MS20-02 | X-Ray Characterization of Morphology and Structure of Materials at Multiple Length Scales

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High-resolution 3D characterization of materials and structures is needed in materials research and development. Currently, two types of laboratory-based XCT setups, micro XCT in projection geometry with a resolution of about 1 micrometer and nano XCT with focusing X-ray lenses with a resolution down to < 100 nanometers, are available commercially for nondestructive 3D inspection of medium and small sized objects, as well as object interiors and materials' microstructure components. Because of their ability to reveal structural characteristics, materials' microstructure and flaws, such as cracks and pores, or local composition and density differences, they are potential techniques for imaging of micro- und nano-structured objects. Examples for high-resolution X-ray imaging will be shown: Crack propagation in composites and failure localization in microchips, morphology of porous or skeleton materials and interior of biological objects.

Perspectives of high-resolution XCT for nondestructive 3D imaging of materials will be provided. Potential and limits of these XCT techniques for nondestructive evaluation of geometrical features, materials' microstructure and flaws will be discussed. Perspectives to overcome two major limitations of state-of-the-art nano XCT tools, i.e. the necessity of sample preparation (typically less than 50 mm thickness, depending on the material composition, if 8 keV photons are used) and low sample throughput, will be given. A novel tool concept for X-ray microscopy at high photon energies, using advanced X-ray sources with high flux and the option of multi-energy photons, and of advanced X-ray optics with high efficiency at photon energies > 10 keV, will be presented.