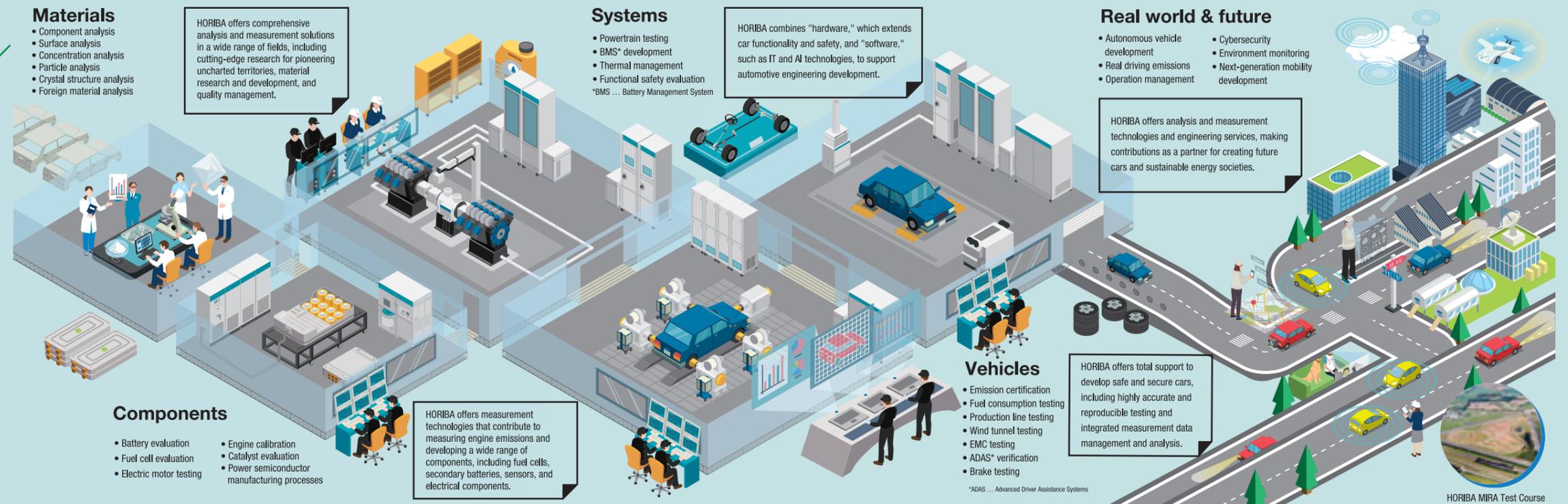


# AUTOMOTIVE NAVI

HORIBA offers a wide range of measuring instruments necessary for automotive development, from laboratory evaluations to on-road measurements.

HORIBA supports your analyses of multi-materials associated with increasingly material strengthening, lightweighting and analyses for developing sensors, batteries, and other components required for autonomous driving and vehicle electrification.

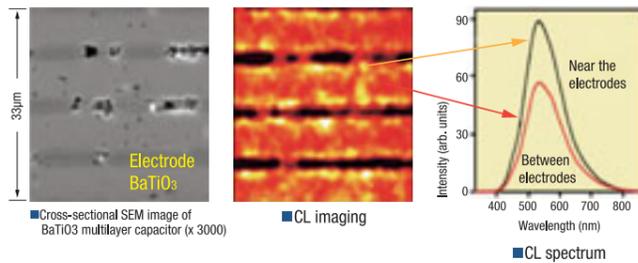


## Vehicle Electronic Components

### Multilayer Ceramic Capacitors (MLCC)

#### Oxygen deficiency analysis

MLCCs are widely used in hybrid cars and smartphones. There are cases when the resistance decreases due to a lack of oxygen in the dielectric layer, resulting in current leakage. The HORIBA CLUE Series can analyze micro areas with high resolution and sensitivity, enabling microscopic analysis of the dielectric layer.



Source: Toray Research Center, Inc.

The CL intensity is high near the electrodes, showing a significant oxygen deficiency.

