FUEL CELL MEASUREMENTS OF PERFORMANCE AND DURABILITY OF NON-PGM ORR ELECTROCATALYSTS
DOE DURABILITY WORKING GROUP
2011

CELL AND ELECTRODES

Fuel cell: The surface area of the electrodes 25-50 cm^2

Conditioning: Appropriate for the catalyst used

CATHODE CATALYST LAYER

Catalyst loading: Optimized for best cell performance. The catalyst loading must be specified and used as reported in all durability and performance testing

Ionomer content: Optimized for best cell performance

Catalyst deposition: Optimized for best cell performance

ANODE CATALYST LAYER

Catalyst loading: Sufficient to guarantee a good performance of the anode as a dynamic hydrogen reference electrode, suggested loading 0.2 mg_{Pt}/cm^2

OTHER EXPERIMENTAL CONDITIONS

Temperature: 80°C

Humidification: 100% for O_2, H_2, and N_2 (chemical grade, no O_2 impurity)

Gas flow rate: Cathode stoichiometry 9.5[a)]

H_2 – 300 sccm

N_2 – 300 sccm

Gas pressure: O_2 – 100 kPa partial O_2 pressure ($\cong$ 150 kPa total gas pressure at 80°C, 100% RH)

N_2 – atmospheric

H_2 – 100 kPa partial H_2 pressure ($\cong$ 150 kPa total gas pressure at 80°C, 100% RH); atmospheric when N_2 used

DURABILITY TESTING BY POTENTIAL CYCLING
(with O_2 or N_2 feed on the cathode side)

Voltage range:	From 0.2 V to 1.1 V
Starting voltage:	Open circuit voltage (OCV) for O_2, 1.1 V for N_2
First scan:	From the OCV (or 1.1 V for N_2 test) towards less-positive potentials
Scan rate:	50 mV/s
Number of cycles:	500, 1000, 5000, 10000, 30000

PERFORMANCE TESTING
After cell conditioning (reported as Beginning of Life (BOL)) and
after 500, 1000, 5000, 10000 and 30000 potential cycles in durability testing

Sampling for OCV: Constant-current polarization at zero current to attain OCV with steady-state; may be specific to the fuel cell test station used

Polarization curves: Either constant-current or constant-voltage starting at OCV towards 0.2 V and back. Time of measurement should be sufficiently long for attaining steady-state at each point

Current density at 0.8 V:

iR-corrected and uncorrected

REPORTING
After cell conditioning (reported as Beginning of Life (BOL)) and
after 500, 1000, 5000, 10000 and 30000 potential cycles in durability testing

OCV: After conditioning and 500, 1000, 5000, 10000, 30000 potential cycles of durability testing

OCV change: OCV (after conditioning) - OCV (after X-cycles)

Polarization curves: No iR correction, going both down (negative) and up (positive direction)

Current density: At 0.8 V both iR-corrected and uncorrected in A/cm^2 and A/cm^3

Catalyst loading: Total catalyst loading in mg/cm^2

Catalyst layer thickness: Average initial thickness of the catalyst layer and the method of the catalyst layer thickness determination should be reported with an assessment of the errors (or certainty) of determination.

Other parameters: Important experimental parameters, e.g., the ionomer content in the catalyst layer should be reported, too.

Reference:

a) Gasteiger at al., *Applied Catalysis B: Environmental*, 56 (2005) 9-35.