Microcomputed tomography based pore network modelling

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Keywords: Fuel Cells, GDL, X-ray imaging, pore network modelling, 3D micro-computed tomography

The polymer electrolyte membrane (PEM) fuel cell is an electrochemical device that converts chemical energy (typically hydrogen) into electricity, with heat and water as by-products. In the past decade the cost of the PEM fuel cell has decreased significantly due to advances in material and system design, as well as thermal and water management strategies. To reach competitive pricing, however, significant challenges must be overcome that involve thermal and water transport at the micro- and nano-scale levels.

While water is formed at the catalyst layer, the location of liquid water formation and the nature of propagation throughout and between these layers is not fully understood. Since liquid water flooding in the PEM fuel cell reduces power output and long term durability, understanding the relationships between pore structure and water transport is vital for informing the design of new materials for ultimate performance. The recent development [1] done in 3D reconstruction of micro-structure on one hand and in pore-scale modelling on other hand are one the most promising way to obtain a deeper insight of the fuel cell water management.

In this work, microcomputed tomography will be used to capture the detailed, three-dimensional pore space of the gas diffusion layer [2]. Pore network modelling is a technique whereby the pore space of a porous material is modelled as an interconnected system of pores and throats. This modelling technique will be applied directly to the pore space captured through computed tomography, and the liquid water saturation distributions will be correlated to the spatial distributions of pores in gas diffusion layers. This work is based on the OpenPNM framework which provides an open source pore network modelling package [3].

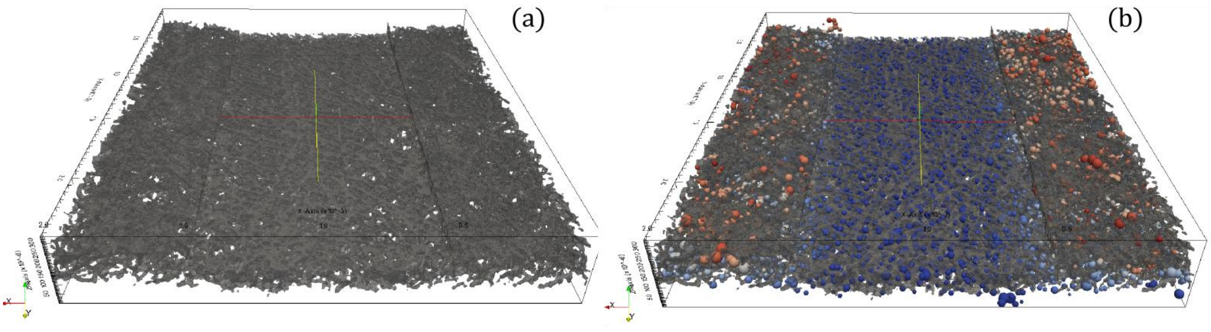

Figure 1. (a) The 3D structure of the compressed GDL obtained by micro-computed tomography. (b) Comparison between the 3D structure and the pore network generated, each sphere modelled one pore.

REFERENCES

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