STEMx 4D STEM System
Model 1020

Introducing STEMx™, a powerful tool that adds 4D scanning transmission electron microscopy (STEM) diffraction capabilities to your existing Gatan *in-situ* camera (OneView® IS and K2® IS).

4D STEM is the capture of a full 2D diffraction pattern at each pixel position in a STEM map.

Benefits

- **Leverage your existing camera for new 4D STEM applications:** Build on the high spatial and temporal resolution of your Gatan *in-situ* camera

- **Scan large sample areas with high diffraction space resolution:** View and analyze large sample areas during your STEM experiments, including dislocations and strain

- **Streamline your workflow for advanced applications:** Quickly obtain high-quality strain maps or apply a unique virtual aperture through an easy to use interface

- **Examine preliminary results in <10 min:** Preview results and modify experimental parameters, as needed, to ensure you collect the best dataset possible

Using STEMx, now acquire a 2D diffraction pattern at every STEM probe position on the sample so that you can turn results into information-rich 4D datasets. By leveraging the high spatial and temporal resolution of Gatan *in-situ* cameras, STEMx enables for a wide variety of 4D STEM experiments, including strain mapping, indexing (offline), orientation mapping, virtual apertures, and differential phase contrast.

Once a diffraction pattern is generated for each data point, a single, interactive Gatan Microscopy Suite® (GMS) 3 display enables you to view and manipulate all the information in the 4D STEM diffraction cube; including diffraction planes or individual diffraction patterns at each pixel location. STEMx is then able to process these large datasets within minutes using data size reduction methods that comprise of binning in four dimensions, sub-sampling in the spatial domain, or selecting a small region of interest. By consolidating both acquisition and analysis into GMS 3, not only can you quickly analyze and assess results at the microscope, but immediately decide whether to modify acquisition parameters or capture a new dataset.
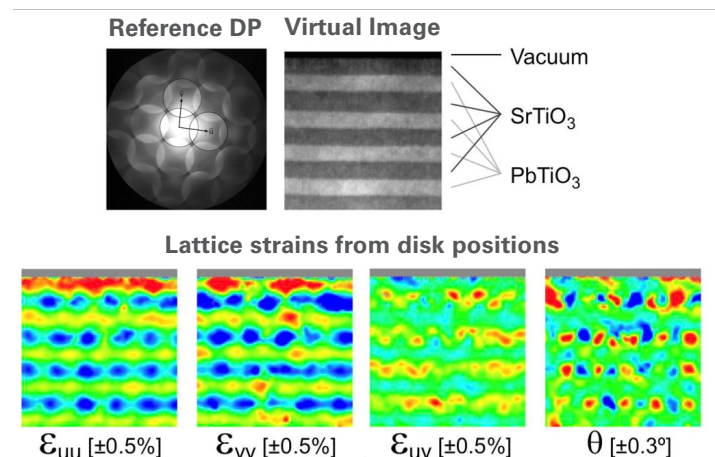
To ensure you get the most out of your information-rich 4D datasets, STEMx offers integrated analysis tools. Specifically, you can calculate high-resolution strain maps by comparing a reference diffraction pattern (DP), that is automatically calculated from an unstrained region of the specimen selected by the user, to all the diffraction images in a 4D dataset. With these results,

you can evaluate dimensional changes in a crystal lattice (Figure 1) to understand material growth or its structural integrity better.

STEMx also enables you to generate a unique virtual aperture image from distinct reflections in your 4D dataset. To create this virtual aperture image, simply select a reflection with a region of arbitrary shape, then combine the virtual apertures from one or more reflections. By overlaying multiple images, you can study grain orientations (Figure 2) from actual or theoretical constructs as well as predict their impact on the electrical and thermal conductivity of a material.

In combination with spectrum imaging, STEMx allows you to spatially resolve the distribution of diffraction patterns relative to electron energy loss spectroscopy or cathodoluminescence data. This capability makes it possible for you to create a comprehensive dataset that includes qualitative compositional or chemical maps and profiles.

