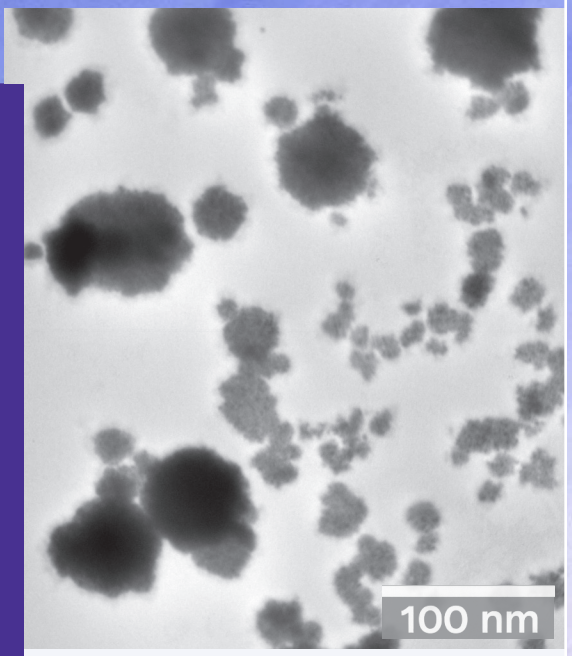
ARTEMIS CAMERA

Low-Dose in-situ TEM with ultimate contrast

Delivering Bigger | Better | Faster | Cameras For Electron Microscopy

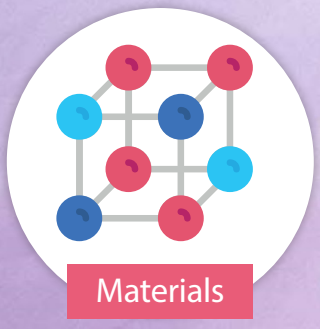


Snapshot of platinum nanoparticle formation during in-situ electrochemistry.
Courtesy of Maria de Marco, IPCMS Strasbourg.

COUNTING-ONLY DIRECT DETECTOR FOR MATERIALS SCIENCE

- Our novel direct detection device (DDD®) delivers ultra-low noise and beam-sensitve maerials science applications.
- Electron counting *in hardware* is elegant, fast, easy-to-use, and enables low-dose in-situ movies.
- Change the paradigm for liquid-cell TEM by reducing total dose and quantifying the exposure rate.
- On-chip CDS and digital output of detected events minimizes noise without a reduced framerate.
- 4k × 4k (16.8 million) physical pixels with larger 8 µm pixel size to maximize resolution.
- Counted movies saved to the computer, live drift correction applied to single images.
- Integrated with Protochips for holder metadata.
- Generate better results than you've ever achieved before.

DETECTOR APPLICATIONS:



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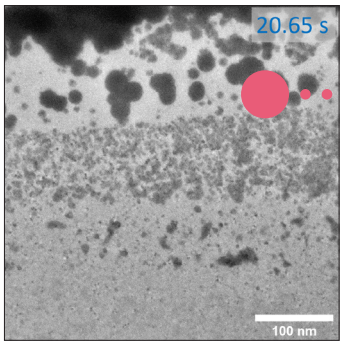
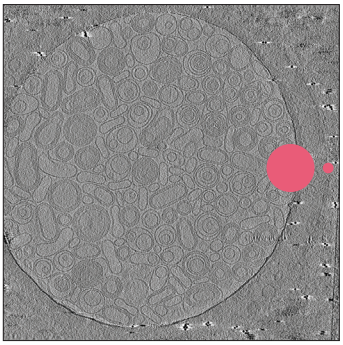
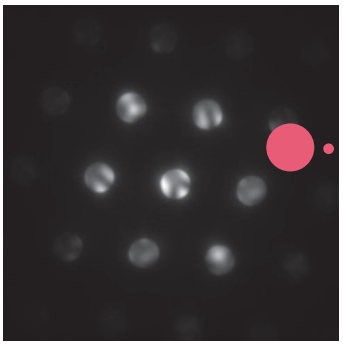
OPTIMIZED FOR BEAM SENSITIVE TEM APPLICATIONS



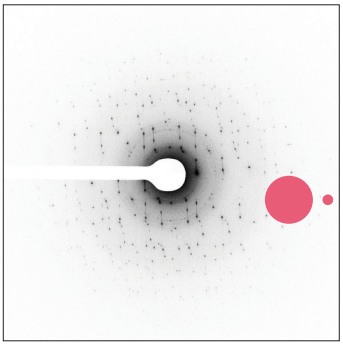
Low-Dose In-Situ TEM Movies
Ultra-fast electron counting enables live imaging



