DATASHEET

CETA-D Camera and MicroED Package

Complete solution for fast, high-resolution 3D structure determination

Micro-electron diffraction (MicroED) allows for 3D structure determination of small chemical compounds and biological macromolecules. It can be applied in fields as diverse as structural biology, medicinal chemistry and other organic and inorganic chemistry disciplines such as catalyst research and metal-organic frameworks (MOF).

Data collection is completed in only a few minutes, and 3D structures can be determined at atomic resolution, similar to X-ray crystallography.

Small crystals

MicroED data is acquired using a cryo-transmission electron microscope (cryo-TEM) using electrons instead of X-rays. Since MicroED is a diffraction technique like X-ray crystallography, the sample needs to be crystalline.

The crystallization process is essentially the same as for X-ray crystallography; however, much smaller crystals can be used because the interaction of electrons with the crystal is much stronger than for X-rays. Crystals considerably smaller than 100 nm in size can readily be analyzed. This may significantly shorten the sample preparation process and allows for the analysis of crystals that are too small to diffract with other methods.

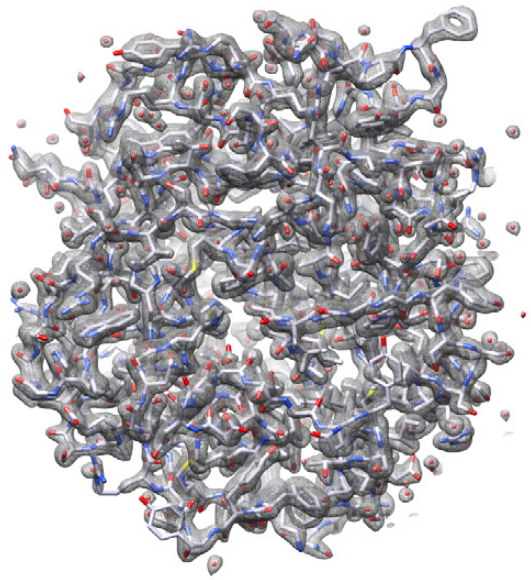

Figure 1. Proteinase K. MicroED data provided by the Gonen Laboratory HHMI/UCLA.

Key benefits

Fast atomic-resolution 3D structural information. Collect diffraction data from nanocrystals in minutes.

Instant productivity. Nanocrystals as small as 100 nm can be readily analyzed, removing the burden of growing large crystals (as with X-ray crystallography). Also reduces the amount of sample material required. Mixtures of different polymorphs and compounds can be analyzed.

Complete turnkey solution. Including hardware, software and support from one single vendor. Acquired data can be readily processed using established reconstruction packages for X-ray crystallography.

2-in-1 solution. MicroED and single particle analysis (SPA) can be performed on the same cryo-electron microscope. This solution is compatible with new microscopes but is also retrofittable on existing units.

Small amount of sample, mixtures of compounds and polymorphs

Because of their extremely small size, nanocrystals require orders of magnitude less sample volume than crystals for X-ray crystallography. This makes MicroED ideal for the characterization of precious molecules and enabling fast analysis of scarce materials. Intermediate-sized crystals that are too large for MicroED but too small for X-ray crystallography can be solved by simply breaking up the crystals physically or using a cryo-focused ion beam (cryo-FIB) to thin them.

Furthermore, since many crystals are typically combined on a single TEM grid, it is straightforward to analyze mixtures of different compounds and polymorphs. The structure of dry chemical compounds can be solved directly from powder, without further preparation.

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A complete solution for MicroED

In combination with a Thermo Scientific™ cryo-transmission electron microscope (cryo-TEM), the following two elements make up a complete MicroED solution:

CETA-D camera for low-dose diffraction

The Thermo Scientific CETA-D™ Camera is a scintillator-based camera optimized for low-dose diffraction data collection. It is ideal for working with dose-sensitive materials, such as proteins, pharmaceutical molecules and organic materials.

