

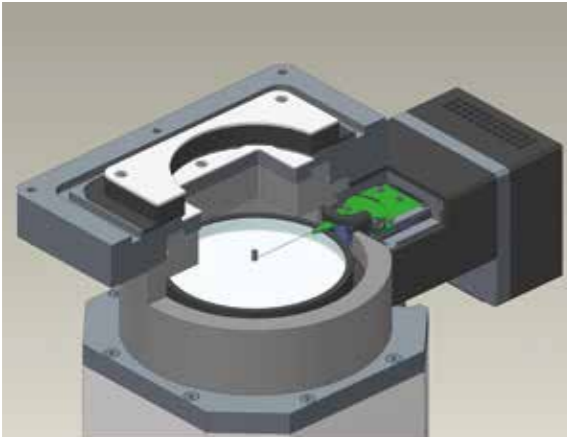
Complete solution for TEM imaging

- > CAMERAS
- > IMAGE PROCESSING
- > STEM

TVIPS
TIETZ VIDEO AND IMAGE PROCESSING SYSTEMS



TVIPS CAMERAS
CMOS CAMERAS FOR
ALL APPLICATIONS
PAGE 4

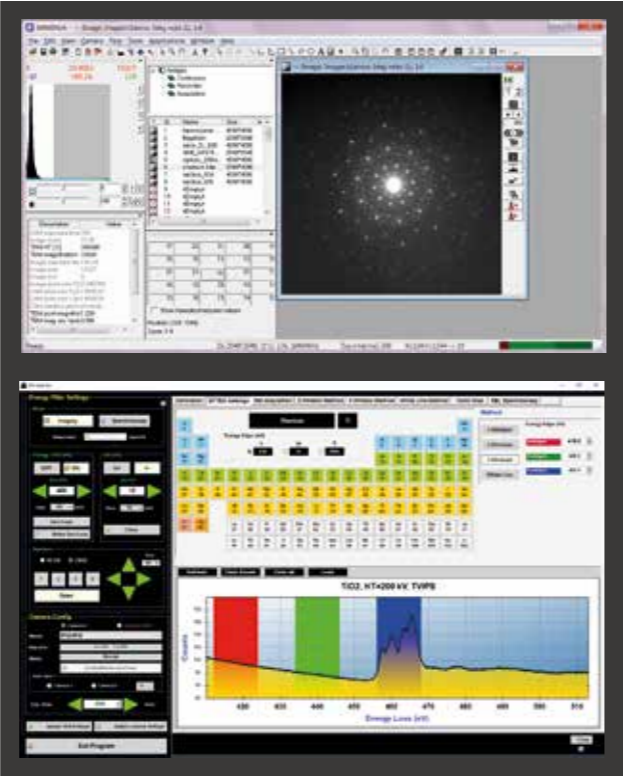


MOTORIZED BEAMSTOP
NEXT-LEVEL DIFFRACTION
DATA ACQUISITION
PAGE 9

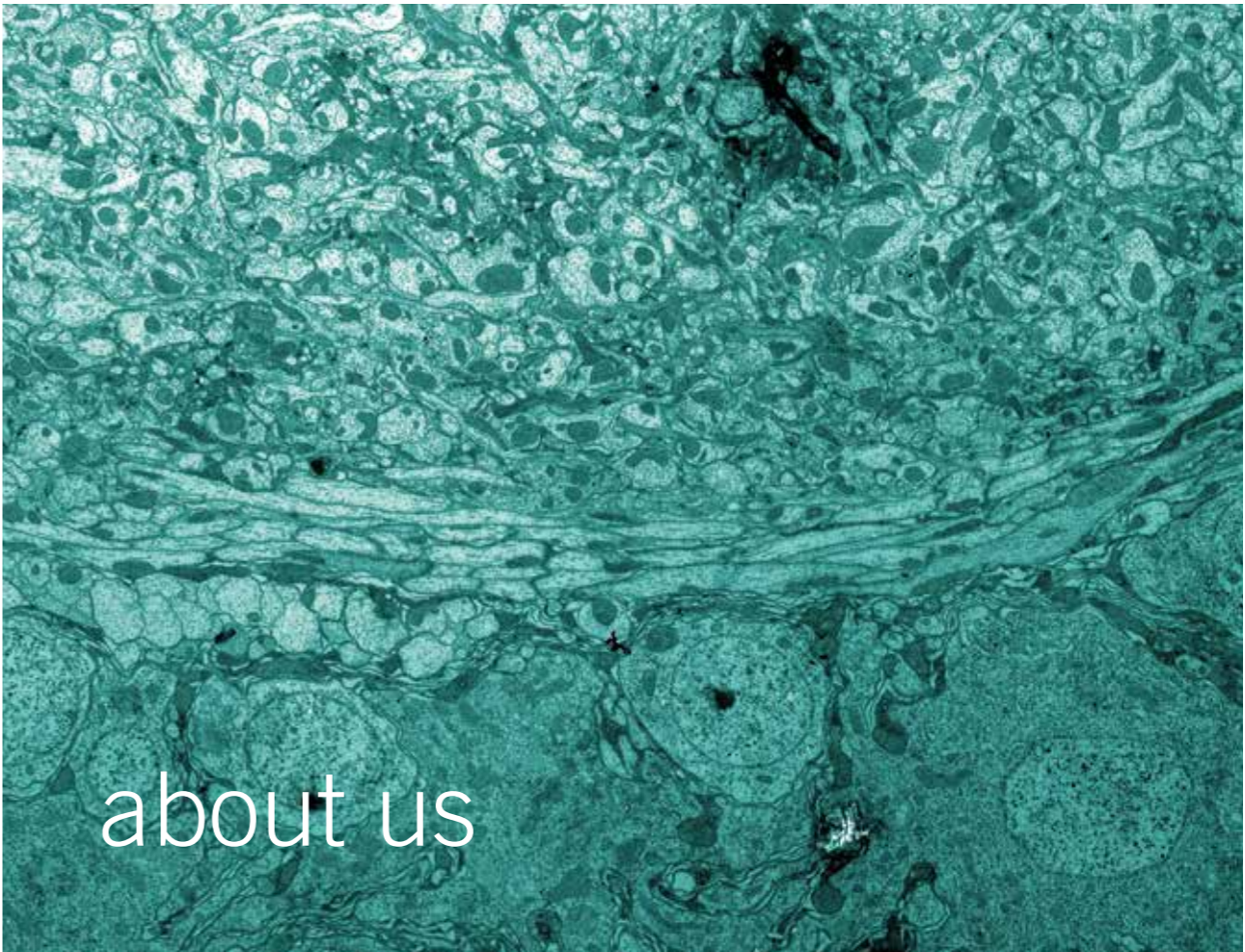
Cover, top right:
Nat Protoc. 2016 May;11(5):895-904.
doi: 10.1038/nprot.2016.046
A.C.Richardson Durham University (bottom right)



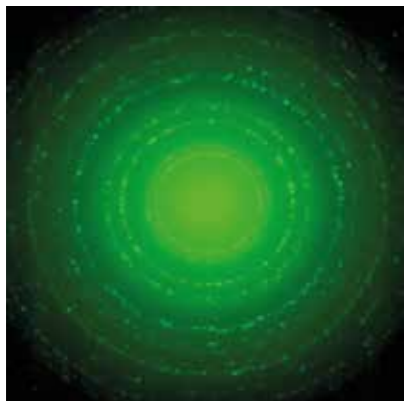
UNIVERSAL SCAN GENERATOR
MANIPULATE THE BEAM FOR
ADVANCED ANALYSES
PAGE 8



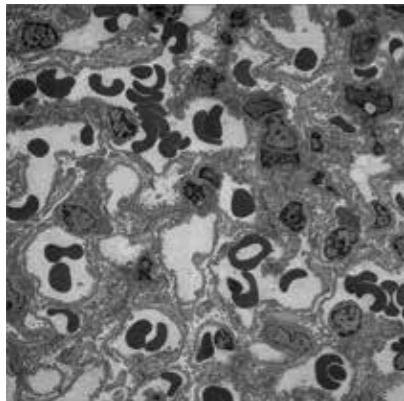
IMAGING SOFTWARE
FULL CONTROL OF CAMERA AND TEM,
AUTOMATIZATION AND ANALYSIS
PAGE 11