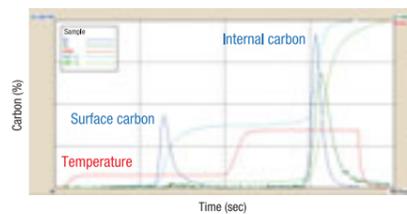
#### Residual carbon analysis

Measurement of residual carbon in the degreasing and calcination processes of MLCCs is essential since such residue causes internal defects. With EMIA-Step (tubular electric resistance heating furnace type), its variable heating temperature and time function enables the quantitative analysis of carbon separately by temperature and by condition as well as total quantity analysis.



Sample weight (g)	Surface carbon (ppm)	Internal carbon (ppm)
1.033	19	51
1.071	22	58
1.060	16	60
Average	19	56.3

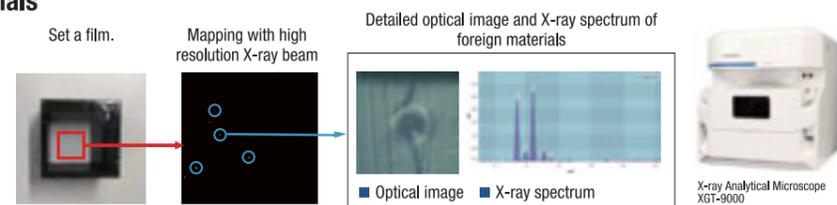
■ Quantitative results



### Films

#### Foreign material analysis of film materials

The XGT-9000 enables quick detection of foreign materials via high-speed screening with its high resolution X-ray beam and highlighted display. This does not require any pretreatment and enables contactless and non-destructive analysis, making it possible to obtain a cross section in a shorter time without affecting foreign materials.

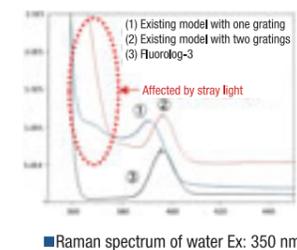
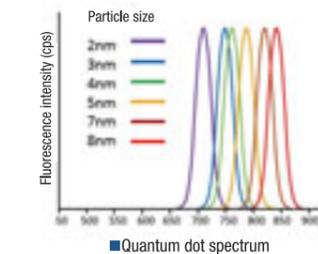


### Display

#### Fluorescence analysis of quantum dots

Quantum dots are used as next-generation display materials because they can change the color of light by the adjustment of the particle size at the nano level.

Fluorolog-3 is equipped with a spectrometer having two gratings, enabling accurate detection of faint, sharp peaks.



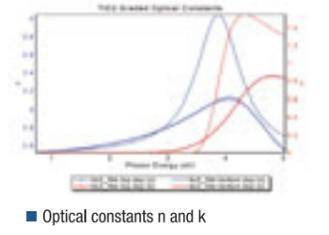
#### Film thickness analysis of antireflection coatings

Antireflection coatings, which are mainly used for image sensors, are thin and consist of multiple layers, so they cannot easily be analyzed. The UVISEL Series adopts phase modulation technology, which enables high-sensitivity detection of gradual structural changes in the film.



SiO <sub>2</sub>	158 Å
Graded TiO <sub>2</sub>	1242 Å
SiO <sub>2</sub>	500 Å
Glass	
Cr	

■ Sample composition



Concentration gradients of the refractive index were observed on the upper and lower sides of the TiO<sub>2</sub> layer.

### Motors

#### Analysis of oxygen in neodymium magnet materials

The magnetic characteristics of rare-earth magnets, which are used in motors for hybrid cars and electric cars, depend on the oxygen content; thus, oxygen analysis is required. Our Oxygen / Nitrogen Analyzer, the EMGA Series, enables easy and quick quantitative analysis of oxygen.

Sample weight (g)	Oxygen (mass %)
0.1088	0.273
0.1277	0.279
0.1399	0.279
Average	0.277

■ Result of analysis of oxygen in neodymium magnet material (Analytical results for oxygen in neodymium magnet material)



The analytical results can be displayed as numeric values and graphs in real time.



