The Hydro-electro-thermal Performance of Air-cooled, Open-cathode Polymer Electrolyte Fuel Cells: Combined Localised Current Density, Temperature and Water Mapping.

Datenbank

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Deskriptoren

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Abstract

In situ diagnostic techniques provide a means of understanding the internal workings of fuel cells so that improved designs and operating regimes can be identified. Here, a novel metrology approach is reported that combines current and temperature mapping with water visualisation using neutron radiography. The approach enables a hydro-electro-thermal performance map to be generated that is applied to an air-cooled, open-cathode polymer electrolyte fuel cell. This type of fuel cell exhibits a particularly interesting coupled relationship between water, current and heat, as the air supply has the due role of cooling the stack as well as providing the cathode reactant feed via a single source. It is found that water predominantly accumulates under the cooling channels (thickness of 70-100 μm under the cooling channels and 5-25 μm in the active channels at 0.5 A cm−2), in a similar fashion to the lands in a closed-cathode design, but contrary to passive open-cathode systems. The relationship between current, temperature and water accumulation is complex and highly dependent on location within the cell. However, there is a general trend that higher currents and cooling limitations, especially above 0.7 A cm−2 and below 3.9 × 10−3 m3 s−1, leads to temperatures above 60 °C, which dehydrate the membrane (water thickness of 10-25 μm) and the cell operates below 0.5 V.

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