

Advanced Electron Microscopy for Advanced Materials
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An electron microscope is no longer a “big magnifying glass”. It has evolved into a full analytical instrument, able to provide information on the position of atoms with picometer precision, the nature of the atoms and the valency of the atoms, down to an atomic scale. However, electron microscopy images remain 2D projections of a 3D reality! This can be overcome by taking images under different angles and reconstructing the 3D arrangement. Classical electron tomography was always limited to nanometer resolution, but recently we found ways to analyse nanomaterials down to atomic scale in 3D. Not only the atom positions can be located in 3D, but also the chemical nature of the atoms can be mapped in 3D. Recently we have further developed the technique in order to map not only atom positions or the chemical nature of the atoms, but also the valency or the bonding of the atoms. In CeO₂ nanoparticles for example, one can map the Ce³⁺ versus the Ce⁴⁺ in 3D and quantify the different behaviour of the terminating planes ({111} versus {100}).