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STEM - Monochromated EELS: the Real Swiss Army Knife of Spectroscopy

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Scanning transmission electron microscopy (STEM) in combination with electron energy-loss spectroscopy (EELS) is probably the most versatile spectroscopy technique to study materials at sub-nanometer length scales. For instance, nowadays it is possible to obtain chemical maps of composition, bonding information and dielectric response of materials [1]. EELS measurements and mapping were carried out in TEM/STEMs till 2000, but since then mapping with atomic resolution (d < 2 Å) has become routinely possible with the advent of aberration-corrected STEMs [2].

Improvements in the understanding of the scattering process involved in EELS has also led to measure and quantify ferromagnetic phases in materials, just like with X-ray circular magnetic dichroism (XMCD) in synchrotrons, but with the phase of the electron playing the role of polarization of light [3].

The recent development of a new generation of monochromators [4] and spectrometers [5] has transformed EELS in a much more versatile tool. Phonon mapping with atomic resolution [6], the detection of isotopes in water [7] and amino acids [8] for instance, are now the new 'tools'of this Swiss Army Knife of spectroscopy that is EELS.

I will go through some of the technical details of the aforementioned tools and discuss some of the relevant 'blades and tools'of the monochromated-EELS toolkit that I think would be must relevant to the Catalan research community.

References:
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