The camera's high sensitivity allows for reliable detection of high-resolution, low-intensity diffraction peaks. Its high signal-to-noise ratio allows for accurate measurement of the integrated peak intensity. Both of these elements are prerequisites for obtaining high-resolution structural information.

After acquisition, the diffraction patterns and metadata are readily available for processing like standard X-ray diffraction data, using packages like DIALS or XDS. Resolutions better than 1 Å have been reported.

MicroED package to form a complete solution

When combined with the CETA-D Camera, the Thermo Scientific MicroED Package comprises all necessary elements to form a complete solution, whether it be on a new cryo-TEM or as a retrofit on an existing unit.

Thermo Scientific EPU-D™ Software for screening and automated data acquisition. Coordinating the screening of crystals and diffraction, and data collection itself, can be overwhelming and time-consuming when done manually. EPU-D Software offers ease of use in a user-friendly environment. For example, it enables quick switching between imaging and diffraction, it guides optimal low-dose setup, and drives the constant speed continuous tilt for data collection. EPU-D Software now expands the intuitive capabilities and unified user experience of EPU Software to the electron crystallography domain.

Optimized smaller beam stop to mask the central beam without blocking low-resolution diffraction spots.

Optimized aperture set so that unwanted background signal from the area surrounding the crystal can be maximally suppressed.

Set of dedicated electron-optical settings to enable optimal camera utilization while benefiting from best sample-beam geometry.

The MicroED Package is a perfect match with the CETA-D Camera but may also be combined with other Thermo Scientific cameras for special application requirements.

Works with new microscopes as well as retrofits

Both the CETA-D Camera and the MicroED Package are compatible with new microscopes and can be retrofitted on existing units. Our cryo-TEMs provide all the necessary capabilities for efficient and high-performance MicroED activities:

Stable column with low hysteresis for switching between imaging and diffraction mode.

Stage with smooth continuous tilt for automated tilt series acquisition. The eucentric performance avoids the need for sample tracking and re-centering while only a small area on the selected crystal is illuminated.

Reliable cryogenic operation is important to prevent radiation damage to the sample. For vitrified protein samples, it is critical to prevent devitrification throughout the entire workflow. The robotized Autoloader handles samples safely throughout grid loading, screening and data collection, and recovery of the vitrified grid for further study. In case of high workload, it will also help with faster grid exchange of cryo-samples for screening.

For many labs, being able to use the same equipment for both MicroED and single particle analysis (SPA) further solidifies the rightful presence of cryo-TEMs.

Technical specifications

CETA-D Camera

- Sensor: 4,096 × 4,096, 14 µm pixel CMOS
- Camera architecture: Fiber optic coupled scintillator (1:1) Frame rate
  - Standard: 4k × 4k, 2 fps; 2k × 2k, 8 fps; 1k × 1k, 18 fps
  - Noise reduction: 4k × 4k, 2 fps; 2k × 2k, 6 fps; 1k × 1k, 6 fps
- Imaging performance in 4k × 4k mode:
  - DQE @ 0.1 Nyquist > 26% @300 kV > 40% @200 kV
- Duty cycle in movie mode: 100% in rolling shutter mode
- Conversion efficiency:
  - >26 counts/primary electron @200 kV
  - >22 counts/primary electron @300 kV
- Mounting position: On-axis, bottom mounted, retractable

MicroED Package

- Dedicated software for crystal and diffraction screening and automated data acquisition
- Modified beam stop, optimized for MicroED
- Set of optical presets for optimizing camera exposure for MicroED
- Optimized C2/SA aperture set and 90-degree rotation projection system (200 kV systems only)
- Compatible with Thermo Scientific Krios™, Glacios™, Talos Arctica™ and Talos™ F200 TEMs. For evaluating compatibility with other systems, please consult your sales representative.

Find out more at **thermofisher.com/MicroED**

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