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nano3DX: A Tool for High-Resolution X-ray Microtomography for Low Density Materials

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Tomography is the study of the three dimensional-structure of an object by slicing it into thin sections. Microtomography implies that the slices are very thin; thin enough to be viewed by an optical microscope. Classical tomography is a tedious and time-consuming process, and can also result in significant perturbations to the sample. In X-ray tomography, the entire sample is imaged at multiple rotation angles. This multitude of images is processed by sophisticated computer algorithms to provide a three dimensional reconstruction that can be sliced in any direction, providing new insights into the internal features of the object. X-ray microscopy provides this visualization at a resolution better than a micrometer (μm).

The nano3DX is a true X-ray microscope (XRM) with the ability to measure relatively large samples at high resolution. This is accomplished by using a high-power rotating anode X-ray source and a high-resolution CCD imager. A rotating anode X-ray source provides for fast data acquisition and the ability to switch anode materials easily, to optimize the data acquisition.

In the nano3DX, the magnification takes place in the detector using true microscope elements. This design places the sample close to a high-resolution detector, allowing for a quasi-parallel beam experiment. This means greater instrument stability and shorter data collection times, providing the highest resolution of any X-ray microscope in its class.

The nano3DX provides for a field of view as large a 14 mm x 10 mm at 4.32 μm pixel size down to 0.9 mm x 0.7 mm at 270 nm pixel size. The contrast for low-Z materials is enhanced by the use of the appropriate target material: chromium (5.4 keV), copper (8.0 keV) and molybdenum (17.5 keV).

We will review some example data sets and explore potential uses of the nano3DX.