Evaluation of EW value of electrolyte membrane for fuel cell

EW* (equivalent weight) is important index that characterizes the performance of electrolyte membranes of fuel cells. For EW evaluation, Toray Research Center can provide two methods, ion exchange method and solid-state NMR, depending on the sample form, customers' analytical purpose.
*: The amount of substance that can exchange unit amount of ions, reciprocal of ion exchange capacity.

- Fuel cell material properties and deterioration analysis
  - Changes in proton conductivity after operation
  - Non-uniform chemical structure changes inside large electrode membrane
  - Mechanical properties deterioration through changes in molecular weight

→ Quantitative evaluation of EW

- Toray Research Center's strength
  - Propose appropriate method
  - High quantification accuracy
  - Small amount of sample (several mg)

Ion exchange method

- Experimental value calculated from the amount of metal ion for ion-exchange group

Ion exchange (M+)
↓
Inverse exchange by acid
↓
Quantification of extracted ion by Atomic absorption
↓
EW evaluation from sample weight

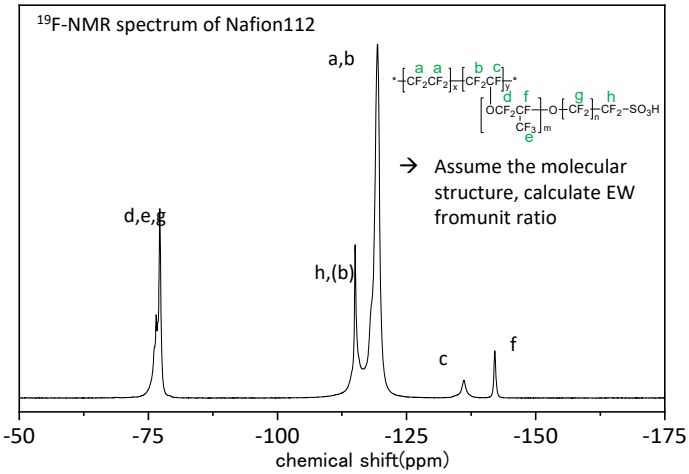
Nafion112 (Catalog value : EW1100)

	EW
N=1	$1.0_5 \times 10^3$
N=2	$1.0_5 \times 10^3$
Average	$1.0_5 \times 10^3$

For higher accuracy, Know-how such as proper ion species selection and ion exchange conditions is important

Solid state NMR

- Theoretical numerical values calculated from molecular structure of fluorine ion exchange resins



x	y	m	n	EW
5.8	1.0	1.0	1.1	$1.0_4 \times 10^3$

	Ion exchange method	Solid state NMR
Features	– **Quantitative comparison between samples with different and / or unknown chemical structure** – Applicable to cation/anion exchange resin by selecting appropriate ion species	– **Effective for fluorine-based ionomers and can provide data with chemical structures** (if chemical structure is unknown, structural analysis is required) – Analysis of ionomer degradation products and estimation of the degradation pathway
Sample form	Film, powder, grain, etc. (For MEA, the catalyst layer needs to be scraped)	Film, powder etc. (For MEA, the catalyst layer needs to be scraped)
amount of sample	5 mg or more, several 10 mg if possible	3 mg or more, 10 mg if possible, depends on sample form

We can propose appropriate analysis methods and contribute to solve customer's R&D problems.
(Catalyst layer ionomer, PTFE reinforced electrolyte membrane, hydrocarbon electrolyte, EW change after durability test)

P02171構造化学第2研究室20200630-2

Toray Research Center, Inc.