Talk Title : Mapping Crystalline Regions During In-Situ Heating: Comparing TEM and 4D STEM

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Talk Abstract :

Often during in-situ TEM experiments, it is important to see and distinguish crystalline regions in a sample. Yet, this can be challenging for several reasons. In a large TEM image, it may be difficult to see at a glance the extent of crystalline regions because neighboring regions are not easily distinguished, or because the large image cannot be displayed at full resolution on the monitor. When using 4D STEM, it is also inherently difficult to see anything as visualization requires a dimensional reduction that can hide important information. In both cases, the difficulty is increased if a series of images or data cubes are acquired as part of an in-situ experiment.

In this work, we demonstrate Python-based processing of both 4D STEM and high-resolution TEM images to map the spatial distribution of crystalline regions. This can be done (with some limitations) during live during acquisition, or it can be applied to previously acquired datasets. While we are processing the 4D STEM data and the HR TEM data in a similar way, there are differences and tradeoffs which make each technique optimal for some different experiments. These will be briefly covered.

Ultimately, the goal for this processing is to perform it live during acquisition to guide decision making at the microscope. This can already be done for TEM imaging at a rate of about 1 fps. Better parallelization of the processing in Python, faster CPUs or GPUs, and other optimizations, will undoubtedly make this faster in the future.