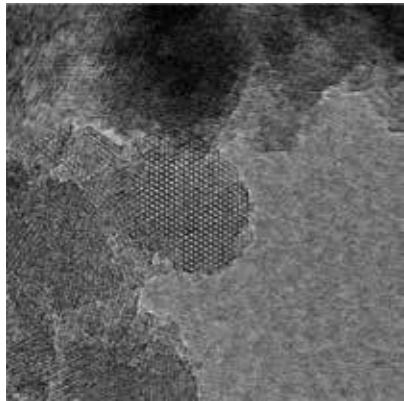
- | | |
|------|--|
| 2018 | UPCOMING TemCam-XF416R (Retractable) |
| 2017 | ADVANCED 4k CMOS CAMERA (TemCam-XF416) |
| 2014 | MOTORIZED BEAMSTOP / DIFFRACTION TOMOGRAPHY |
| 2012 | RELEASE OF UNIVERSAL SCAN GENERATOR (USG) |
| 2011 | 2k CMOS CAMERA (TemCam-F216) |
| 2009 | 4k CMOS CAMERA (TemCam-F416) |
| 2006 | WORLD'S FIRST 8k CAMERA (TemCam-F816) |
| 2001 | 4k SLOW-SCAN CCD |
| 1996 | FIRST COMMERCIAL 2K SLOW-SCAN CCD |
| 1993 | FIRST COMMERCIAL TOMOGRAPHY SOFTWARE PACKAGE |
| 1991 | FIRST COMMERCIAL 1k SLOW-SCAN CCD |
| 1987 | FOUNDED BY HANS R. TIETZ IN GAUTING (MUNICH) GERMANY |



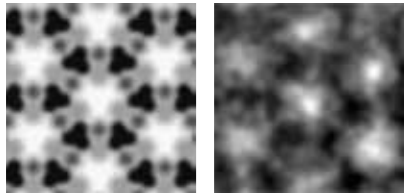
AI Diffraction Pattern



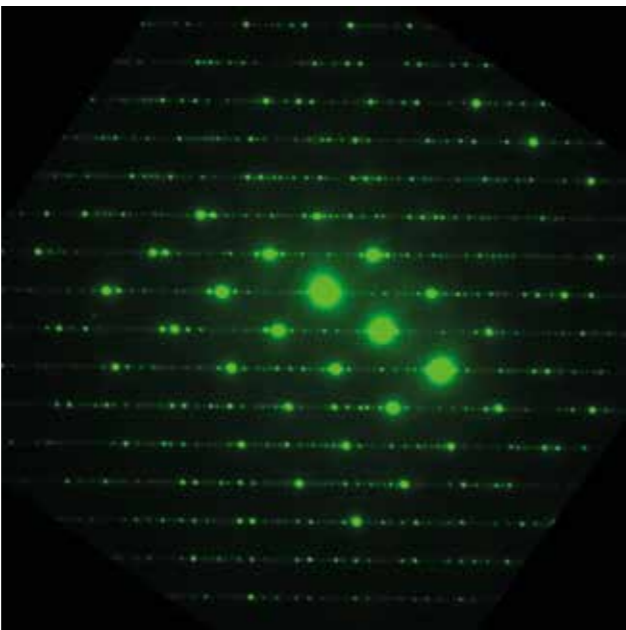
Kidney Section



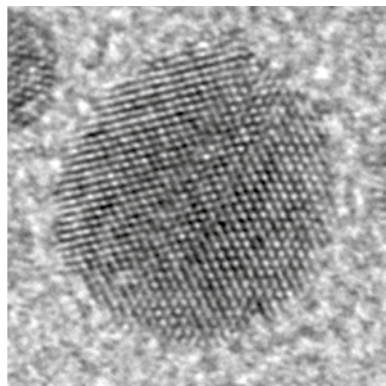
Metal-Organic-Framework (MOF)



Metal and Imidazole Rings



BiClO Diffraction Pattern



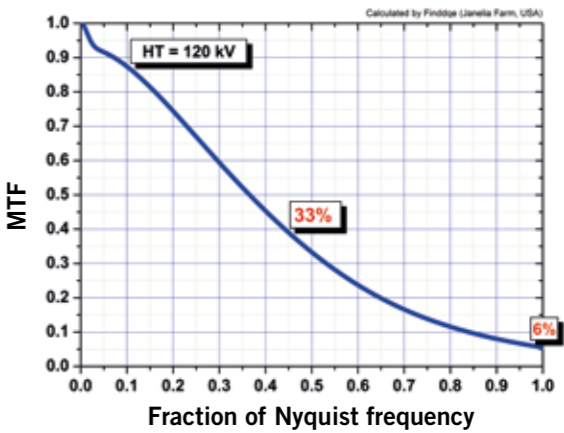
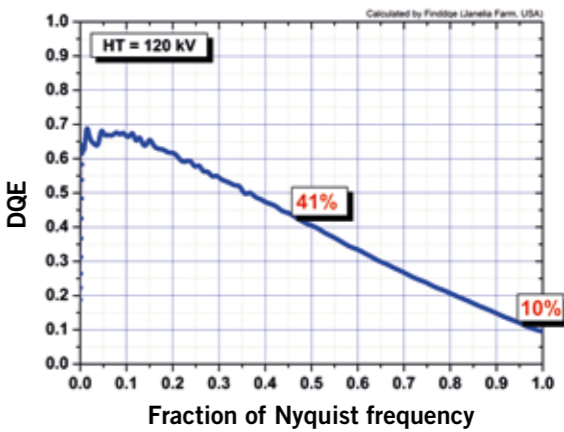
Au nano particle

TemCam-XF416

The TemCam-XF416 is TVIPS' newest development featuring an entirely new sensor design. While maintaining the single-electron sensitivity of the previous model, it excels with an extended dynamic range and a ten-times faster acquisition rate!

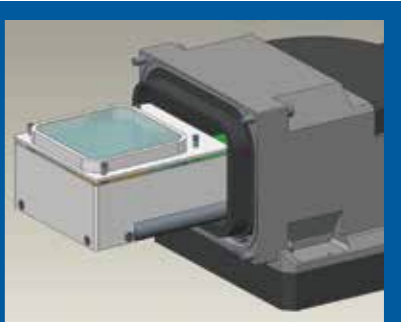
With the generous field-of-view of $63.5 \times 63.5 \text{ mm}^2$ structured in $4k \times 4k$ pixels, the XF416 is the ideal camera for various applications. The high frame rate allows dose-fractioning and in-situ experiments.

Get a clear view of your unstable samples by using the real-time drift-correction feature at full resolution and readout rate. Extend the dynamic range by frame averaging while maintaining a normal beam intensity.



