Experiment Brief

Metro Camera

Title

Acquiring counted 4D STEM with the Metro camera

Gatan Instrument Used

With a simple user interface, the Metro™ counting camera enables **low-dose** imaging and **diffraction** at low kV **via real-time electron counting**. In a 4D STEM experiment, the STEMx™ system **precisely synchronizes the speed of the scanning probe to the camera frame rate** to enable high-speed data acquisition and eliminates the potential for data loss.

Background

2D materials like boron nitride are increasingly studied for their unique and tunable properties. Determining the alignment and morphology of 2D sheets is important for characterizing material quality, and 4D STEM coupled with electron counting is an ideal technique to characterize the structure of meaningful sample areas quickly. When coupled with post-processing tools such as Python scripting, results can be quickly validated at the transmission electron microscope (TEM).

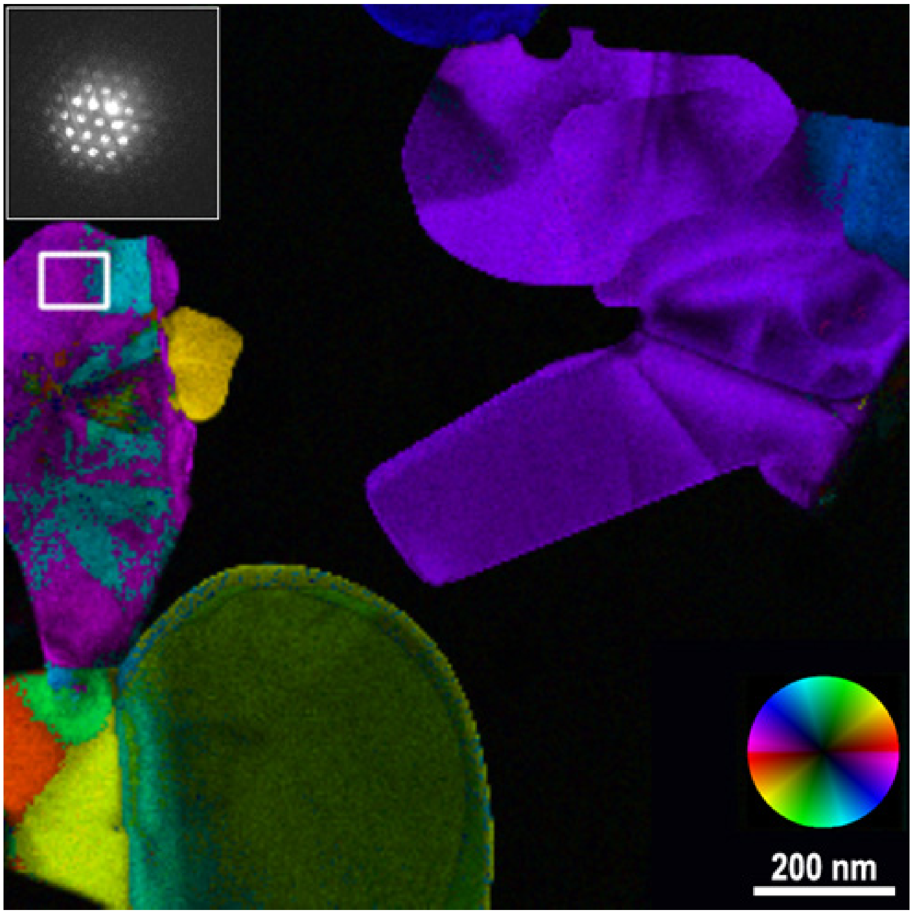

Figure 1. Map of boron nitride from a counted 4D STEM dataset collected with the Metro camera. A color scale is shown at the bottom right, to indicate which color corresponds to each angle, as well as the brightness variation from very dim spots (center) to very intense spots (edge). The inset shows the sum of diffraction patterns from the region in the white rectangle.

Materials and Methods

The TEM used to capture the data was a JEOL F200 with a cold field emission gun operated at 200 kV. A 128 x 128 (scan) x 512 x 512 (pattern) 4D STEM dataset was collected in 33 s using the Metro camera and STEMx system in hardware synchronized mode (492 fps). The dose rate was 3.1×10^6 e^-/s on the camera and an average of 2.5 $e^-/Å^2$ on the sample. Figure 1 shows a map of crystalline regions produced by a Python script run in DigitalMicrograph® software. Each pixel in this map is colored based on the direction (hue) and the intensity (brightness) of the highest intensity reflection in the diffraction pattern corresponding to that pixel in the 4D STEM dataset. This results in a map that usually distinguishes regions of different crystalline orientations but does not identify the orientation.

Summary

The Metro camera with STEMx is an excellent tool for acquiring 4D STEM data because of its size and speed, low noise, and integration with DigitalMicrograph. The Metro camera captured this 4D STEM dataset in half a minute. The benefit of the counting algorithm is that it rejects background noise. The DigitalMicrograph utilities and Python integration generate maps post-acquisition to verify the sample and data integrity quickly.

Gatan, Inc. is the world's leading manufacturer of instrumentation and software used to enhance and extend electron microscopes—from specimen preparation and manipulation to imaging and analysis.

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