Chemical imaging: a powerful tool for functional materials characterization

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Thanks to the recent developments in the synchrotron instrumentation and detectors technology, chemical imaging becomes increasingly more popular to provide reconstructions of sample cross-sections with spatially resolved chemical information. Chemical imaging includes a wide range of the synchrotron-based X-ray scattering and spectroscopy methods like X-ray diffraction (XRD-CT), X-ray fluorescence (XRF-CT) and X-ray absorption spectroscopy (XANES-CT).

In this talk I will briefly introduce the X-ray diffraction computed tomography (XRD-CT) that is a coupling of powder diffraction and computed tomography using a “pencil” beam approach. The spatially resolved signals obtained with XRD-CT can reveal information that would otherwise be lost in bulk measurements, which opens up new possibilities in functional material characterization.Also case studies where chemical imaging was applied by the Finden team to track the evolving solid-state chemistry of complex functional materials and devices like catalysts and batteries will be discussed [1,2]. Talk will also focus on the current limitations and advances in data analysis strategies [3].

[1] Emerging chemical heterogeneities in a commercial 18650 NCA Li-ion battery during early cycling revealed by synchrotron X-ray diffraction tomography, 2022, DOI: 10.1016/j.jpowsour.2022.231589

[2] Real-Time Scattering-Contrast Imaging of a Supported Cobalt-Based Catalyst Body during Activation and Fischer–Tropsch Synthesis Revealing Spatial Dependence of Particle Size and Phase on Catalytic Properties, 2017, DOI: 10.1021/acscatal.6b03145

[3] A deep convolutional neural network for real-time full profile analysis of big powder diffraction data, 2021, DOI: 10.1038/s41524-021-00542-4