

Pore Network Modelling and in Situ Imaging to Investigate Transport in Polymer Electrolyte Membrane Fuel Cells and Electrolyzers

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Polymer electrolyte membrane (PEM) fuel cells and electrolyzers provide the opportunity to enable a renewable energy infrastructure by producing on-demand electricity from renewably sourced hydrogen. However, due to cost and inefficiency barriers, polymer electrolyte membrane (PEM) fuel cells and electrolyzers have not yet reached widespread commercial adoption in the transportation sector. Mass transport limitations arising from liquid water flooding in low temperature PEM fuel cells leads to inefficiencies. If these issues become resolved, smaller and more reliable devices could be produced at a lower cost. Mass transport limitations can be minimized through the development of optimized materials, which have tailored pore structures, connectivities, conductivities, and surface wettabilities. The porous materials in PEM fuel cells and electrolyzers could be customized for mass transport with detailed information about their structure and the dominating mass transport mechanisms that result from these structures. In this talk, visualization techniques, such as microcomputed tomography, synchrotron X-ray radiography, and neutron radiography for investigating multiphase transport in PEM fuel cells and electrolyzers, will be discussed. The combination of these experimental diagnostic tools with pore network modelling will be discussed as a unique platform for investigating the transport behaviour of liquids and gases in electrochemical conversion technologies.