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Diffraction computed tomography and its applications

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Attenuation-based radiography and tomography (CT) are well-established experimental techniques for non-destructive visualisation of the object interior, where X-/gamma-rays and neutrons are most commonly used types of the incident radiation, but also protons or heavy particles (e.g. ions) can be used as a source. Different radiation sources are used along with phase-contrast, Bragg and/or energy-selective imaging for gathering complementary information enabling the enhancement of contrast and sensitivity beyond the limitations of X-rays.
Alternative way to increase sensitivity to density variations and chemical composition as well as to improve the discrimination of chemically and morphologically similar, but structurally distinct phases is the accounting for scattering effects in the radiography and tomography. This pawed the way to diffraction CT –an experimental technique combining diffraction with Computed Tomography in the form of either XRD-CT or ND-CT, where similar to traditional CT, the sample is scanned by a pencil-beam, but the diffraction picture is collected instead of the attenuation pattern in the transmitted beam. Prominent progress has been achieved during the last decades in increasing spatial and temporal resolution especially for studies of energy materials, biological samples, catalysts, fuel cells etc.
In the current contribution we report the applications of diffraction-CT to studies of lithium distribution in commercial cylinder-type Li-ion batteries as well as the implementation and first results of ND-CT (Neutron Diffraction with Computed Tomography) experiments using monochromatic thermal neutrons.

Authors: KOCHETOV, Vladislav (TUM); Dr MÜHLBAUER, Martin (Deutsche Patentamt); PETZ, Dominik; Dr BARAN, Volodymyr (DESY, FS-PETRA-D, P02.1); SCHOEKEL, Alexander; HOFMANN, Michael; SENYSHYN, Anatoliy

Presenter: SENYSHYN, Anatoliy

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