ELECMI INTERNATIONAL WEBINARS 2021

24th March

Coincidence experiments combining EELS and EDX spectroscopy

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In this talk I will give an overview of recent developments exploiting new possibilities in single event detection in the transmission electron microscope. New hybrid pixel direct electron detectors are revolutionizing the way we detect electrons in the microscope, providing the individual localisation of electrons when they hit a camera surface as well as the precise time they do so. Here we report on placing such a camera in an electron energy loss spectrometer and combining it with a digital pulse processor coupled to a 4 quadrant energy dispersive X-ray detector. This prototype setup now offers to detect all EELS and EDX events as a series of single events with time stamping. This rich dataset contains all the conventional information obtained in a more traditional EELS or EDX experiment, but now augmented with timing information that allows to correlate individual events in time. As EELS and EDX spectra are fundamentally linked to the excitation (EELS) and de-excitation (EDX) of a given atom in the sample, these events are intrinsically correlated and this indeed shows in the experimental data. We demonstrate that this augmented dataset provides unique opportunities to remove the background in EELS spectra without any assumptions on its shape or to distinguish overlapping EDX peaks.

We believe this experiment holds great promise for applications where trace elements need to be detected, an area where traditionally EELS has had difficulties, but the event based detection has many other benefits and can be applied to other signals in electron microscopy as well.