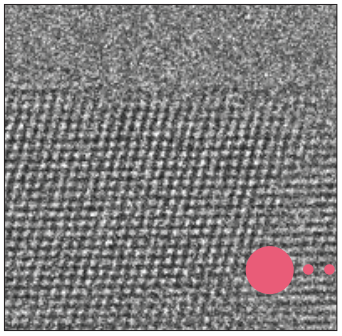
Cryo-Tomography
Large field-of-view and high contrast



4D-STEM Compatible
Capture crystallographic information from nanodomains

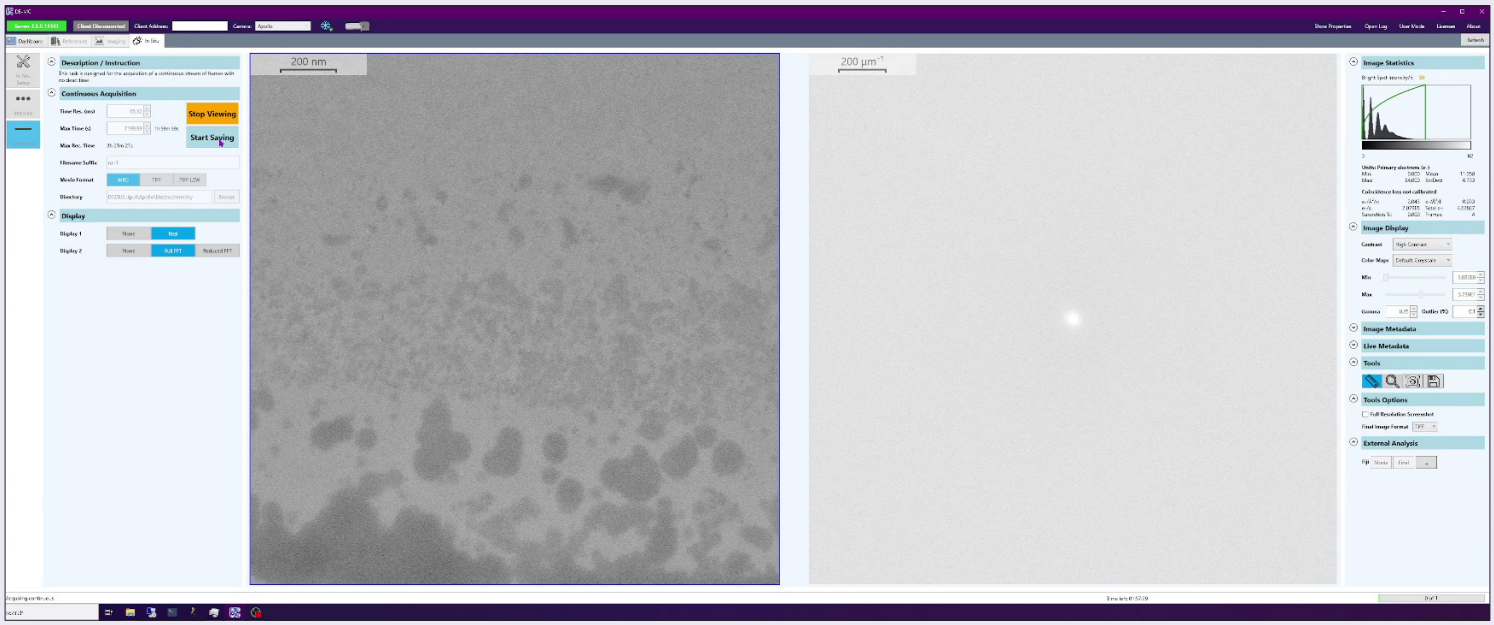


MicroED (Diffraction)
No background noise for crystallography of micro-crystals



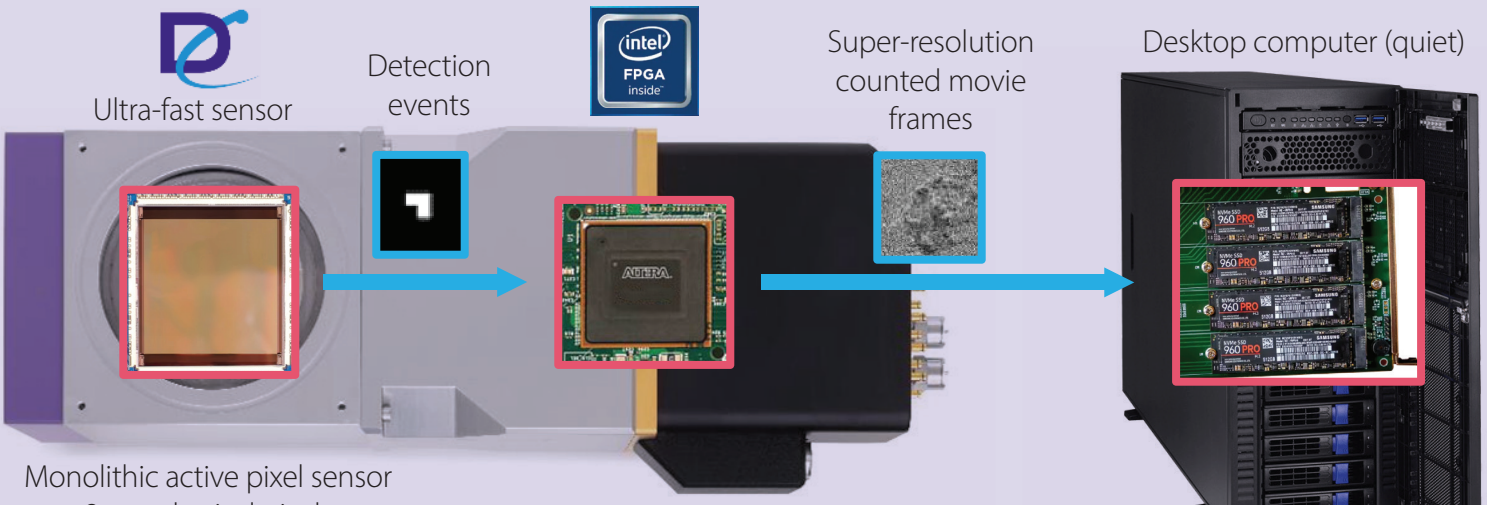
Imaging Beam Sensitive Materials
Electron counting ensures the highest DQE and incredible resolution

IN-SITU ACQUISITION SOFTWARE



Mission Control: in-situ electrochemistry movie acquisition with Artemis at 15 fps and 0.4 e/Å^2/s corresponding to 47 e/pix/s