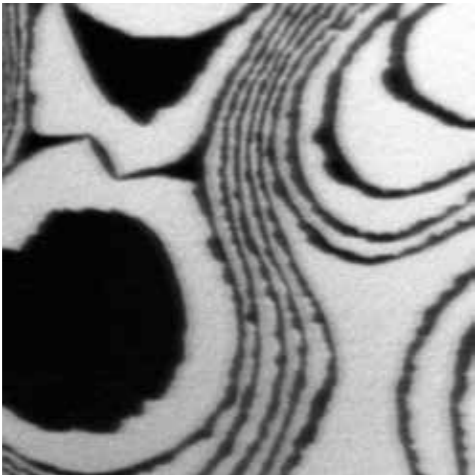
XF416 (4K)		
Sensor Size	4096 × 4096 pixel	
Pixel Size	15.5 × 15.5 μm^2	
Field of View	63.5 × 63.5 mm^2	
	Standard Mode	Fast Mode
Read out Rate	32 × 16 megapixel/s	32 × 32 megapixel/s
Frame Rate, Rolling Shutter	25 fps, 4k × 4k 50 fps, 2k × 2k 100 fps, 4k × 1k 200 fps, 4k × 512	50 fps, 4k × 4k 100 fps, 2k × 2k 200 fps, 4k × 1k 400 fps, 4k × 512
Read Out Time Single Exposure	4k × 4k, 40 ms	4k × 4k, 20 ms
Exposure Time Single Exposure	2 ms – 60 s	2 ms – 60 s
Digitalization	16 bit, on chip CDS	
Dynamic Range max/noise	20 000:1	
Signal/Noise for single electron*	~30:1 @ 120kV ~25:1 @ 200kV ~20:1 @ 300kV	
Resolution*	~13% (200kV) ~35% (200kV) 4% @ (200kV) 27% @ (200kV) ~4% (200kV) ~28% (200kV)	

*Depending on scintillator. Data in this brochure are typical and not binding.



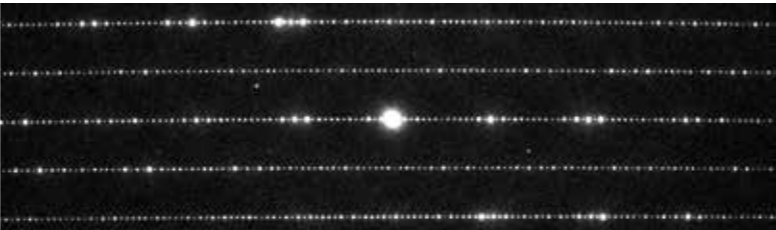
Upcoming
2018:
TemCam-
XF416R
(Retractable)

TemCam-F216

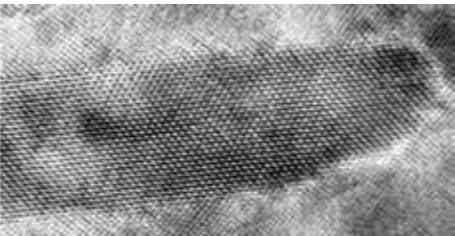


Low-energy electron microscopy (LEEM)

TemCam-F816



BiClO Diffraction Pattern



Left: Steel

TemCam-F216

The TemCam-F216 is TVIPS' smallest and most cost-efficient camera, featuring 4 MegaPixels in a 2k × 2k configuration.

It shares the same custom pixel design as the F816 and the now-retired F416 models with the same performance figures regarding sensitivity and dynamic range.

The high signal-to-noise ratio allows clear detection of single-electron events. As all TVIPS cameras, the F216 is equipped with a robust fiber-optically coupled scintillator. Upon request, its thickness can be adapted to the application's needs to optimize either resolution or sensitivity.

TemCam-F816

Meet the TemCam-F816, the world's first digital camera with an active area larger than that of a sheet-film camera.

With its impressive size of 128 × 128 mm² in an 8k × 8k configuration it clearly surpasses the performance of photo plates. This camera opens up extraordinary possibilities for high-throughput applications such as single-particle data collection or rapid screening of serial sections.

In a single exposure both a large field of view and high-resolution information is recorded for maximum insight into your sample.

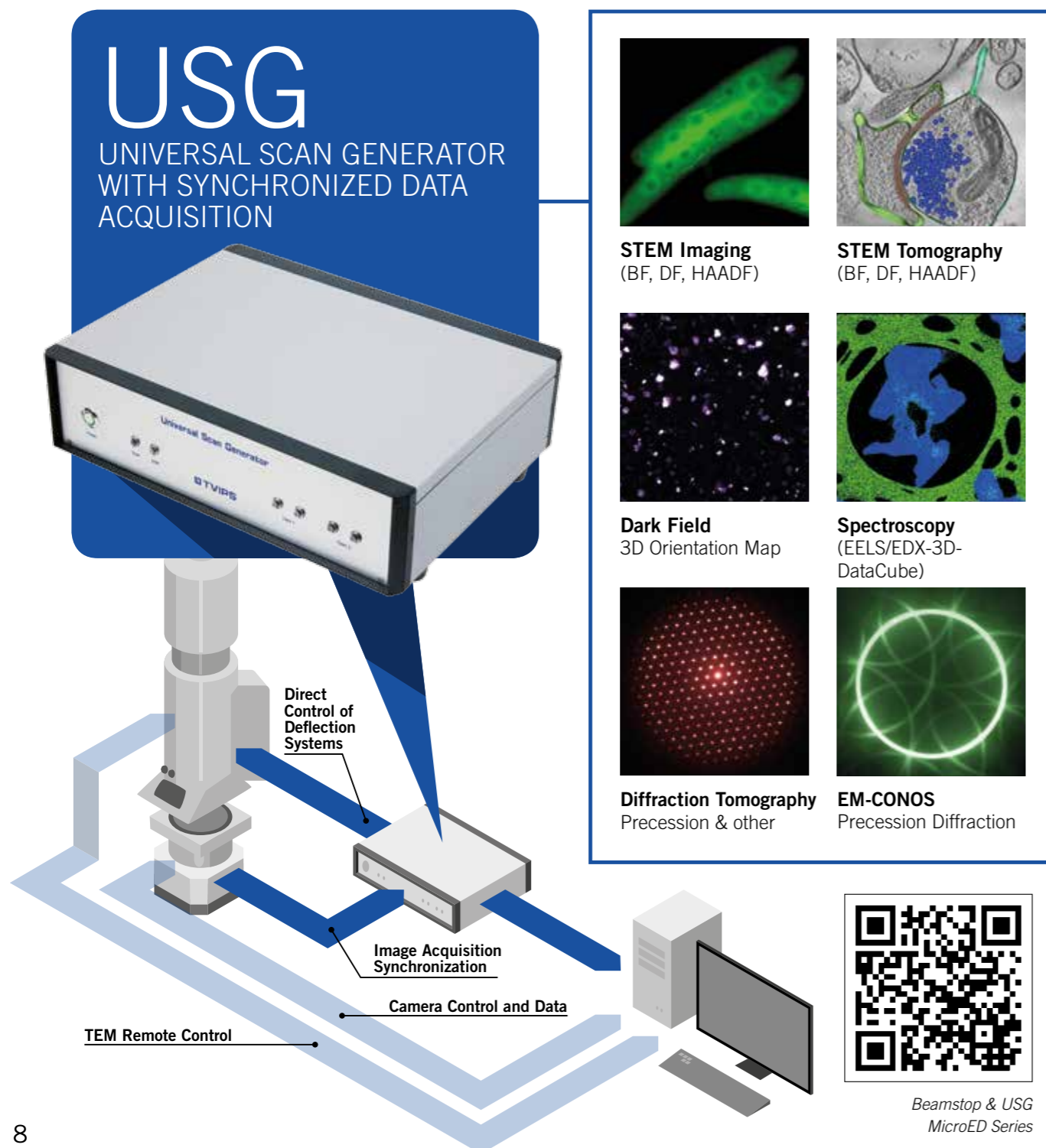
	F216 (2K)	F816 (8K)
Sensor Size	2048 × 2048 pixel	8192 × 8192 pixel
Pixel Size	15.6 × 15.6 μm ²	15.6 × 15.6 μm ²
Field of View	31.9 × 31.9 mm ²	127.8 × 127.8 mm ²
Read out Rate	2 × 10 megapixel/s	8 × 10 megapixel/s
Frame Rate, Rolling Shutter	4.5 fps, 2k × 2k 8.5 fps, 2k × 1k	
Digitalization	16 bit, off chip CDS	16 bit, off chip CDS
Dynamic Range (max/noise)	10 000:1	10 000:1
Signal/Noise for single Electron	~14:1 @ 120 kV ~12:1 @ 200 kV	~10:1 @ 120 kV ~8:1 @ 200 kV
Resolution		
NTF @ Nyquist	~15 % (200 kV)	~10 % (200 kV)
NTF @ Nyquist/2	~30 % (200kV)	
Mounting Position	on-axis	on-axis
HT Range	20–300kV	20–300kV