# Lightweighting

## Multi-materials

### Analysis of hydrogen in carbon black, aluminum, and other materials

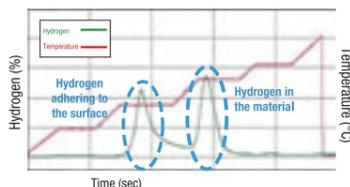
The organic matter content of carbon black, which is used to improve the physical properties of rubber products, can be measured by quantifying hydrogen. With the temperature rising analysis function, it is possible to separately measure the content of hydrogen present as organic matter and the hydrogen present as water on the surface. EMGA enables analysis of hydrogen not only in metallic materials but also in carbon black and aluminum materials.



Hydrogen Analyzer EMGA-921

#### Examples of analysis of carbon black

Sample weight (g)	Hydrogen (mass %)
0.0304	0.2573
0.0315	0.2574
0.0321	0.2599
Average	0.2582



Example of quantitative analysis result of hydrogen

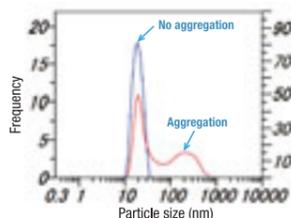
Example of hydrogen analysis by means of temperature rising analysis

### Combined analysis of filler in resin

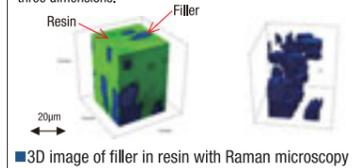
It is difficult to control the dispersibility of filler in resin, and if there is an aggregation of filler, the contact area decreases, and the performance decreases accordingly. In particular, nano-size filler is prone to aggregation, so it is important to check the dispersibility with nanoPartica SZ-100V2, which can measure particle size distribution at the nano level.



Nano Particle Analyzer nanoPartica SZ-100V2



With Raman microscopy, the dispersion can be observed in three dimensions.



Raman Microscope XploRA Series

## Bonding Materials

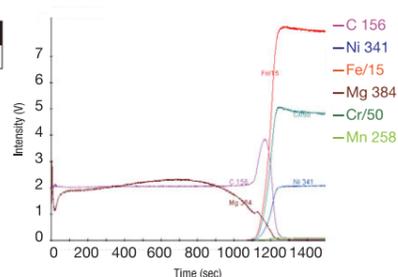
### Depth profile analysis of rubber-coated stainless steel material

Conventional sputtering methods cause thermal damage to rubber coatings. The GD-Profilier2 has a pulse sputtering function, which reduces thermal damage, and can detect the composition of the substrate (Fe, Ni, and Cr) after detecting the composition of the rubber on the coating surface (C and Mg).



Pulsed RF Glow Discharge Optical Emission Spectrometer (GD-OES) GD-Profilier2

Rubber coating  
Sample structure: Stainless steel material



Measurement result by thermal-relaxation low-speed sputtering

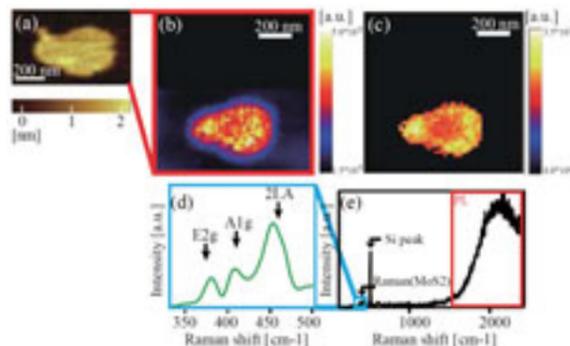
# Sliding and Surface Treatment

## Tribology

### Evaluation of MoS<sub>2</sub> (molybdenum disulfide) flakes by TERS\*

The AFM Raman XploRA Nano can determine the crystallinity of each layer of a multi-layer molybdenum disulfide film and differences in the number of layers at different positions.

Also, it allows you to obtain surface shape and physical information with the AFM function and chemical information with Raman microscopy at the same time.



\*TERS (Tip-Enhancement Raman Microscopy) Raman measurement with a spatial resolution beyond the diffraction limit (min. of several tens of nanometers)

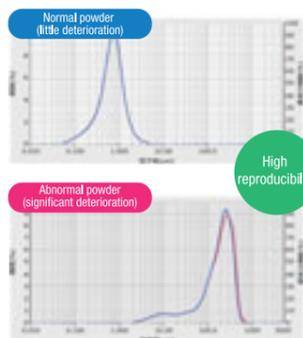


AFM Raman XploRA Nano

### Particle size measurement of wear debris in lubricating oil and hydraulic oil

The Partica LA-960V2 can determine how much a machine has deteriorated by measuring the particle size of wear debris in oil when doing conditioning monitoring.

