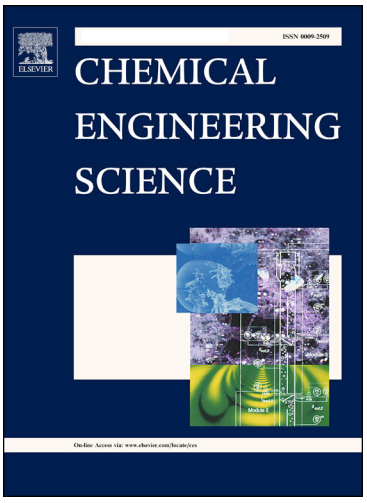

Current density distributions in polymer electrolyte fuel cells: a tool for characterisation of gas distribution in the cell and its state of health

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Current density distributions in polymer electrolyte fuel cells: a tool for characterisation of gas distribution in the cell and its state of health

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Abstract

Distributions of current density (cd) in a 100 cm^2 single polymer fuel cell have been measured, leading to a 12x12 data array. For a freshly matured MEA, the dimensionless distributions have been shown to be of moderate uniformity, whatever the cell current, with average deviations of the dimensionless cd in the range 0.16-0.25 (i.e. cd measured deviated from 16 to 25% from the expected value). More thorough examination of the data acquired showed that the non-uniformity is likely due to maldistribution of the gas in the 23 parallel channels of the multiple serpentine pattern of the commercial bipolar plates. For the sake of comparison, the MEA – including the two GDL was submitted to ageing with a standard cycling protocol (FC_DLC) emulating transportation conditions for 500 hours. Characterisation of the cell state of health afterwards revealed visible degradation of the GDL, whereas the catalytic layer and the membrane were little affected. In the aged cell, distributions were shown to be far more non-uniform, with deviations ranging from 0.30 to 0.50: the current distributions were then depending on the cell current density. Presumably, due to the GDL ageing, liquid water produced at high cd, could not be removed efficiently, resulting in very low cd's near the outlet.

Keywords: Polymer electrolyte fuel cells, current distribution, gas distribution, flow phenomena, flow patterns, degradation of fuel cells