OUR CAMERA SYSTEMS ARE COMPATIBLE WITH TEMS FROM ALL MAJOR MANUFACTURERS, I.E. JEOL, THERMOFISHER/FEI/PHILIPS, HITACHI AND ZEISS.

OUR CAMERAS ARE SUPPORTED BY SEVERAL THIRD PARTY SOFTWARE, E.G. SERIAL-EM AND LEGINON. BESIDES OUR OWN CAMERAS TVIPS SUPPORTS CAMERA SYSTEMS FROM DIRECT ELECTRON.

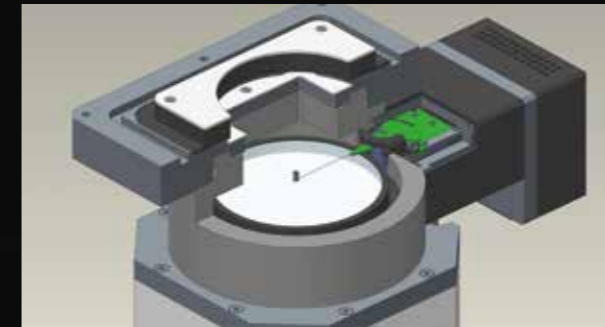
USG

The Universal Scan Generator is a powerful tool to gain complete control of the electron beam. Simultaneous access of deflectors and camera enables a quick succession of data acquisition, paving the way for STEM, EELS datacubes and sophisticated diffraction applications like MicroED. Additionally, the USG can be used to perform precession diffraction mapping for enabling high resolution structure determination of randomly oriented nanoscale crystals (crystal orientation maps).



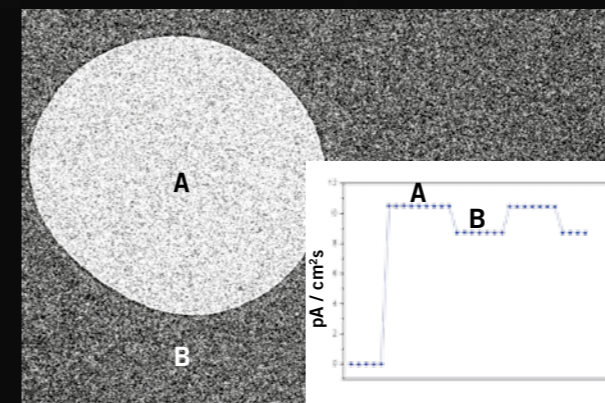
MOTORIZED BEAMSTOP

TVIPS newly developed motorized beamstop takes acquisition of diffraction images to the next level with significantly fewer obstructions and integrated measurement of the beam current.



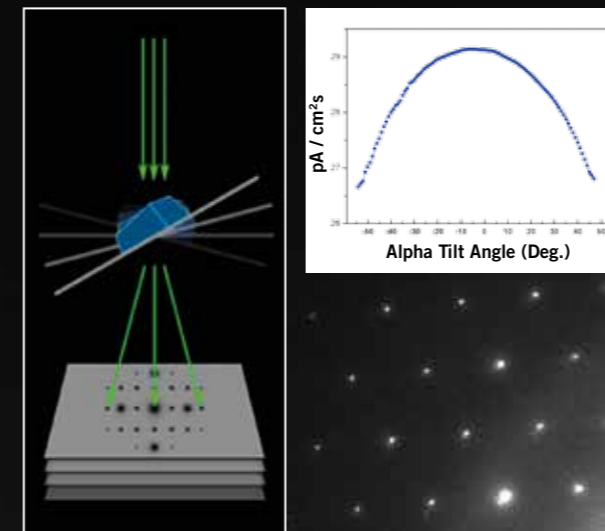
The device uses fast piezo actuators controlled by absolute position encoders to ensure fast (<1s) and accurate positioning of the beamstop.

Since it is located only a few millimeters above the scintillator and thanks to its delicate support, the obstructions in the diffraction patterns are kept minimal.



