Advances and Future Directions in 3D X-ray Microscopy: Orientation and k-space.

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The ability to perform x-ray diffraction with beam sizes of ~200 nm permits studying the actual microscopic structure in an inhomogeneous sample rather than just a large spatial average. To understand materials properties, it is important to measure the local grain-to-grain or point-to-point variations in orientation, strain, or structure, since that is the source of many important materials properties. For example, validation of dislocation dynamics calculations that occur on the sub-micron scale requires measurements of tilt or strain at that same short length scale. Further, a measurement of the internal strain field is inherently a 3 dimensional problem that requires a 3 dimensional measurement done at the length scale of the intrinsic dislocation structure. Such strain measurements cannot be done on thinned samples, which would allow the strains to relax. We will present a range of applications, showing measured orientation fields, measured strain fields in 3D, and measured k-space volumes from microscopic real space volumes. We will also highlight new capabilities, and discuss future advancements.

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