Electron Energy Loss Spectroscopy Videos During In-Situ Experiments

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Electron energy loss spectroscopy has been used to study the changes in materials during *in-situ* TEM experiments since the early days of *in-situ* TEM[1]. EELS spectra can map the redistribution of elements in a material nanostructure, monitor oxidation or reduction, or even observe the exchange of elements from the gaseous or liquid environment into solid structures during growth processes. EELS can also be used to measure the conditions surrounding the sample, including gaseous or liquid environments[1] as well as temperature[2].

In the past EELS spectra or maps were usually acquired before and after some observed or expected transformation. Spectra were typically not acquired throughout the course of these transformations for a variety of reasons, including beam damage, sample instability/drift, and because the acquisition of EELS spectra/maps was too slow for continuous monitoring.

Today, using sensitive new direct detection cameras like Gatan's K2 to collect the EELS signals, lower dose rates can be used to reduce beam damage, and spectra can be acquired rapidly while maintaining reasonable signal-to-noise in the acquired spectra. New MEMS-based sample holders now significantly reduce the drift previously associated with heating materials in the TEM. Due to these advances, it is now possible to continuously collect EELS data, producing the equivalent of a video during *in-situ* transformations. Data acquired using several methods will be shown, including counted EFTEM videos, time-sequences of EELS spectra, and time series of EELS maps.

[1] PA Crozier, BK Miller, in "Controlled Atmosphere Transmission Electron Microscopy", ed. TW Hansen, JB Wagner, (Springer International Publishing) pp. 95 - 141.

[2] M Mecklenburg et al, Science 347 (2015), p. 629-632.