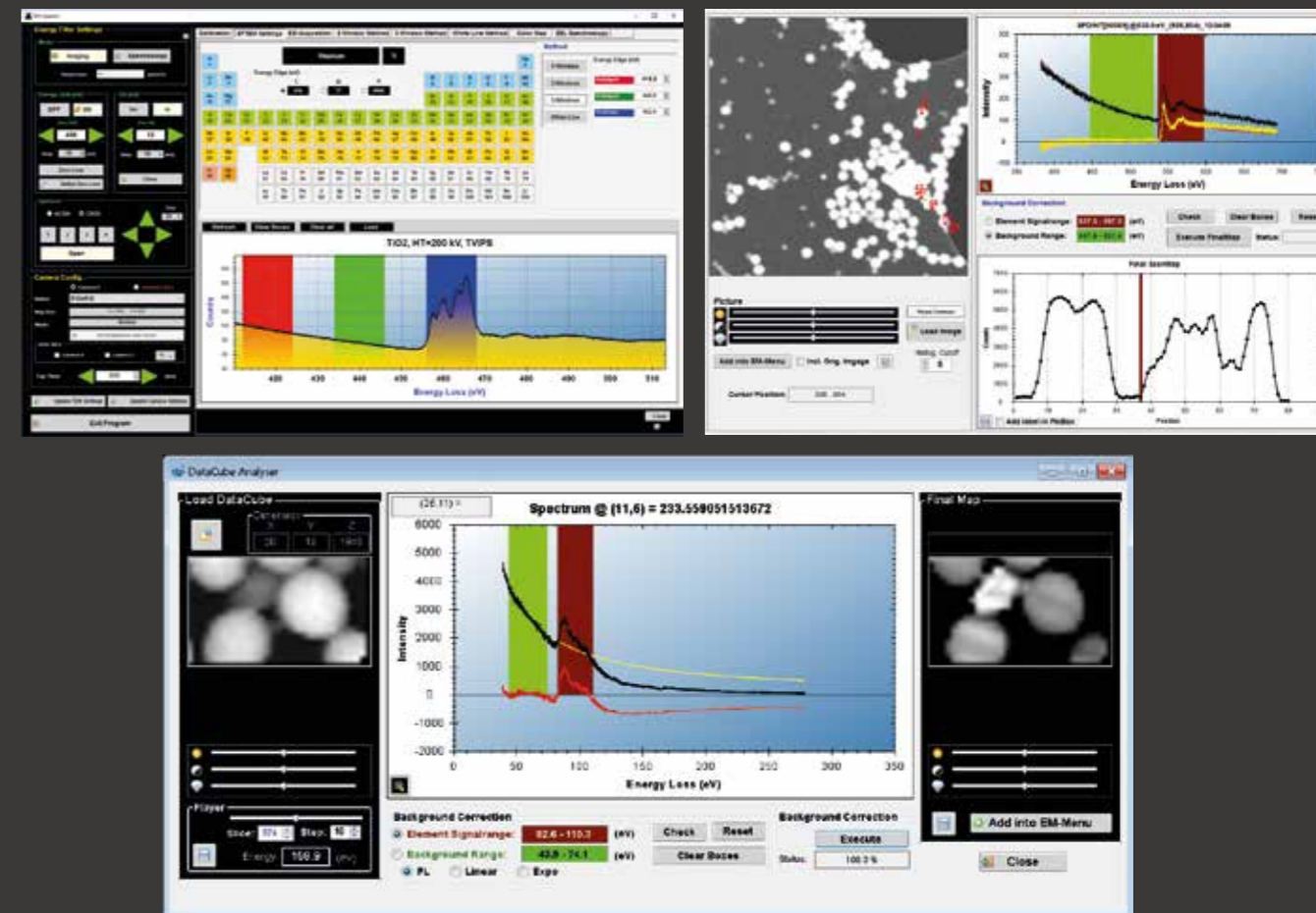
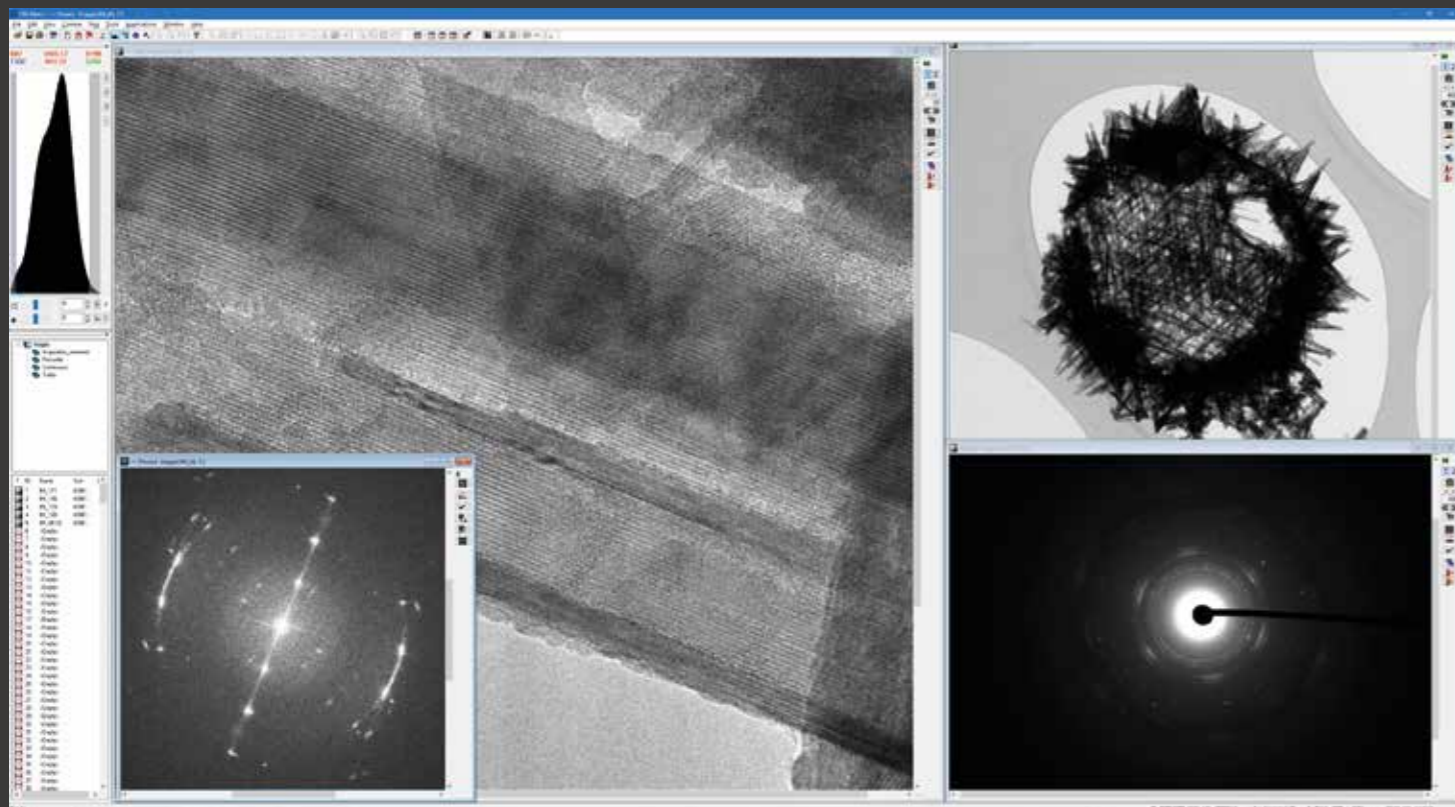
The integrated Faraday cup enables online measurement of the intensity of the zero order beam right with the exposure, with the result stored to the image's metadata. This enables quantitative measurements of diffraction spot intensities across several images, e.g. to compensate for the varying intensity in diffraction tomography experiments.

The user-friendly GUI supports manual and automated positioning of the beamstop. Several positions can be defined and accurately revisited afterwards. An easy-to-use API allows the integration of the beamstop into your custom acquisition schemes.



Available as an option to the TemCam-XF416.

Size comparison of standard and TVIPS beamstop



EM-MENU Image acquisition and analysis

EM-Menu is the central hub managing the raw data from the cameras and providing a higher-level interface for the more specialized software products. It presents a highly configurable interface to each camera's individual feature set.

KEY FEATURES:

- Unique highly linear flatfielding algorithm for flat detector response
- Clutter-free presentation of still and live images in configurable viewports
- Flexible mapping of HDR image data to monitor's color depth
- Neatly organized access to all images recorded within the microscopy session
- Image data saving in 8 or 16-bit tiff format, annotated with rich information about microscope state and camera configuration at the time of exposure
- Powerful calibration and measurement tools in image, fourier and diffraction domain
- Dedicated shutterbox hardware for precise beamblanker and shutter control, enabling preexposure acquisition schemes
- Series acquisition (time delay/dose, beam/stage tilt, defocus)
- Sophisticated series-alignment features
- Burst mode for fastest camera read-out
- Automatic tiling and image alignment
- Autofocus, navigator and center detail functions
- Real-time drift correction
- Extensible scripting interface via COM and VBScript

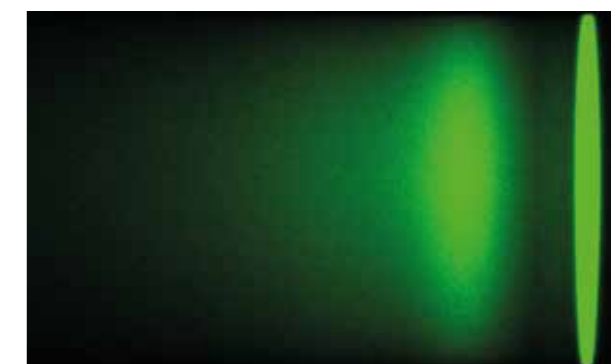
- Supports Win 10 64 Bit
- High-speed GPU computation
- Runs on compact desktop formfactor PC



ONE-STOP SOLUTION FOR EFTEM

EM-Spectro enables getting the most analytical insight out of your energy filter. Its intuitive and user-friendly interface facilitates advanced acquisition schemes in both Electron Spectroscopic Imaging (ESI) and Electron Energy-Loss Spectroscopy (EELS) mode.

