Nano-Tomography in Environmental TEM: towards a fast 3D characterization of the evolution of nano-materials under dynamic gas and temperature conditions

S. Koneti[1]*, L. Roiban[1] and T. Epicier[1,2]

[1]*Université de Lyon, MATEIS, UMR 5510, CNRS, INSA de Lyon, 69621 Villeurbanne Cedex, France*
[2]*Université de Lyon, Institut de Recherches sur la Catalyse et l'Environnement de Lyon, UMR 5256, CNRS, Université C. Bernard Lyon 1, 2 avenue A. Einstein, 69626 Villeurbanne, France*

Modern environmental Transmission Electron Microscopes (ETEM) enable chemical reactions to be directly observed which opens wide perspectives in the operando characterization of nano-materials. However, morphological features are essentially missing in 2-dimensional observations, thus nano-tomography under environmental conditions is a new promising challenge. Obviously, the essential condition to achieve this goal is to run fast tilt series acquisitions as compared to the kinetics of the reactions which are followed in situ in the microscope.

This contribution shows that such experiments are possible, and we will present results obtained on the same object followed in 3D at different temperatures under gaseous environments in a Cs-corrected ETEM (FEI-TITAN). Firstly, simulations were performed on ghost models in order to appreciate the influence of the goniometer rotation speed during image acquisition on their quality (sharpness, blurring effects). Secondly, we report the calcination of hollow silicates containing silver nanoparticles [1].

[1]The CLYM (Consortium Lyon - St-Etienne de Microscopie, www.clym.fr) is acknowledged for its guidance in the ETEM project which was supported by the CNRS, the Région Rhône-Alpes, the 'GrandLyon' and the French Ministry of Research and Higher Education. The authors thank their colleagues from the Université de Lyon S. Li, A. Tuel and D. Farrusseng for the synthesis of materials, and M. Aouine, F. Cadete Santos Aires, N. Blanchard and C. Langlois for their technical contributions.