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**IT-10-O-2787 EELS and tomography: from EELS Spectrum Images to Spectrum Volumes.**

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In transmission electron microscopy (TEM), 3D tomographic reconstruction can be achieved by acquiring a series of images at different tilt angles. A different approach is obtaining 3D chemical reconstructions from energy filtered images in the TEM (EFTEM)[1-3], and more recently, by acquiring EELS spectrum images (EELS-SI), each pixel containing a complete EELS spectrum [4,5]. However, in both techniques only a limited amount of information is effectively reconstructed. In this paper we aim to derive a full EELS dataset in 4D, where every voxel of a whole volume contains a complete spectrum of energy losses, as schematized in Fig. 1. By analogy to the spectrum image notation, we will name this 4D dataset as EELS spectrum volume (EELS-SV).

Our approach to EELS-SV reconstruction is based upon SI, thus taking a single SI for every tilt angle. It takes advantage of Multivariate Analysis (MVA), and more precisely of blind source separation (BSS)[6], to find a new spectral basis (Fig. 2a) which can describe all the spectra in the dataset as a weighted sum of its components. Therefore only the 3D reconstructions of the weighting components (Fig. 2b) will be necessary to recover the spectra in each voxel (Fig. 2c-e). We will apply this approach to analyze a BFO/CFO nanocomposites, enabling the characterization of a CFO nanocolumn embedded in BFO matrix.

References

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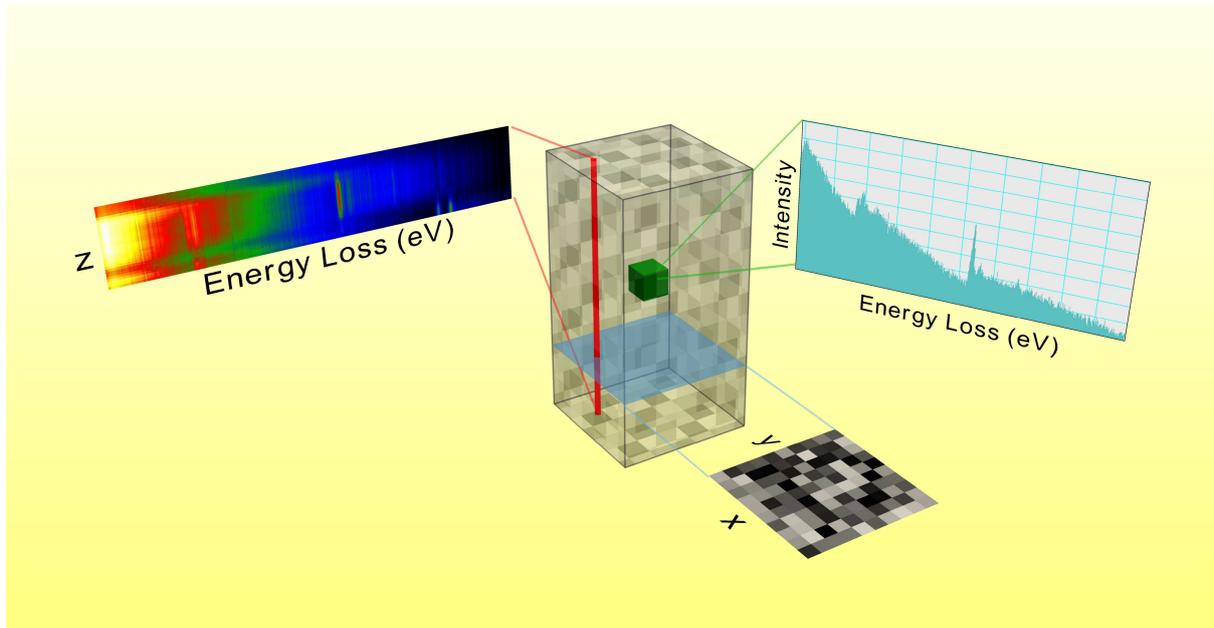


Fig. 1: Schematic of the 4D dataset, the EELS spectrum volume, consisting of 3 spatial dimensions plus an additional energy loss dimension. Here it is presented along with an extracted xy spectrum image, a spectrum line along z direction and a single spectrum from an inner voxel.

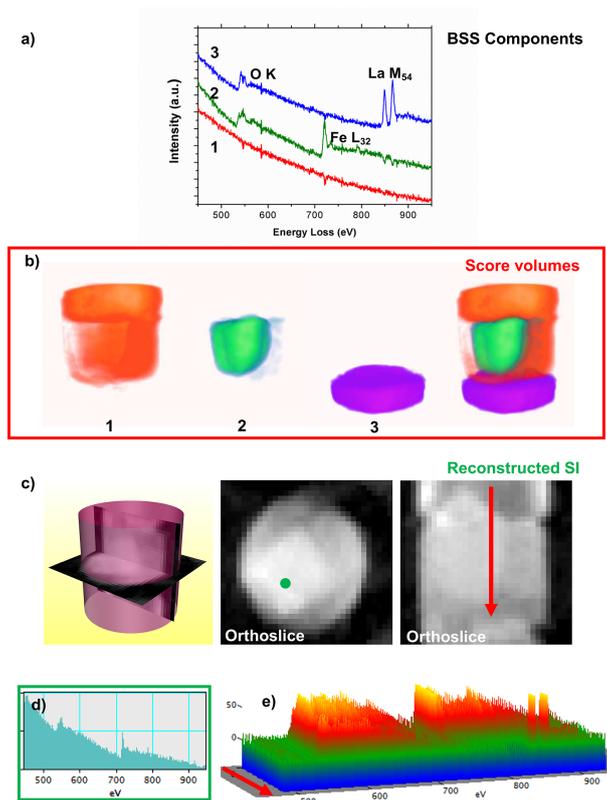


Fig. 2: EELS-SV reconstruction procedure. a) Components of the spectrum. b) 3D reconstructions, c) Schematic representation of two orthoslices and reconstructed SI for transversal and longitudinal orthoslices. d) Single spectrum and e) spectrum line extracted from the slices.