

Ceta-S Camera

The high-speed, high-sensitivity camera solution

The Thermo Scientific™ Ceta-S™ Camera is our high-tension, flexible imaging solution for beam-sensitive materials and dynamic movie recording of *in situ* experiments. The high-speed readout with frame summing and the high DQE sensor offer a unique solution for *in situ* applications and CTEM application recording.

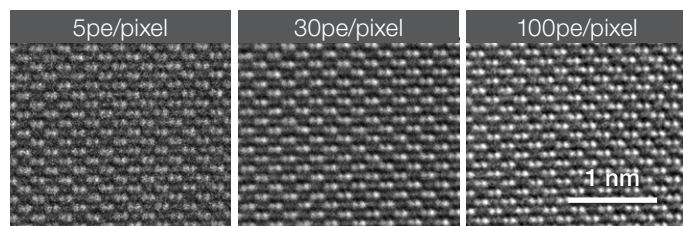
All-in-one camera for all high tensions

The Ceta-S Camera combines high speed and high sensitivity at low electron doses per pixel with a large field of view across the entire high-tension range of the electron microscope. Time-consuming retraction, insertion of multiple cameras, and changes in illumination and magnification are no longer required. This enables easier and more accurate quantitative operation with faster time-to-data.

High dynamic range and high-dose experiments (e.g., SAED diffraction or CTEM imaging) are still supported by the frame summing function of the camera and its high-speed recording capability. All imaging column specifications are guaranteed with the camera.

Optimized design for low-damage imaging

The Ceta-S Camera provides a unique combination of high DQE with high-tension flexibility in the 30–300 kV range. The high sensitivity at low electron dose per pixel allows for minimum total electron dose in the entire workflow of an imaging experiment. This capability minimizes beam damage and therefore increases the yield in the imaging experiments on sensitive materials like polymers, MOF, or 2D materials. The DQE in low electron counts per pixel, down to five primary electrons per pixel (5pe/pixel), enables minimum electron dose imaging with fewer artifacts.



Si[110] HRTEM imaging with different dose/pixel with image Cs corrector at 300 kV.

Key Benefits

High DQE and MTF at low-dose conditions at any high tension: Optimized sensor produces high-quality images down to a few electrons per pixel in electron dose.

Superior performance in dynamic imaging: The high-speed solution enables recording of high-quality 4k × 4k movies at up to 40 fps or 512 × 512 movies up to 300 fps. The high DQE reduces the electron dose per frame to avoid beam-induced effects.

Optimum performance at any high tension (30–300 kV): High sensitivity, robust fiber optic-coupled scintillator combined with large 14 μm pixel size delivers the best quality images.

Optimized settings for any material or application in one camera: Select low-dose imaging for beam-sensitive materials or high-dose imaging for diffraction applications and use fast frame adding for at least 16-bit dynamic range.

Compatible with post-column filters and spectrometers: The bottom-mounted Peltier cooled sensor is positioned on-axis for minimum distortions and is retractable, which enables easy integration with post-column filters and spectrometers.

Data storage: The optional speed enhancement solution (with analysis computer and/or storage server) enables capture, storage and transfer of terabyte file size movie recordings.

Superior performance for dynamic imaging

Fast, high-quality movie recording is pivotal to understanding material kinetics in dynamic microscopy, because it produces low electron counts per pixel in each individual movie frame. The high DQE and MTF at low dose increase the S/N ratio, which reduces the electrons required to observe dynamic effects with high time resolution. The integration of the Ceta-S Camera with our data-acquisition solution assures high-quality, 16-bit dynamic range movies at 40 fps with 4k × 4k pixel resolution and 300 fps with 512 × 512 pixel resolution (only available with speed

enhancement, else see standard specification in table below). Sophisticated data management with the optional speed enhancement enables handling of terabyte data files and movie recording of at least 40 minutes in full-resolution 4k mode.

System requirements

The Ceta-S camera is available on the Spectra and Talos platform. For retrofits please contact your local service and sales organization to check for hardware and software compatibilities.

Ceta-S Camera specifications		
Operation voltage	30–300 kV	
Sensor	4,096 × 4,096, 14 μm pixel CMOS	
Camera architecture	Fiber optic coupled scintillator (1:1)	
Recording frame rate	Standard:	Speed enhancement:
	4k × 4k 1fps	4k × 4k 40 fps
	2k × 2k 8 fps	2k × 2k 80 fps
	1k × 1k 18 fps	1k × 1k 160 fps
	512 × 512 25 fps	512 × 512 300 fps
Imaging performance in 4k × 4k mode DQE @ 0.5 Nyquist down to 10pe/pix MTF @ 0.5 Nyquist	>9% @300 kV; >9% @200 kV; >40% @60 kV (typical) >16% @300 kV; >17% @200 kV; >40% @60 kV (typical)	
Detection modes	Triple mode: Low dose, medium dose, high dose Sampling 1x, 2x, 4x, 8x	
Dynamic Range	>16-bit with fast frame summing	
Duty cycle in movie mode	100% in rolling shutter mode	
TEM shutter	Pre-specimen, post-specimen	
Movie mode shuttering	Electronic (rolling shutter) or TEM shutter (camera controlled)	
Conversion efficiency	25 counts/primary electron (typical) @200 kV 19 counts/primary electron (typical) @300kV	
Non-linearity	<1%	
Cooling	Sensor Peltier cooled	
Mounting position	On-axis, bottom-mounted, retractable	
Computer platform	Windows® 10, 64-bit	
Network Interface	Standard:	Speed enhancement:
	Gigabit Ethernet	10 Gb Ethernet to storage server/analysis PC 1 Gb Ethernet to TEM PC
Data management and storage	Standard:	Speed enhancement:
	HD space of microscope PC	4 TB SSDs on electronic board 4 TB storage in analysis PC (optional) 66 TB data storage server (optional)
X-ray safety	96/29/EURATOM - Ionizing Radiation	

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