X-MET8000

Application Note - 38

HITACHI

X-MET8000 Series for the rapid measurement of Pt and Ir loading on Proton Exchange Membranes (PEM)

Background

Proton exchange membrane electrolysis is a key technology for future sustainable energy systems. Proton exchange membrane fuel cells convert hydrogen into electricity efficiently with no hazardous emissions. PEM fuel cells are widely used in water hydrolysis for hydrogen and PEM play a critical role in the hydrogen energy industry.

Precious metals, like Platinum (Pt) and Iridium (Ir), are used in membranes as catalysts for hydrogen reaction. Expensive and scarce catalyst materials are a challenge for PEM fuel cells, therefore it is important for manufacturers to optimize and reduce the loading of precious metals in PEM.

Handheld XRF can be used by PEM manufacturers to verify the Pt and Ir loading in the membranes before assembling the fuel cell. Pt and Ir loadings can be easily verified from large membranes sheets without cutting the membrane into smaller pieces.

Instrumentation

Handheld X-ray fluorescence (HHXRF) is an analytical technique that is widely used for the analysis of metal analysis. It provides reliable and rapid analysis – results are available in seconds. It is non-destructive method – no need to break the sample and scrap smaller sample pieces after analysis, and it can be used by any operator with minimal training.

The X-MET8000 offers truly portable analysis, making it ideal for the testing of large and/or heavy parts at any location. Hitachi High-Tech's X-MET8000 analyzer combines a high-performance X-ray tube and a high resolution SDD (silicon drift detector) to deliver the speed and performance needed for the analysis of membranes. Its ruggedness (IP54 rated) and long battery life (up to 10 to 12 hours make it the tool of choice for process and quality control.

Key Features

- Compact and robust: fully portable for true on-site analysis
- Easy to use: reliable results with minimum operator training
- Results in seconds: fast incoming material verification

All rights reserved ©Hitachi High-Tech Analysis Corporation 2026

Routine analysis

Sample preparation is not required prior to analysis. Measurements can be taken straight from the membrane surface by placing the nose of the analyzer on the part to be measured and pressing the trigger to start the analysis. Typical analysis time for loading of precious metals in membranes is 10 to 30 seconds. Loading uniformity over a large part can be verified quickly by taking several readings over the surface of the part.

Accessories like background plate and light radiation shield should be used with X-MET8000 analyzer to exclude the effect of the measurement environment on the measurement result and to block x-ray scattering from the samples. Light stand and safety shield can be used to measure small samples.

Calibration and validation

Empirical calibrations were created for this application. The calibrations included reference samples with a large variety of Pt and Ir loadings. Each sample was measured for 60 seconds. Calibrations were optimized for calibration ranges of Pt: 0.05-0.5 mg/cm^2 and Ir: 0.2-2.0 mg/cm^3.

Table 1. Calibration performance summary

	Pt	Ir
Calibration range	0.05-0.5 mg/cm2	0.2-2.0 mg/cm2
R2 (linear model)	0.9989	0.9990

To demonstrate the X-MET8000's precision and accuracy, three reference materials were measured ten times for 30 seconds.

Example of PEM sample

All rights reserved ©Hitachi High-Tech Analysis Corporation 2026

Table 2. X-MET8000 repeat results for Pt loading

Sample 1 (mg/cm²)		Sample 2 (mg/cm²)		Sample 3 (mg/cm²)	
Known value	**0.047**	**Known value**	**0.169**	**Known value**	**0.452**
1	0.0461	1	0.1681	1	0.4511
2	0.0465	2	0.1683	2	0.4521
3	0.0472	3	0.1736	3	0.4423
4	0.0483	4	0.1689	4	0.4522
5	0.0467	5	0.1672	5	0.4532
6	0.0475	6	0.1671	6	0.4529
7	0.0459	7	0.1692	7	0.4509
8	0.0467	8	0.1683	8	0.4525
9	0.0468	9	0.1676	9	0.4521
10	0.0459	10	0.1674	10	0.4643
Average	0.0468	Average	0.1686	Average	0.4524
Standard deviation	0.0008	Standard deviation	0.0019	Standard deviation	0.0053
RSD %	1.6	RSD %	1.1	RSD %	1.2

Table 3. X-MET8000 repeat results for Ir loading

Sample 1 (mg/cm²)		Sample 2 (mg/cm²)		Sample 3 (mg/cm²)	
Known value	**3.1**	**Known value**	**2.0**	**Known value**	**1.5**
1	3.149	1	1.923	1	1.543
2	3.152	2	1.942	2	1.532
3	3.151	3	1.947	3	1.521
4	3.185	4	1.976	4	1.541
5	3.186	5	1.932	5	1.524
6	3.162	6	1.934	6	1.522
7	3.171	7	1.953	7	1.533
8	3.165	8	1.923	8	1.543
9	3.154	9	1.946	9	1.532
10	3.152	10	1.946	10	1.524
Average	3.163	Average	1.942	Average	1.532
Standard deviation	0.014	Standard deviation	0.016	Standard deviation	0.009
RSD %	0.4	RSD %	0.8	RSD %	0.6

All rights reserved ©Hitachi High-Tech Analysis Corporation 2026

Summary

Once calibrated, Hitachi High-Tech's X-MET8000 provides accurate and repeatable results for the loading of precious metals in PEM. The X-MET's ease of use and ruggedness make it an ideal tool for use on the factory floor for process and quality control. The versatility of the calibration software also enables the analysis of other kinds of PEM samples, single and multielement, ensuring the rapid monitoring of the loading of precious metals. With results being available on the X-MET's screen in seconds, decision to accept or reject a part or modify the production process can be made on the spot, maximin productivity and saving costs.

Ordering information

- X-MET8000 with calibration software or customized calibration.

Optional accessories:

- Background plate and light radiation shield
- Light stand and safety shield for measuring small samples

More information

To find out more visit:
www.hitachi-hightech.com/hha

This publication is the copyright of Hitachi High-Tech Analysis Corporation and provides outline information only, which (unless agreed by the company in writing) may not be used, applied or reproduced for any purpose or form part of any order or contract or regarded as the representation relating to the products or services concerned. Hitachi High-Tech Analytical policy is one of continued improvement. The company reserves the right to alter, without notice the specification, design or conditions of supply of any product or service.

Hitachi High-Tech Analytical acknowledges all trademarks and registrations.

All rights reserved ©Hitachi High-Tech Analysis Corporation 2026

All rights reserved ©Hitachi High-Tech Analysis Corporation 2026