Using the paste cell eliminates the need to dilute the sample solution with a solvent; in other words, measurement can be done with the grease alone.



High reproducibility



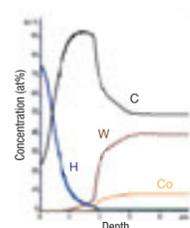
Laser Scattering Particle Size Distribution Analyzer Partica LA-960V2



Paste Cell for LA-960V2

## DLC

GD-Profilier2 provides fast, simultaneous depth profile analysis of hydrogen in DLC. It can also evaluate quantification and differences in the hydrogen profile before and after baking

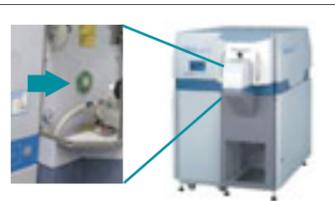


DLC deposited from graphite

Non-flat samples, such as automotive parts, can be measured in addition to flat samples.

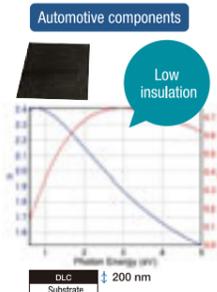
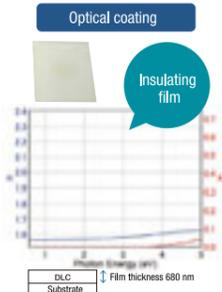


Examples of non-flat samples analyzed (The round hole was made through analysis.)



Pulsed RF Glow Discharge Optical Emission Spectrometer (GD-OES) GD-Profilier2

DLC films can be classified by obtaining the optical constants and film thickness in a nondestructive, contactless manner.



Spectroscopic Ellipsometer UMSEL Series

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

## Plating

### Plating thickness control of coating materials

With XPS (X-ray Photoelectron Spectroscopy) which adopts typical depth-direction elemental analysis, it may take half a day or longer to analyze one specimen.

Through fast analysis, GD-Profilier2 enables evaluation of multiple specimens under development.

Conventional method

With XPS, it takes one day to analyze one specimen.

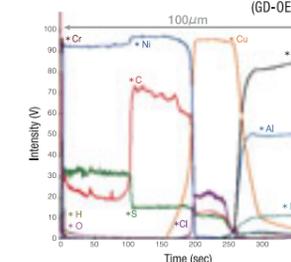


With GDS

Ten or more specimens can be analyzed in one day.



Pulsed RF Glow Discharge Optical Emission Spectrometer (GD-OES) GD-Profilier2



Measurement result of multi-layer plated, zinc die-cast (ZDC) material

### In-line control of plating solution

Without the need for pretreatment such as diluting, the MESA-50 can measure changes in the concentration of main components. Also, it can measure nickel, chrome, and other coexistent elements mixed into the plating solution while the solution is in use.



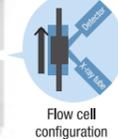
Pour the plating solution into a cell.



Set the cell.



X-Ray Fluorescence Analyzer MESA-50



With some customization, it is possible to use continuous concentration control in production lines.

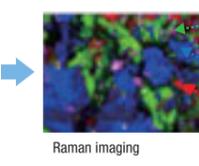
## Corrosion

### Corrosion action analysis

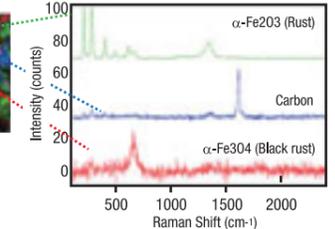
Raman spectrometers can distinguish between oxide components and hydroxide, which SEM-EDX cannot do; thus, they can analyze corrosion behavior by determining the chemical species of iron rust. They can also measure micro areas of 10 μm or less, which XRD cannot measure. Even samples with rough surfaces can be measured with high spatial resolutions.



All-focused image of the measured area



Raman imaging



Even with a rough surface, an all-focused image can be obtained with single button operation.

### Corrosion testing of a vehicle body

