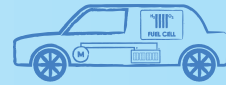
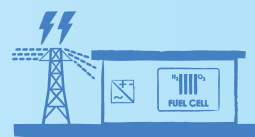


Application Navi Fuel Cell

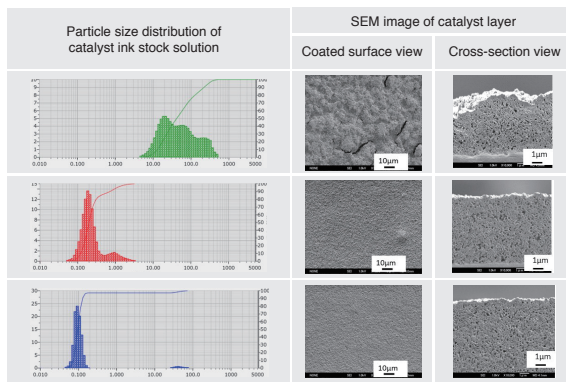


HORIBA offers a wide range of analysis and measurement solutions for fuel cells—from nano-level analysis of fuel cell materials to performance evaluation of cells and stacks—by leveraging its analysis technologies that are useful for R&D and verification in the fuel cell field.

Fuel cell material evaluation

Particle size measurement of catalyst ink stock solution

Particle size distribution of catalyst ink stock solution significantly affects the performance and quality of the catalyst. The high concentration cell unit of Partica LA-960V2 makes it possible to evaluate particle size distribution with minimal dilution sample or ink stock solution sample. This will contribute to status estimation after Membrane Electrode Assemblies (MEA) dry process.



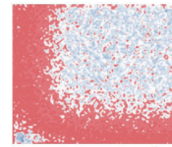
• Data provided by: Hirai & Sasabe Laboratory, Tokyo Institute of Technology, FC-Cubic

- High concentration samples can measure with minimal dilution rates by HORIBA original design cell. Instead of traditional transmittance adjusted by diluting, with HORIBA original cell adjusted by change the optical path length.
- Various cells are selectable according to the viscosity of sample.



Evaluation of quencher distribution in electrolyte film / Analysis of metallic foreign material on fuel cell separator

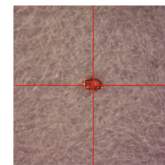
When metal such as Fe in the fuel cell material is eluted and metallic ions are mixed into electrolyte film, radical formation is accelerated and degradation of the electrolyte film progresses. To counter this problem, a radical quencher (e.g., Ce) is added to the electrolyte film to inhibit radical formation, but it is necessary to fix the quencher evenly so that it does not move through the film and cause uneven durability.



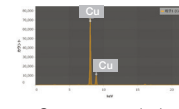
X-ray Analytical Microscope XGT-9000 is a device that can map the distribution of radical quenchers (Ce) in the planar direction.

Metallic foreign material analysis on fuel cell separator

Foreign material on the separator may cause the electrolyte degradation. Therefore, the detection of metallic foreign material and analysis of element composition are required in quality control.



Measurement position on an optical image



Spectrum analysis with 10 μm probe



Cu mapping on whole a separator sheet

- Spatial resolution at the level of several tens of micrometers
- Highlighting by image processing is also possible.
- Customizing the sample chamber allows accommodation of large samples.

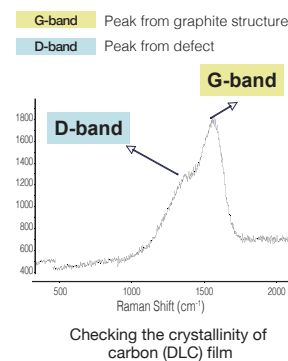


X-ray Analytical Microscope XGT-9000

Analysis of carbon film on separator-observation of carbon bond state

Separators are sometimes coated with a carbon film on the surface to improve their conductivity and prevent the elution of iron atoms.

- Raman imaging system LabRAM Soleil can evaluate crystallinity by observing the carbon bonding state.
- By looking at the ratio of the G-band peak, which has high crystallinity, to the D-band peak, it is possible to evaluate the crystallinity of the carbon film.



Raman Imaging System
LabRAM Soleil

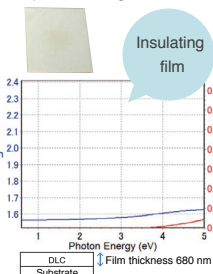


Checking the crystallinity of carbon (DLC) film

Analysis of carbon film on separator-classification/evaluation of DLC film

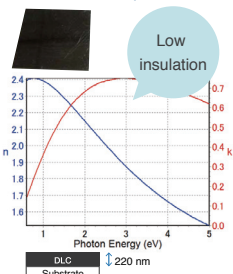
Spectroscopic ellipsometer UVISEL Plus, capable of obtaining optical constant and film thickness in a non-destructive and non-contacting manner, can be utilized for classifying and evaluating DLC films.

Optical coating



• Sample provided by: Prof. Kenji Hirakuri, Tokyo Denki University

Automotive components



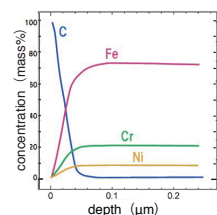
Fully Automated Ellipsometer
UVISEL Plus

Analysis of carbon film on separator-Elemental analysis in depth direction

Pulsed RF Glow Discharge Optical Emission Spectroscopy GD-Profil2 is ideal for analyzing carbon distribution in the depth direction from the surface of the separator. Carbon is likely to dissolve into iron. Therefore, when using carbon film in applications at high temperatures, such as SOFC, it is also important to check the degree of its solubility.

