray fluorescence spectrometers comprises:

- Micro-XRF spectrometers
- Total reflection X-ray fluorescence (TXRF) spectrometers.

Bruker Nano GmbH
Am Studio 2D
12489 Berlin
Tel: +49 (30) 670990-0
info@bruker-nano.de
www.bruker-nano.com