- Intuitive calibration routines
- Automatic zero-energy calibration
- Spectrum autodetection
- Plain-text spectrum data export
- Support of usual ESI acquisition schemes
e.g. 2/3 Windows, Thickness Map
- Automatic alignment of ESI data
- EELS data processing directly during microscopy session e.g. Background Subtraction, Fourier Filtering/Deconvolution
- Fast data cube acquisition using the camera's synchronization signal
- Drift correction for STEM-EELS acquisition
- Long-range spectrum acquisition for enhanced resolution and extended span



Acquisition and advanced data analysis software for:
JEOL in-column energy filter
Zeiss in-column energy filter
CEOS post-column energy filter



EM-TOOLS

Low-dose imaging and automation

EM-TOOLS consists of 4 modules developed with the needs for automated low-dose data collection in mind. There are modules for navigation across multiple scales, TEM auto-tuning and automated collection of single-particle data or tomographic tilt series.

EM-NAVI

NAVIGATION FOR LOW-DOSE APPLICATIONS

Especially developed for low-dose applications, this module enables finding the area of interest while keeping the specimen's exposure to the electron beam minimal. This is done by subsequent refinement of the target positions across multiple scales. Focusing and tracking can be done away from the area of interest, avoiding excess beam exposure of the final image.

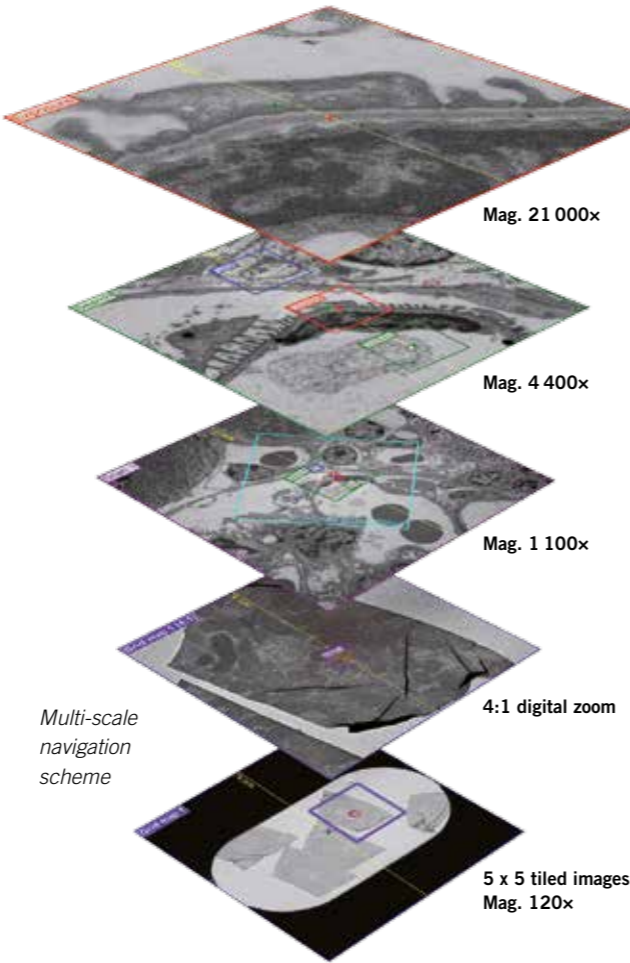
- Built-in navigation for low-dose applications
- Compensation of each magnification's displacement
- Automated focusing, beam centering and eucentric height correction
- Supports TEM and STEM acquisition, also in mixed-mode

EM-SPC

AUTOMATED DATA COLLECTION FOR SINGLE-PARTICLE PROJECTS

This module was developed for the automated and mostly unattended collection of the large data sets required for the single-particle method. The target positions for the collection can be either selected manually or automatically by defining limits to the desired ice thickness and the acceptable homogeneity.

- Automated data collection including auto-eucentricity and drift-check
- Auto-focusing and target centering with an accuracy to within 100 nm
- Optional manual target definition by a single mouse-click
- Flexible target pattern geometry (rectangular, hexagonal and triangular)
- Focus and time-series acquisition (focal pair, beam-induced movement)
- Online auto-tuning at regular intervals for compensating TEM instabilities (illuminated area, astigmatism, coma-free alignment)
- Operates on regular and irregular support films, e.g. Quantifoils and Lacey carbon films
- Supports internal and retrofit automated LN₂ refill systems (www.simpleorigin.us)

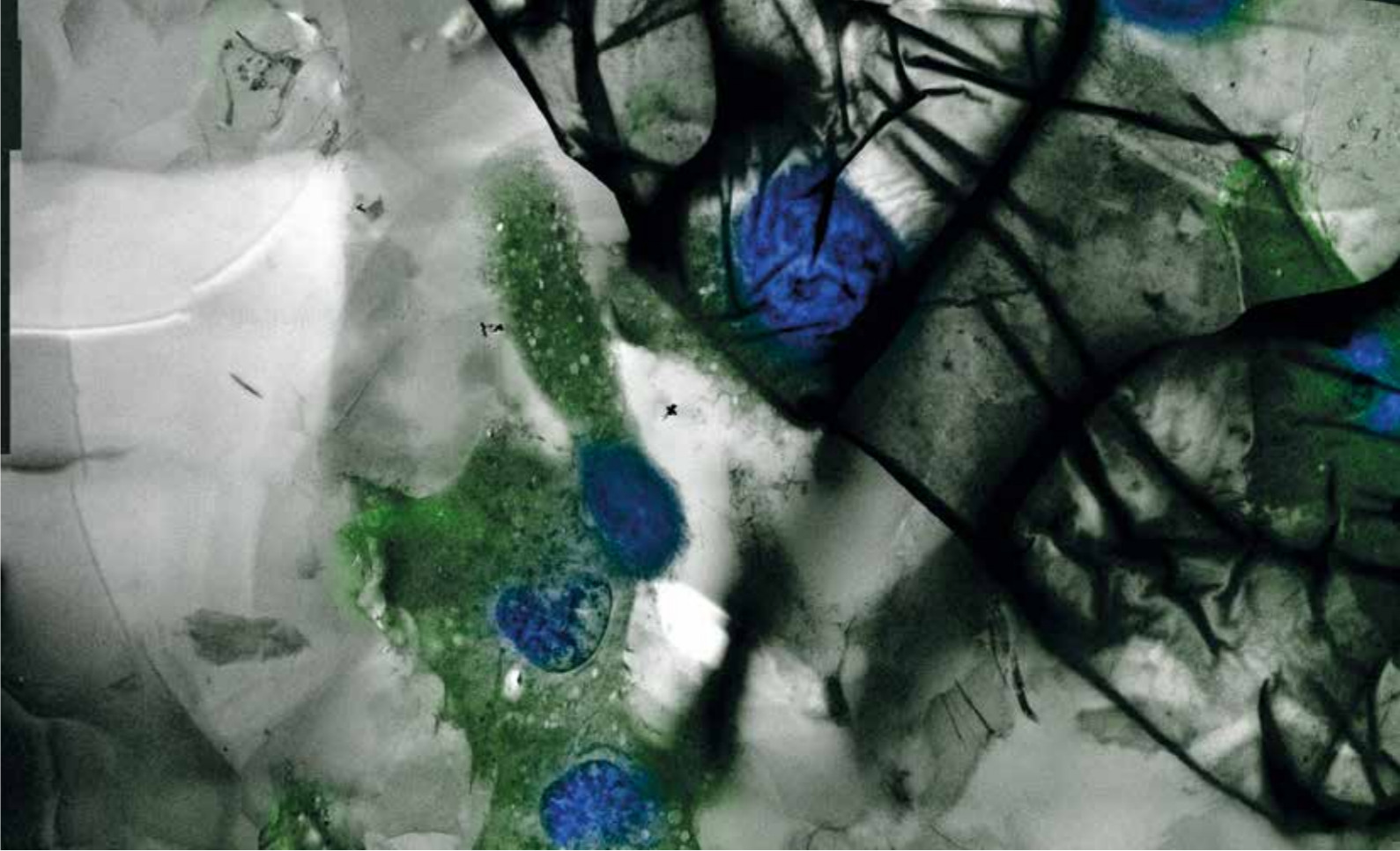


EM-TOMO

AUTOMATED TILT-SERIES ACQUISITION

Module for automated acquisition of tomographic tilt-series under low-dose conditions.