- GD-Profil2 performs sputtering from the surface, and can evaluate the distribution of carbon, which is a light element, in the depth direction in a short time.

Pulsed RF Glow Discharge Optical Emission Spectrometer (GD-OES)
GD-Profil2



Analysis of element distribution in SUS separator surface in depth direction

Gas/water analysis related to fuel cells

Measurement of CO and CO₂ that affects the service life of fuel cell as well as impurities including sulfur-based gas is possible. We also offer water quality meters for measuring pH of discharged water.



Trace Gas Monitor
GA-370

Accurately monitors the concentration of impurities such as CO₂ and CO, which can lead to deterioration of the fuel cell



Multi-Component Gas Analyzer
VA-5000 Series

Monitors sulfur gases and other impurities in the reforming process in real time



Micro Volume pH Monitor
UP-100 Series

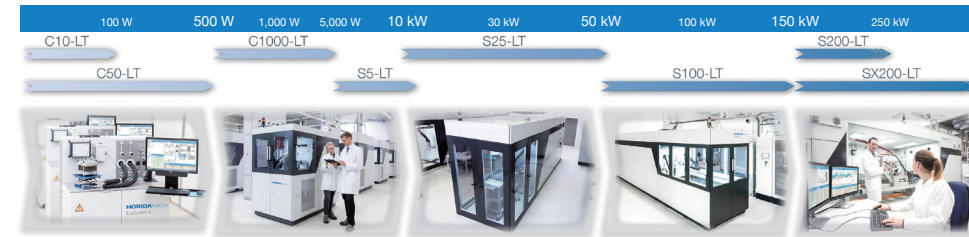
500-μL micro-sampling enables continuous pH monitoring

Cell / stack evaluation of PEM FC/EC and SOFC/EC

We offer a wide range of fuel cell test stations called "Evaluator series" for cells / stacks of PEM FC/EC and SOFC/EC, and the power generation and durability performance of auxiliary devices.

- C series: Test stations for cell, suitable for performance evaluation and durability evaluation of new material
- S series: Test stations for stacks, suitable for verifying fuel cell performance

PEM FC/EC Test Stations



High level of stability and quick response in dew point control

Achieves a high level of stability and response speed by controlling the dew point through precise mixing of wet and dry gases.

Highly accurate flow rate control

Multiple mass flow controllers achieve highly accurate flow rate control in a wide range.

System integration

With various measurement instruments including electric impedance measurement devices and electronic load devices neatly housed in the housing, the test station can be operated from a single PC.



SOFC/EC Test Stations



Our proprietary integrated management software — centrally manages measurement and control as well as supports test man-hour reduction and stable device operation

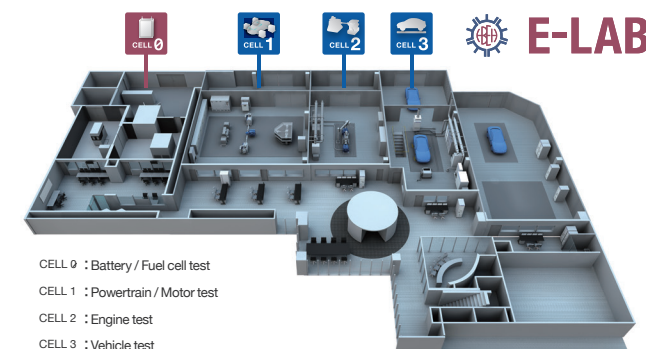
Sets and displays device parameters and status
Batch-manages scripting and execution, and data recording

Integrates management of multiple test rooms, including remote device control and script sharing

Batch-manages statuses, thresholds, and alarms from the part level to the whole-system level as tags

Even when a problem occurs, the cause can be quickly identified by tracking tags

Electrified vehicle evaluation solutions



CELL 0 : Battery / Fuel cell test
CELL 1 : Powertrain / Motor test
CELL 2 : Engine test
CELL 3 : Vehicle test

At its automotive measurement R&D/production base, HORIBA BIWAKO E-HARBOR in Shiga Prefecture, HORIBA has a test center, E-LAB, where visitors can "see," "use," and "experience" the effects of automotive measurement solutions.

E-LAB will introduce "Test in the Loop™", HORIBA's proposed solution to improve system calibration efficiency, using actual test equipment.

HORIBA proposes "Test in the Loop™", which enables the evaluation of components and vehicle systems in a simulated the real-driving environment by freely connecting fuel cell, battery, motor, powertrain, engine, vehicle or its model and evaluation devices. This enables highly accurate performance verification and system optimization of components and systems in the vehicle development and design phases.

* "Test in the Loop" is a registered trademark or trademark of HORIBA, Ltd.

Vaporization system solutions for optimizing gas concentration and humidity control



Multi-Component Gas Mixer
MU Series

Equipped with a mass flow controller, uses the "flow ratio mixing method" to generate a gas mixture of precise concentration



Mixed Injection System
MI·MV Series

Compact, highly efficient liquid-vaporizing system that delivers stable vaporization at low temperatures



High-Flow Vaporizer
LE Series

Vaporizer for high flow rates, with stable injection of liquid flow into the vaporizer using a quantification nozzle



Mass Flow Controller
SEC-N100 Series/LV Series

HORIBA STEC's core technology for precisely measuring and controlling the flow of gases and liquids can meet a wide range of needs

Your Partner in Science

HORIBA Scientific www.horiba.com/scientific

Bulletin: HRE-3771B