Energy-Loss Spectroscopy in a STEM (STEM-EELS)

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In this second lecture, we will discuss the basics of Electron Energy-Loss Spectroscopy (EELS), a preferred spectroscopic technique in STEM. We will show how EELS, when spatially resolved at the atomic column scale, makes it possible to study structural reconstructions at interfaces such as the nature of the termination planes or cations inter-diffusion. In addition, we will show how this technique can probe the electronic structure at the local scale for quantifying the number of electrons in the 3d bands of transition metals. It becomes possible, for example, to image charge orders or to map the charge distribution associated with interface reconstructions. We will end this lecture by presenting some new directions in transmission electron microscopy for the study of oxide heterostructures: in-situ experiments (temperature change or application of electrical voltage during the observation) or spectromicroscopy with an energy resolution of about ten meV opening access to a new spectral range of interest for the physics of strongly correlated oxides (dd type intra-band transitions, spectral signatures of energy gaps or plasmon modes involved in metal-insulator transitions)…