A NEW STRATEGY FOR ELECTRON COUNTING: EVENT DETECTION IN HARDWARE

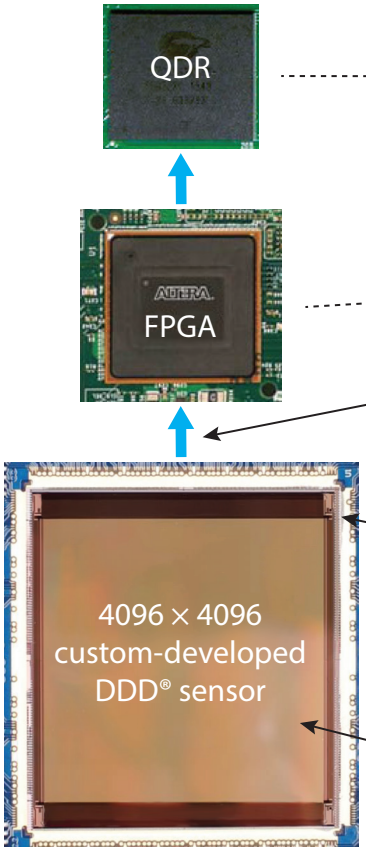


Monolithic active pixel sensor
8 µm physical pixels
4096 × 4096 physical pixels
On-chip CDS
On-chip thresholding
On-chip event detection
Event encoding

Field-programmable gate arrays
Sensor control
Real-time event processing
Super-resolution centroiding
Generation of output frames

User interface
TEM automation
Data storage/transfer
Post-processing

NEXT-GENERATION REAL-TIME ELECTRON COUNTING



US patent #10,616,521

Digital output of event blocks

Integrated circuitry on the top and bottom edges of the sensor (shielded from the electron beam)

