Micro and nano tomography and topography

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PROJECT DESCRIPTION:

The project is set up to visualize 3D microstructures of materials and devices from inside out in micron and nano scale by surface and volume reconstructions, i.e. topography and tomography. A number of techniques have been developed in the group and the resolution of the reconstruction has reached down to 5 nm. A wide range of porous materials from PEM fuel cell GDL to diatomaceous frustules and nanoporous layers have been reconstructed.

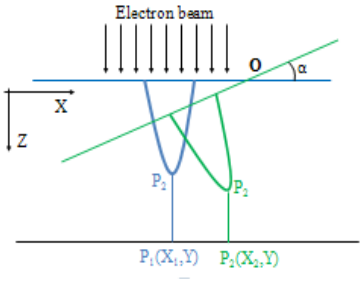

Figure 1. One of the techniques is micro/nano topography using stereo imaging.

Principal: Tilting an object with respect to another will give the third dimension.

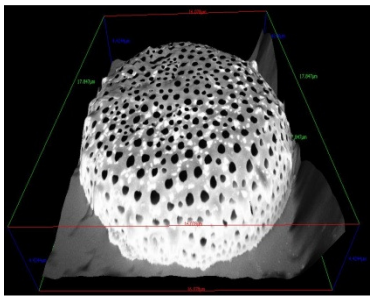

Figure 2. A nanotopography of the diatomaceous frustules using SEM stereo imaging technique.

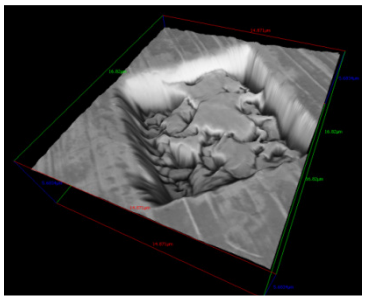

Figure 3. 3D reconstructed image of FIB milled area on Copper.

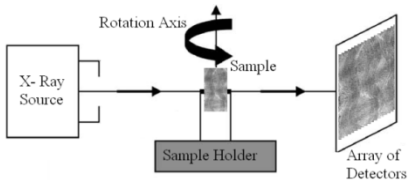

Figure 4. Another technique is X-ray micro/nano tomography.

Principal: Rotating an object in front of an X-ray source and acquiring numerous views of the sample.

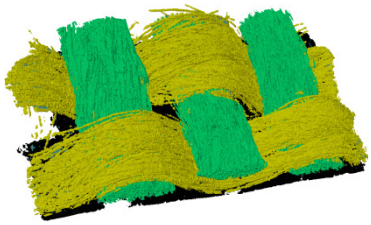

Figure 5. A 3D image of a 4×2×0.4 mm GDL sample with pixel resolution of 2 µm, reconstructed using X-ray microtomography.

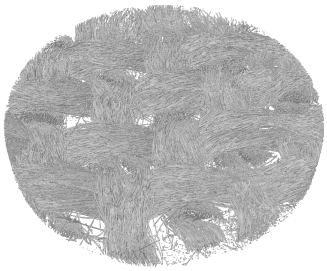

Figure 6. A 3D reconstructed image of a 2 mm diameter GDL sample with pixel resolution of 1.1 µm, produced using synchrotron X-ray microtomography.

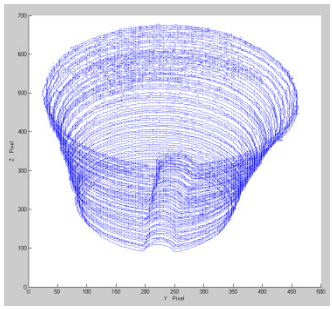

Figure 7. A 3D reconstruction of a 3 µm micro pipette tip, produced with focused ion beam nanotomography.

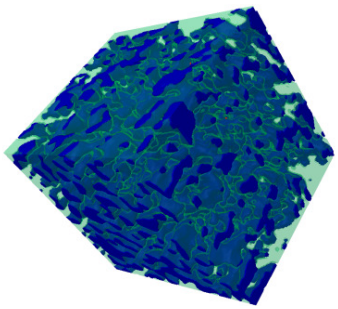

Figure 8. A 3D reconstruction of cathode side of polymer electrolyte fuel cell catalyst layer with voxel size of less than 10 nm, produced with focused ion beam tomography. Each side of the cube is 1 µm.

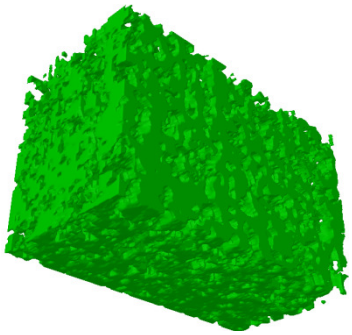

Figure 9. A 3D digital image (4×2.5×1 µm) of anode side of a polymer fuel cell catalyst layer, produced with focused ion beam nanotomography. The voxel size is 15 nm.

Selected publications:

[1] X. Chen, H. Ostadi, K. Jiang, 3D surface reconstruction of diatomaceous frustules, ***Analytical biochemistry***, 403(1-2), 63-66, 2010.

[2] H. Ostadi, P. Rama, Y. Liu, R. Chen, X. X. Zhang, K. Jiang, The influence of threshold variation on determining the properties of a gas diffusion layer in X-ray nanotomography, ***Chemical Engineering Science***, 65(6), 2213-2217, 2010.

[3] H. Ostadi, P. Rama, Y. Liu, R. Chen, X. Zhang, K. Jiang, Nanotomography based study of gas diffusion layers, ***Microelectronic Engineering***, 87 (5-8), 1640-1642, 2010.

[Link to Hossein Ostadi webpage: http://www.eng.bham.ac.uk/mechanical/micro/ostadi.shtml]