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Reducing Nafion content in PEMFCs low loading catalyst inks using surface functionalized carbon supports with sulphonic groups

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Abstract
The present paper deals with the Nafion content effects on the electrochemical surface area, power density and cell resistance and furthermore on catalyst durability and regeneration when working at catalyst low loadings. Vulcan XC-72 was functionalized using less studied aromatics with nitrogen and sulphonic groups and is referred to as C_ABSA. The catalyst (Pt/C_ABSA), with a nominal composition of 20 wt%, was prepared with $H_2PtCl_6.6H_2O$ as a platinum precursor, using formic acid as reduction agent. Average low loadings of catalyst 0.2 and 0.1 mgcm^{-2} were used for half cell and full fuel cell studies, respectively. Characterization of catalysts was done using SEM, TEM X-Ray diffraction as well as electrochemical techniques. Half cell mode assessments were carried out using standard cyclic voltammetry. The stability and durability tests were implemented by the application of demanding aging cycling protocols (30000 cycles) with break in periods to evaluate ESCA and ORR activity. Full cell assessment was done using a fuel cell assembly with a 2.5x2.5 cm^2 MEA geometrical area and a Nafion XL (27.5 µm) membrane, operated using a purpose built fuel cell station. O_2 or air were used for cathode feeding. EIS measurements were implemented to compliment the study. Comparison was made with a commercial catalyst.
The catalyst demonstrated easy activation in acid environment as well as stability under potential cycle in domains relevant for catalyst and catalyst support, presenting superior values than commercial catalyst tested in this work under the same experimental conditions. Furthermore, in full fuel cell testing the catalyst reveals a positive nafion effect since its reduction in the ink to 10 % gave comparable results than the usual 30 % used in the commercial catalyst (see figure 1). The role of sulphonic groups, used to functionalised the carbon catalyst support, on the performance of the MEA will be discussed.

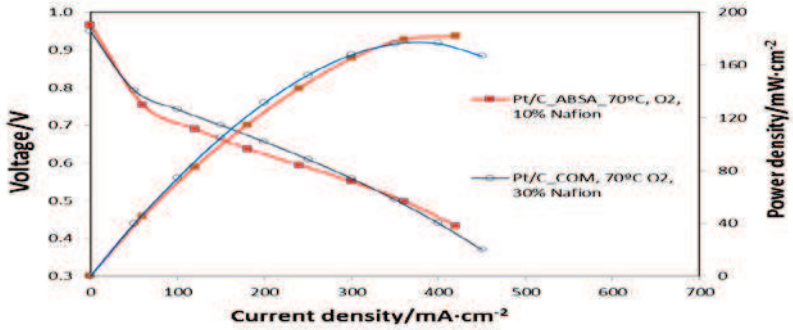

Fig. 1 Polarization and power density curves for fuel cell using catalyst Pt/C_ABSA and Pt/C_COM at 70ºC with oxygen cathode feeding, using a Nafion content in the catalyst ink of 10 and 30 % respectively.

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