

HIGH-ENERGY X-RAY SCATTERING TOMOGRAPHY

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Computed Tomography (CT) and its higher resolution variants microCT and nanoCT typically reconstruct sample cross-sections based on the variation of x-ray attenuation. In mixtures of SiC and Al or aragonite and calcite, however, the contrast in absorption-based tomographs is quite low despite the difference in elemental content and/or density. Other contrast mechanisms provide superior discrimination of these phases and can provide complementary information. The subject of this report is x-ray scattering-based tomographic reconstruction of materials, an approach that focuses on crystallographic phases rather than attenuation.

High-energy x-ray scattering has been used at Sector 1, the Advanced Photon Source, to reconstruct the internal structure noninvasively of mineralized tissue samples and of a SiC monofilament, Al matrix composite. A 65 keV (or higher energy) microbeam and a 2D amorphous Si area detector are used to collect the diffract patterns. The specimen is scanned across the microbeam to record one projection and then rotated to record the next projection (i.e., the translate-rotate or first-generation tomography). Typically, the integrated intensity of one entire diffraction ring is used for the reconstruction although portions of the ring may also be used. Slices reconstructed with different reflections are compared with each other and with matching absorption microCT slices. The data show not only which phases are where but also reveal the spatial variation of crystallographic texture.