HORIBA

Empowering the Battery Value Chain

From Raw Materials to Recycling
Comprehensive Solutions for Every Stage

**For raw material producers,
electrode manufacturers
and battery providers**

Navigating the Battery Value Chain: Challenges at Every Step

HORIBA delivers a range of analytical and testing solutions tailored to each stage of the battery value chain, from raw materials to individual components (electrodes, electrolytes, separators), and on to battery cells, modules, packs, and full systems.

Critical Raw Materials characterization
Ensure purity, performance, and compliance of key battery materials through elemental and structural analysis.

Module and Pack Testing
End-of-line test systems validate performance and safety of final products before deployment and R&D solutions to ensure precise development and validation.

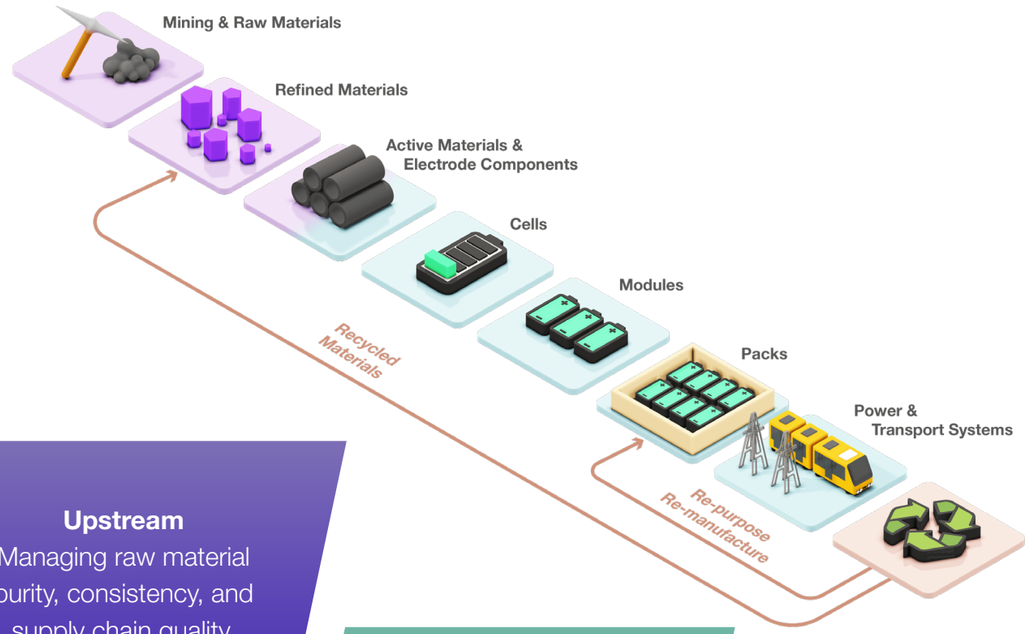
Full Vehicle Testing
Emulation and diagnostic tools for complete electric powertrains and energy systems ensure end-to-end performance verification.

Manufacturing Process Control
Real-time, in-line solutions including XRF allow material verification and process monitoring, improving yield and quality consistency.

Safety Testing
Dedicated systems for thermal runaway, mechanical abuse, and other stress scenarios.

Recycling
Advanced analytical tools support efficient black mass analysis and recovery of valuable elements with in-line metrology or in-line XRF.

Full battery value chain



Upstream
Managing raw material purity, consistency, and supply chain quality.

Midstream
Achieving homogeneity in electrodes and electrolytes, and ensuring safe, high-performance cells.

Downstream
Ensuring reliable module/pack performance, managing recycling, and regulatory compliance.

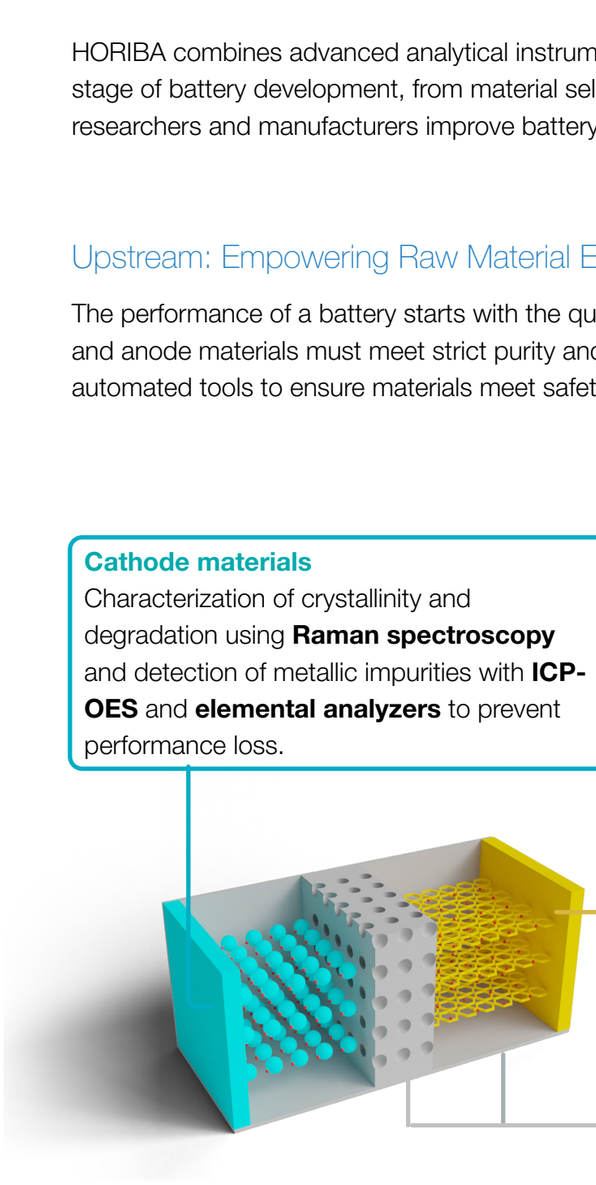
HORIBA combines advanced analytical instruments with complete testing systems to support every stage of battery development, from material selection to final product validation. These solutions help researchers and manufacturers improve battery performance, safety, and lifespan.

