Quantitative 3D reconstruction of nano-particles based on atom counting in STEM

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Mastering the chemical and physical properties of nano-objects in nanomaterials such as nanoparticles is a crucial issue in materials science. These properties are strongly correlated with three dimensional (3D) morphology and composition of nano-objects, which can be accessed by electron tomography. However, although the modern microscopes with aberration correctors allow a spatial resolution below 1 Å, atomic resolution for electron tomography is not obvious. To perform electron tomography and 3D characterization at nanometer scale, high angle annular dark field scanning electron microscopy (HAADF-STEM) is widely used [1,2,3]. Sandra Van Aert *et al.* [4,5] proposed a statistical approach to determine the number of atom in each column on HAADF-STEM micrographies in zone axis. Coupling atom counting along different orientations of a same nano-object, these authors demonstrated the possibility to achieve a 3D reconstruction at atomic scale of nano-particles [6,7]. Based on this statistical method, we developed an original algorithm to reconstruct in 3D at atomic scale one nano-object with only three different orientations. Our 3D reconstruction algorithm was tested with three images from simulations of one nanoparticle under different orientations. The validity of this method is demonstrated and its application is foreseen for nano-objects or correlative microscopy with atom probe tomography [8].

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