Sub-cellular elemental mapping by combined STEM-EDX-EELS

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The scanning transmission electron microscope (STEM) is a powerful instrument for performing quantitative imaging and spectroscopy at extremely high resolution. Powerful techniques in STEM include annular dark-field imaging (which allows heavy elements to be detected and quantified), energy dispersive x-ray (EDX) and electron energy-loss spectroscopy (EELS). Such methods are routinely used in materials science to provide highly localised compositional information, even down to an atomic scale [1,2,3].

We present simultaneously-acquired high-angle annular dark field STEM, EDX and EELS data, showing ability to detect trace elements which underpin fundamental biological processes. We discuss some specific challenges associated with acquiring such data from biological systems, namely radiation sensitivity and overlap of neighbouring and biologically-relevant elemental peaks, and present multivariate methods as a potential candidate for unwrapping additional information from such combined data.

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