Characterization of porous PEM fuel cell layers in micro and nano scales

Researchers: Hossein Ostadi **Supervisor:** Kyle Jiang

PROJECT DESCRIPTION:

Fluidic properties of PEM fuel cell layers have a strong influence to the efficiency of the fuel cells. In the TSB project, micro and nano tomography techniques have been used to visualize the porous structures of GDL, MPL and catalyst layers. Then 3D digital reconstruction of these layers is implemented. Afterwards, porosity and permeability of the fuel cell layers are analysed. The reconstructed digital models are used for fluid simulation of the fuel cell, producing more realistic results.

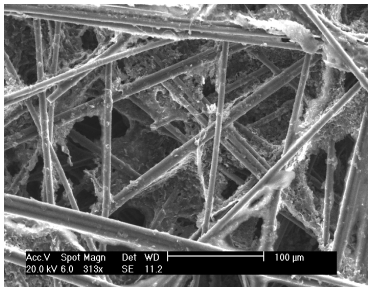

Figure 1. An SEM image of a typical GDL layer.

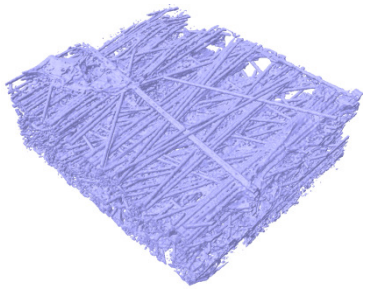

Figure 2. A 3D reconstructed image of a 2×2×0.325 mm of GDL with 680 nm resolution through X-ray nanotomography.

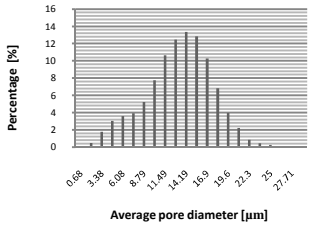

Figure 3. Pore size distribution of the reconstructed image of figures 1&2.

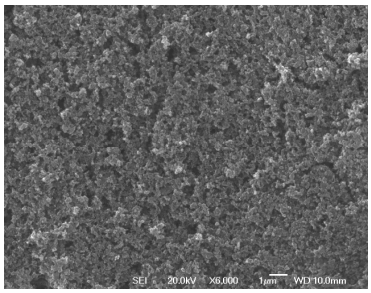

Figure 4. An SEM image of the surface of an MPL.

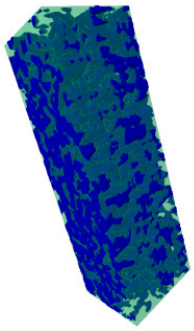

Figure 5. A 1.5×5×1.5 µm 3D reconstructed image of the MPL with 8nm×12nm×8nm voxel size. Blue and green colours show solid and pore networks respectively.

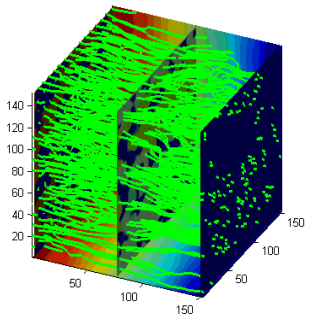

Figure 6. Tortuous flow paths simulated by the single-phase D3Q19 Lattice Boltzmann numerical solver of a 150 pixels cubic MPL sample of figures 4&5.

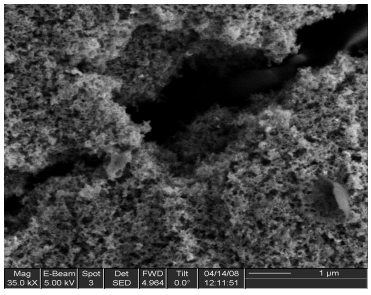

Figure 7. An SEM image of the surface of cathode side of a CL.

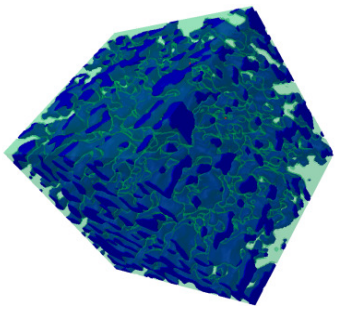

Figure 8. A 3D reconstruction of the CL with voxel size of less than 10 nm. Each side of the cube is around

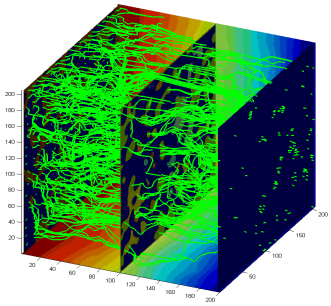

Figure 9. Tortuous flow paths simulated by the single-phase D3Q19 Lattice Boltzmann

5 µm.	numerical solver of a 200 pixels cubic CL sample of figures 7&8.

Selected publications:

[1] H. Ostadi, P. Rama, Y. Liu, R. Chen, X. X. Zhang, K. Jiang, 3D reconstruction of a gas diffusion layer and a microporous layer, ***Journal of Membrane Science***, 351(1), 69-74, 2010.

[2] P. Rama, Y. Liu, R. Chen, H. Ostadi, K. Jiang, X. Zhang, R. Fisher, M. Jeschke, An X-ray tomography based Lattice Boltzmann simulation study on gas diffusion layers of polymer electrolyte fuel cells, ***ASME journal of fuel cell science and technology***, 7(3), 031015, 1-12, 2010.

[3] H. Ostadi, P. Rama, Y. Liu, R. Chen, X. Zhang, K. Jiang, Threshold fine-tuning and 3D characterisation of porous media using X-ray nanotomography, ***Current Nanoscience***, 6(2), 226-231, 2010.

http://www.eng.bham.ac.uk/mechanical/micro/ostadi.shtml