- Collection of tomographic tilt-series
- Compensation of tilt-induced specimen moving
- Works in either TEM or STEM mode
- Auto-focusing, beam centering and accurate eucentric height correction
- Flexible tilt schemes: linear, Saxton, user-defined
- Batch tomography of multiple target sites
- Tiled image-acquisition for increased resolution and extended field-of-view
- Supports internal and retrofit automated LN₂ refill systems (www.simpleorigin.us)



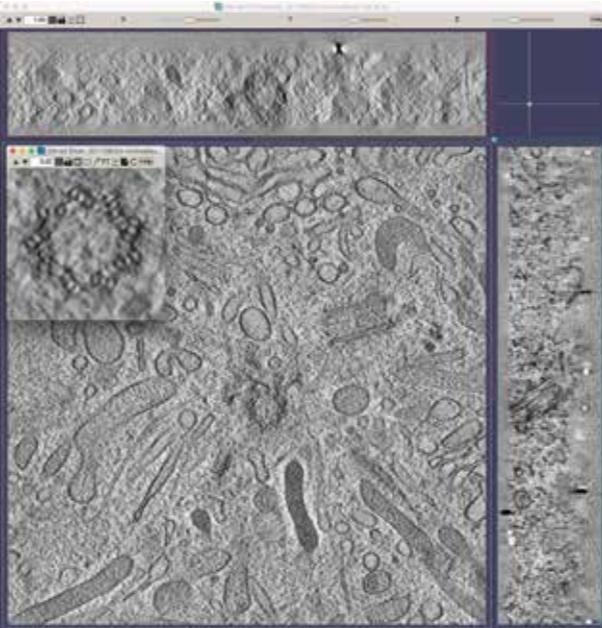
Courtesy of: Reinhard Rachel, Ralph Witzgal, Korbinian Bürger

EM-ALIGN

FULL-AUTOMATIC TEM TUNING

To optimize the image quality, it is necessary to align the beam path to the coma-free axis. EM-ALIGN measures the aberrations of the optical system and optimizes the beam path.

- Zemlin tableau recording and determination of the aberrations
- Correction of twofold astigmatism and alignment to the coma-free axis



EM-CLEM

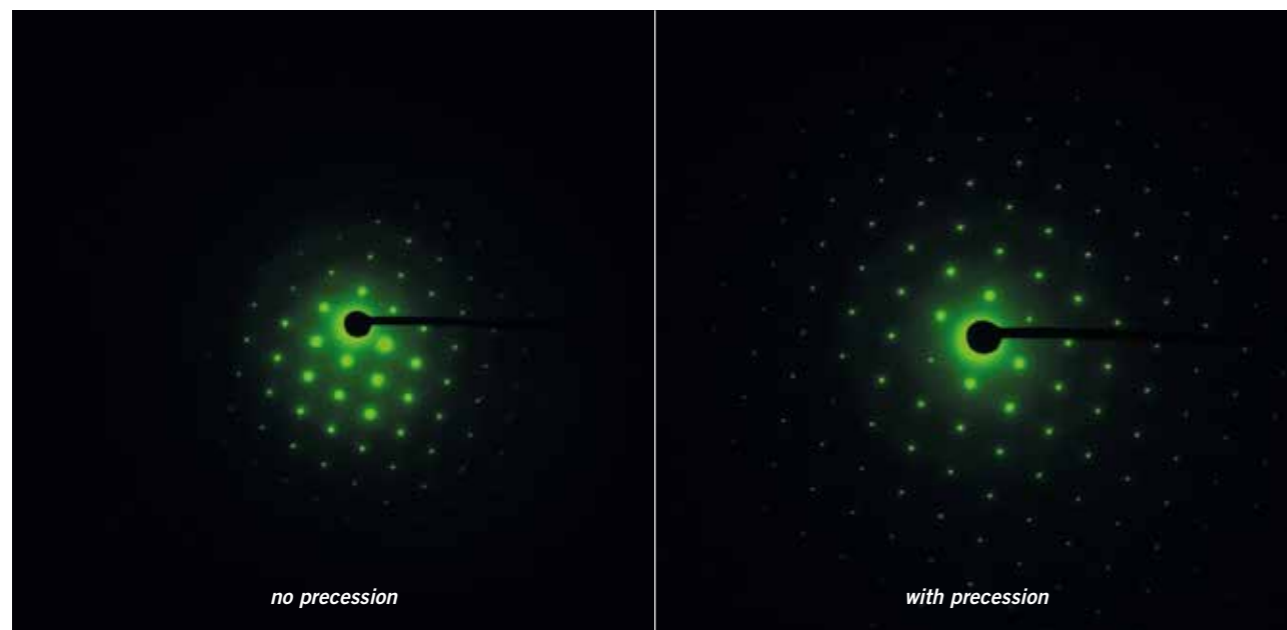
By combining light and electron microscopy images, functional information inferred from light microscopy can be imaged at much higher resolution in the EM.

- Semi-automated landmark based alignment
- Easy orientation of any Light Microscopy image to the current view in the EM
- Save overlay to a combined high-resolution image file



STEM tomogram of amyloid fibers

Scientific Reports
doi: 10.1038/SREP43577



Diffraction pattern of Si shows quasi-kinematic intensities and better resolution by using a 3° beam precession

ADVANCED DIFFRACTION

High sensitivity, low noise, high dynamic range and good robustness make the XF416 an ideal choice for acquiring diffraction patterns.

Precession Mapping

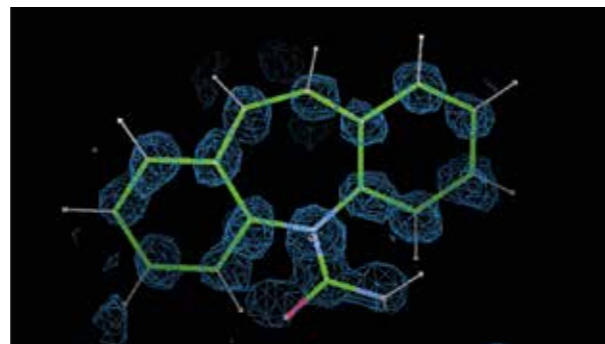
In combination with the Universal Scan Generator, the TEM's beam and image deflectors are commanded synchronous to the camera readout. This enables advanced acquisition schemes such as Precession Electron Diffraction (tomography) for imaging quasi-kinematical conditions at reduced dynamical effects. A precessed electron probe can also be scanned over an area for crystal orientation mapping.