Monolithic active pixel sensor (MAPS) for direct detection of TEM electrons

QDR memory stores each movie frame until it is output

FPGA isolates and centroids each detection event

FPGA isolates and centroids each detection event

Sense amplifier checks pixel values against a threshold

Pixel array uses on-chip CDS to minimize noise

On-board functionality

On-chip functionality

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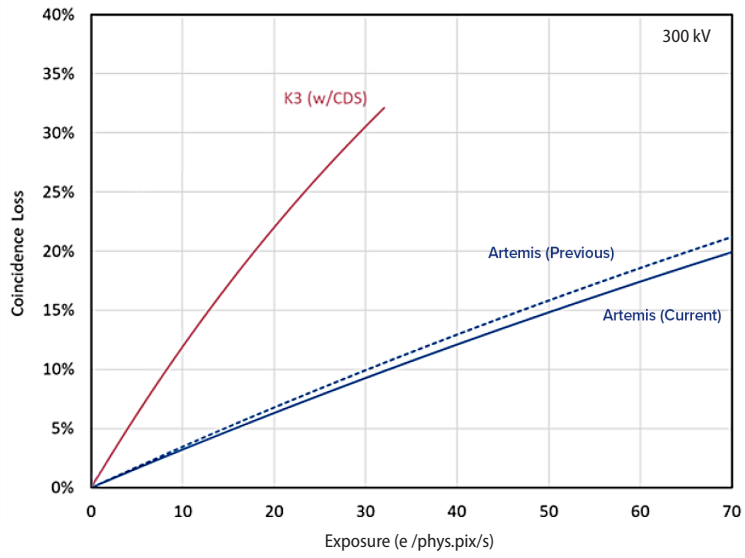
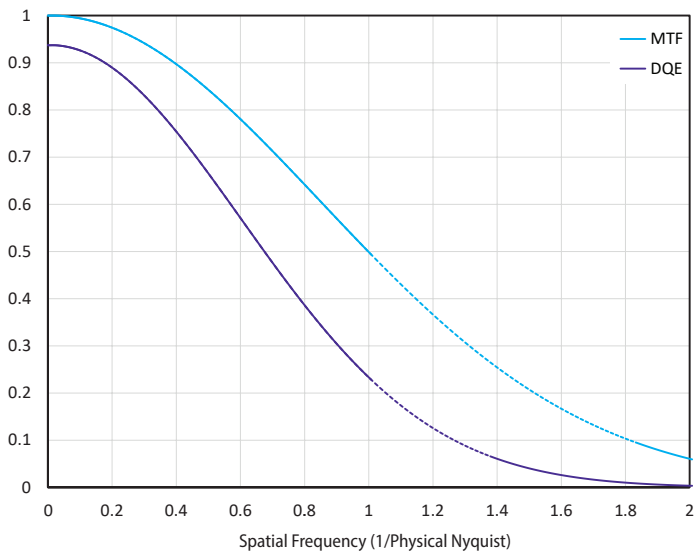
Tem Electron Energy	Sensitive to 80 keV – 1.25 MeV | optimized for 200 - 300 keV
Pixel Array Size	4096 × 4096 (16.8 million pixels) | 8 µm pixel pitch
Sensor Design	Novel event-based ultra-fast DDD® sensor on-chip correlated double sampling (CDS) | on-chip thresholding | digital readout backthinned | radiation hardened
Acquisition Modes	Event-based electron counting, *always*
Detection Efficiency	>90% For 200 - 300 kV
Exposure Rate	~0.01 - 75 e-/pixel/second (ranging ~4 orders of magnitude)
Linearity	>95% linear up to ~15 e-/pixel/second
Frame Rate	Up to 240 fps
TEM Compatibility	All major TEM manufacturers & models
Mounting Position	Fully retractable | compatible with a wide-range of configurations typically in TEM bottom port, pre- or post-energy filter, or in JEOL film drawer
Sensor Protection	TEM blanking/shuttering | failsafe software
Computer System	High-performance computer | Windows 11 | Nvidia GPU(s) | up to 55 TB storage
Image Format	Non-proprietary | MRC, TIFF, or TIFF LZW
Automation Software	SerialEM | Leginon | JADAS (JEOL) | open API (supporting Python, C, C++, C#, etc.)
Integrations	CEFID post-column energy filter (CEOS)





Left: Coincidence loss is a failure to detect electrons when the beam is too bright compared to the speed of the sensor. As you can see from the graph above, Artemis's ultra-fast counting is unmatched [1-3].
Right: DQE curves are shown for 300 kV electrons with Nyquist meaning the physical (non-super-resolution) Nyquist | Specifications and performance are subject to change.