Reference DP   **Virtual Image**

Vacuum

$SrTiO_3$

$PbTiO_3$

Lattice strains from disk positions

ε_{uu} [±0.5%] ε_{vv} [±0.5%] ε_{uv} [±0.5%] θ [±0.3°]

Figure 1. Strain maps were calculated from a 4D STEM dataset that was acquired at 400 frames per second (fps) using the K2 IS camera equipped with STEMx. This 4D dataset included approximately 65,000 diffraction patterns and was collected in about 160 s. *Figure courtesy of J. Ciston and C. Ophus (NCEM). Sample courtesy of C. Nelson, S. Hsu and R. Ramesh (UC Berkeley).*

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Applications

- Strain mapping
- Orientation mapping
- Indexing (offline)
- Virtual apertures
- Differential phase contrast

Specifications

STEM image size pixels	OneView IS camera* 1024 x 1024 pixels, 200 fps	K2 IS camera* 1920 x 1850 pixels, 400 fps
	Total acquisition time (s)	
64 x 64	14	3
128 x 128	55	12
256 x 256	328	164

*The OneView IS camera can run up to 300 fps and the K2 IS camera can run up to 1600 fps.

Specifications are subject to change without notice.

Requirements

- Gatan *in-situ* camera (OneView IS or K2 IS)
- Electron microscope equipped with a STEM interface
- STEM detector

Ordering

Model	Description
1020.1	STEMx System (STEMPack) *Includes a DigiScan™ II system*
1020.2	STEMx System
1020.M	STEMx Memory (K2 IS)
Installation & training	
1020.T1	STEMx Installation (STEMPack) *Includes STEMx and STEMPack installation on a microscope with an existing camera*
1020.T2	STEMx Installation *Includes STEMx installation on a microscope with an existing STEMPack and camera*
1020.T3	STEMx Installation (Camera) *Includes STEMx and camera installation on a microscope with an existing STEMPack option*
Software	
700.LS.1020.31.64.1	STEMx Analysis Software (Offline/64-bit)
700.LS.1020.33.64.1	STEMx Viewing Software (Offline/64-bit)
Service contracts	
1020.EW.5	STEMx Service Contract – Extended warranty, labor, and materials plan
1020.EW.6	STEMx Service Contract – Extended warranty and materials plan
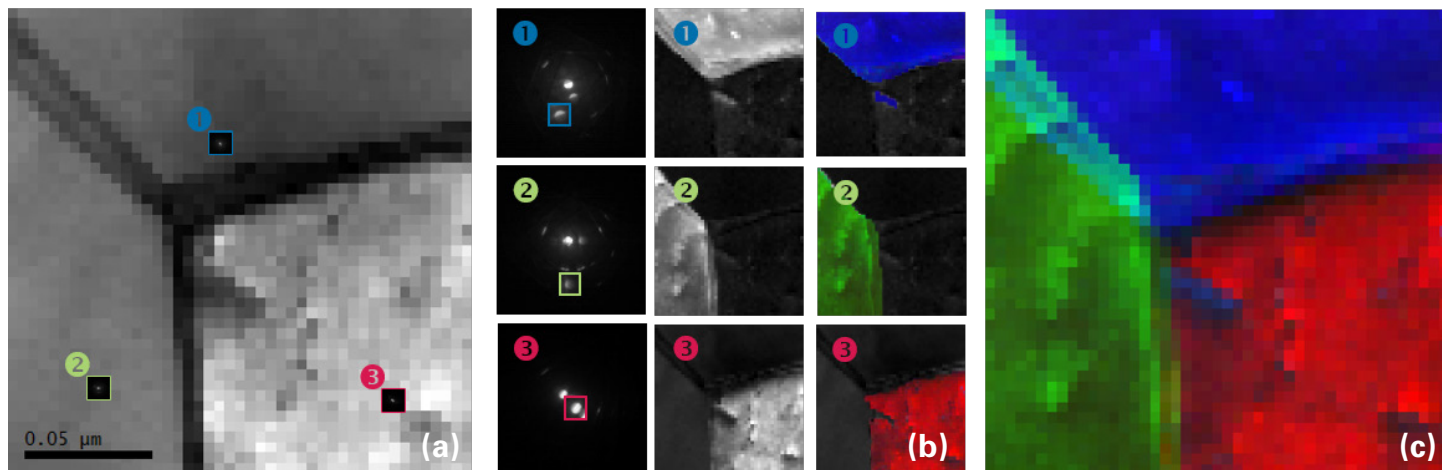
Figure 2. A virtual aperture workflow: (a) highlight the desired reflection with a virtual aperture of arbitrary shape; (b) reconstruct a diffraction image using the selected virtual aperture; and (c) generate an RGB overlay from different individual apertures, for instance, to highlight the different grain orientations. *The dataset was collected with the OneView IS camera using a copper foil sample courtesy of Dr. Geiss, Colorado State University.*

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