MicroED

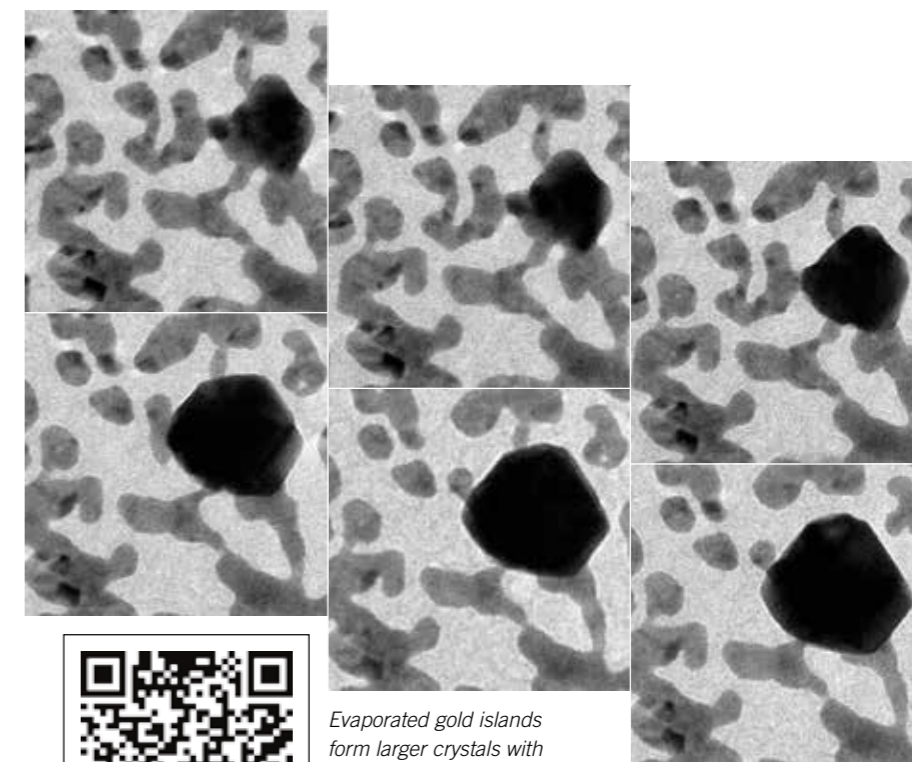
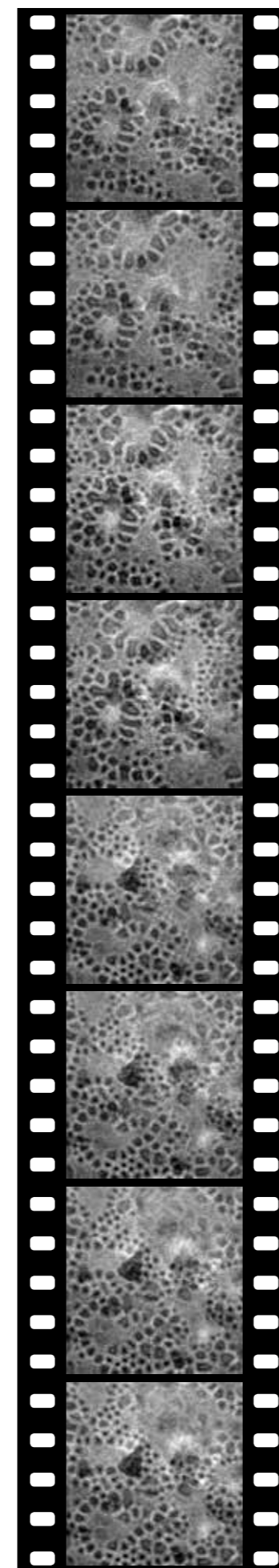
Dedicated software for collection of MicroED data sets available supporting both the continuous stage rotation and the beam pivoting method.



Precessed CBED pattern from a mapping experiment



Electron Diffraction tomographic tilt series of Carbamazepine and reconstructed structure



Evaporated gold islands form larger crystals with applied heating



IN-SITU

With its high sensitivity and high frame rate capability, the XF416 is the ideal choice for In-Situ experiments.

With the In-Situ package, 4k images can be recorded at 50 fps or up to 400 fps for subareas. Post-event triggering is enabled by a configurable ring buffer with a capacity only limited by the host computer's amount of RAM.

Secondary data channels such as temperature, strain etc. can be recorded along with the image stream.

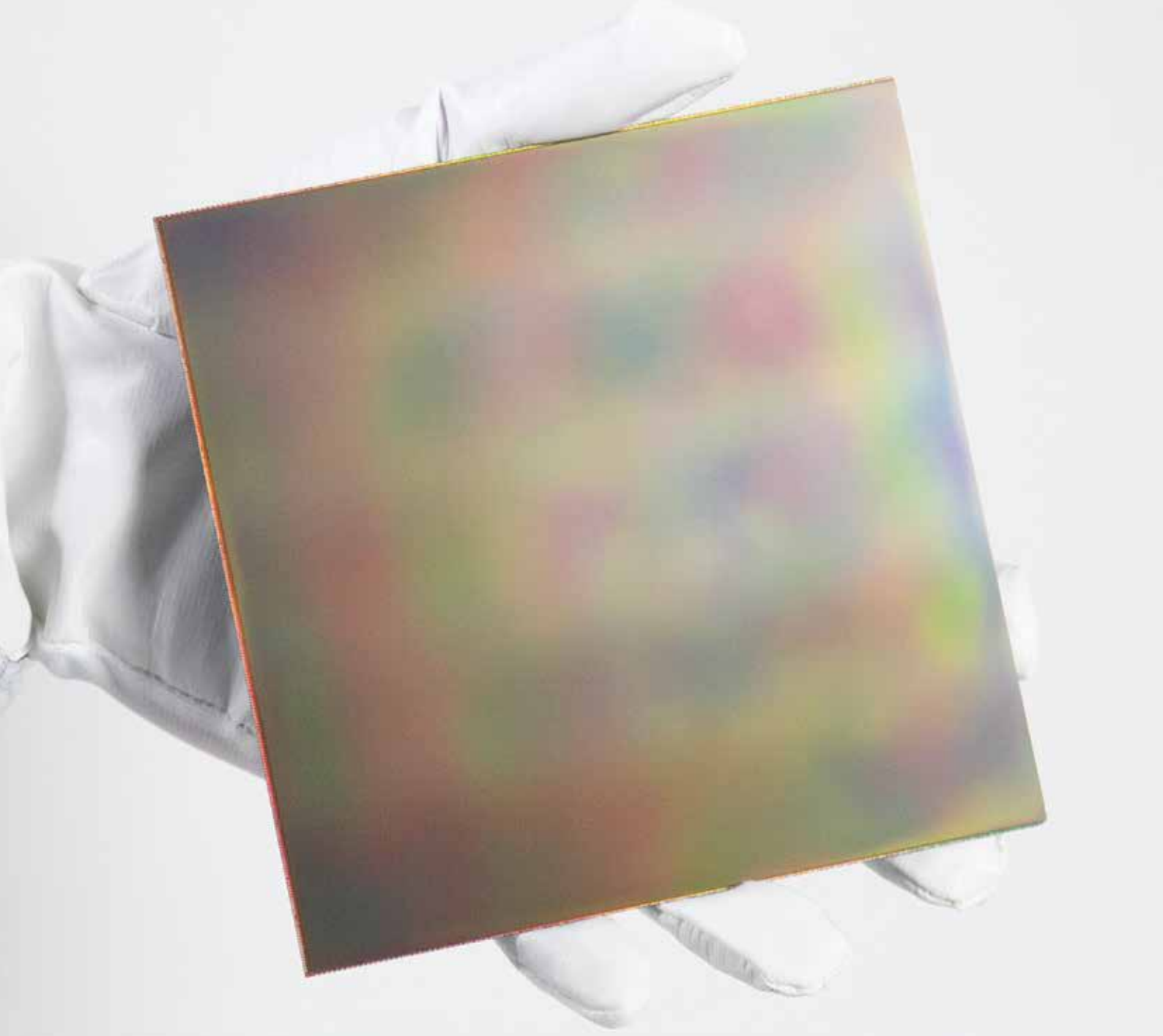
A movie maker software facilitates compilation of the interesting parts of the image stream into a drift compensated standard video file augmented by overlays of frame number, timestamp, scale bar and other data channels.



Nickel sample changes structure with applied heating

Integrates In-Situ holders from:





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