

Degradation Analysis of Chemical Structures of PEFC Electrolyte Membranes and Ionomers

The detailed chemical structure degradation analysis of the ionomer used in the fuel cell is important for interpretation of durability evaluation (proton conductivity, ion exchange capacity, etc.) in accelerated degradation test (H₂O₂ exposure test, etc.) of the electrolyte membrane and power generation test of the cell.

Analysis Method for Chemical Structure Degradation of Electrolyte Membranes and Ionomers

By sampling and analyzing each part, the cathode, membrane, and anode are separated and analyzed.

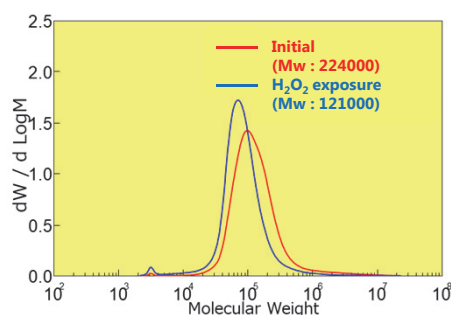
Location of interest	Analytical content	Analytical method
Electrolyte membrane Catalyst bed ionomer ※ Sample each site	Change in molecular weight Polymer structural changes	GPC Solid-state NMR, Raman, and IR
	Degradation product analysis (Solvent Extract Analysis)	Combustion IC (total F,S quantitation), Solution NMR, IC, LC/MS, LC/CAD, MALDI-MS
Wastewater	Ionomer degradation analysis Analysis of eluted compounds of other parts	

Correlation with performance

Proton conductivity
Ion exchange capacity
I-V characteristics
Morphological changes, etc.

Example of Molecular Weight Analysis of Electrolyte Membrane by GPC

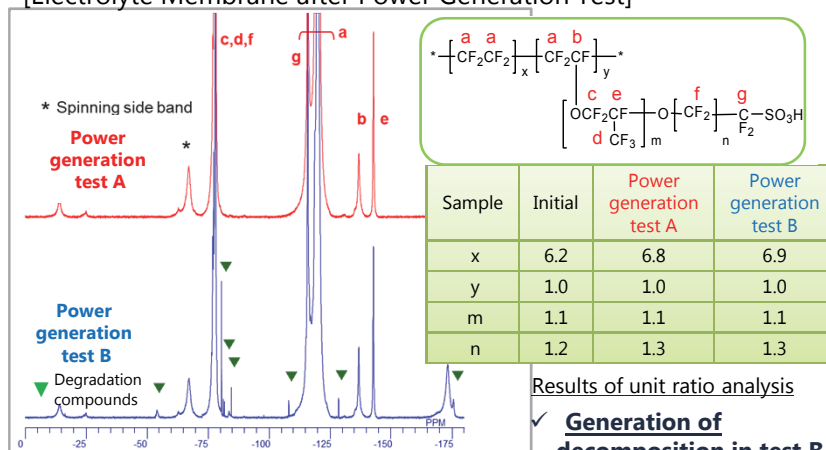
[H₂O₂ Exposure Test of Electrolyte Membrane]



✓ **Molecular weight of membrane halved after hydrogen peroxide exposure test**

Structural Analysis of Electrolyte Membranes by Solid-State ¹⁹F NMR

[Electrolyte Membrane after Power Generation Test]

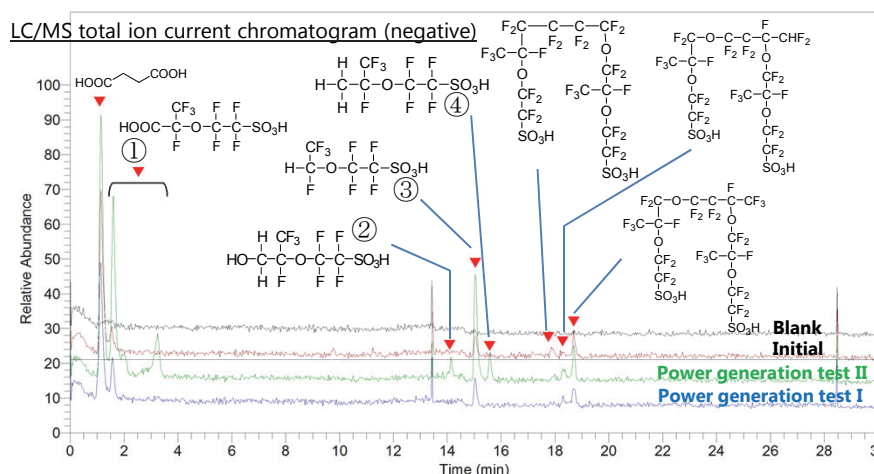


Results of unit ratio analysis

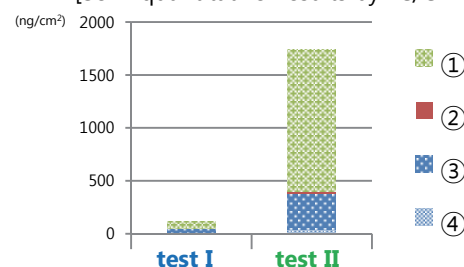
✓ **Generation of decomposition in test B**

Analytical examples of degradation products by LC/MS, LC/CAD

[Solvent Extract of Electrolyte Membrane after Power Generation Test]

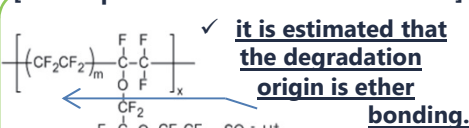


[Semi quantitative Results by LC/CAD]



✓ **more decomposition compounds in Test II**

[Decomposition Mechanism Estimation]



In addition to considering the mechanism of degradation due to polymer structural changes, quantitative comparisons based on degradation markers are also possible.