Upstream: Empowering Raw Material Excellence

The performance of a battery starts with the quality of its raw materials. Producers of cathode and anode materials must meet strict purity and structural standards. HORIBA provides scalable, automated tools to ensure materials meet safety, performance, and regulatory demands.

Cathode materials
Characterization of crystallinity and degradation using **Raman spectroscopy** and detection of metallic impurities with **ICP-OES** and **elemental analyzers** to prevent performance loss.

Anode materials
Analysis of graphite structure and carbon morphology using **Raman spectroscopy** and **particle characterization analyzers** and detection of hydrocarbons and contaminants with **elemental analyzers** and **ICP** for quality assurance.



Electrolyte and separator
Impurity quantification in electrolytes with **ICP-OES** to prevent breakdown reactions and depth profiling of separators with **GDOES** to detect migration of harmful elements.

Safety and stability analysis
Monitoring unstable compounds and degradation using **Raman** and f**luorescence spectroscopy** and detection of separator contamination and structure changes with **microRaman** to prevent short circuits.

Ageing and degradation monitoring
Evaluation of SEI layer composition and thickness with **microRaman** and **GDOES**
Detection of lithium plating and post-ageing impurity migration using **Raman spectroscopy** and **GDOES.**

Midstream: Complete battery cell module and pack testing

Testing battery cells is key to understanding how design and material choices impact real-world performance. It covers everything from basic metrics like capacity and internal resistance to long-term behavior and degradation patterns. These results guide Battery Management Systems (BMS), simulation models, and system-level design.

Reliable testing requires a combination of techniques, such as DC cycling and Electrochemical Impedance Spectroscopy (EIS), all performed under controlled conditions.

HORIBA provides a comprehensive and flexible solution incorporating optimal instruments, hardware and software for the customer application, requirements and future direction.

Key testing needs and HORIBA Solutions

- **Performance Characterization**

Measure capacity, Open-Circuit Voltage (OCV), and internal resistance to support BMS tuning and simulation models.

HORIBA's cell cyclers provide precise DC cycling under programmable current and voltage profiles.

- **Durability & Ageing Evaluation**

Analyze how performance and internal parameters evolve with time, usage, and environmental conditions.

Use EIS modules integrated into HORIBA Evaluator systems to monitor internal degradation and resistance growth.

- **Advanced Characterization Methods**

Combine DC cycling with AC excitation (EIS) to gain a complete view of electrochemical behavior.

HORIBA's module and pack R&D test system supports both techniques with high accuracy and real-time data acquisition.

- **Environmental & Thermal Control**

Ensure reproducibility with tightly controlled temperature and humidity conditions.

Use climate chambers and thermal management systems integrated into HORIBA's test benches.

- **Design-of-Experiments (DoE) Testing**

Perform multivariable testing scenarios to study interactions between materials, designs, and external factors.

HORIBA systems allow flexible programming and high-speed logging to support complex DoE campaigns.

Downstream: Ensuring Safety and Sustainability

In the downstream stage, the focus is on assembling cells into modules and packs, validating their performance, and preparing for reuse or recycling. Maintaining safety, thermal stability, and consistent performance under real-world conditions is complex.

HORIBA meets these demands with advanced tools for testing, safety assessment, and end-of-life analysis. Our portfolio includes high-performance charge/discharge cyclers, Electrochemical Impedance Spectroscopy (EIS), abuse testing systems, and elemental analysis of black mass.

As sustainability and regulatory pressure grow, HORIBA helps customers confidently close the loop with reliable, precise solutions.

HORIBA empowers OEMs, recyclers, and energy storage companies by:

Performance Testing
High-precision cyclers and impedance spectroscopy for modules and packs, vehicle components & systems and full EVs.

Safety Assurance
HORIBA MIRA's abuse testing facilities handle short circuits, crush, thermal runaway, and more.

Black Mass Recycling
ICP-OES and microXRF enable efficient elemental analysis for purity control and regulation compliance.

Consulting & Certification
HORIBA MIRA guides customers through functional safety, cybersecurity, and homologation processes.

HORIBA — Your Partner at Every Stage

HORIBA is more than an equipment supplier. We are your strategic partner across the battery lifecycle. With a legacy of analytical innovation and deep market understanding, we deliver tailored solutions that empower battery developers, manufacturers, and recyclers to meet their goals.

Our integrated approach combines robust hardware with intuitive software and world-class consulting. Whether you're scaling production, improving safety, or navigating evolving regulations, HORIBA is here to support you at every turn.

Backed by global expertise and local presence, we're committed to advancing battery technology for a cleaner, more connected world.

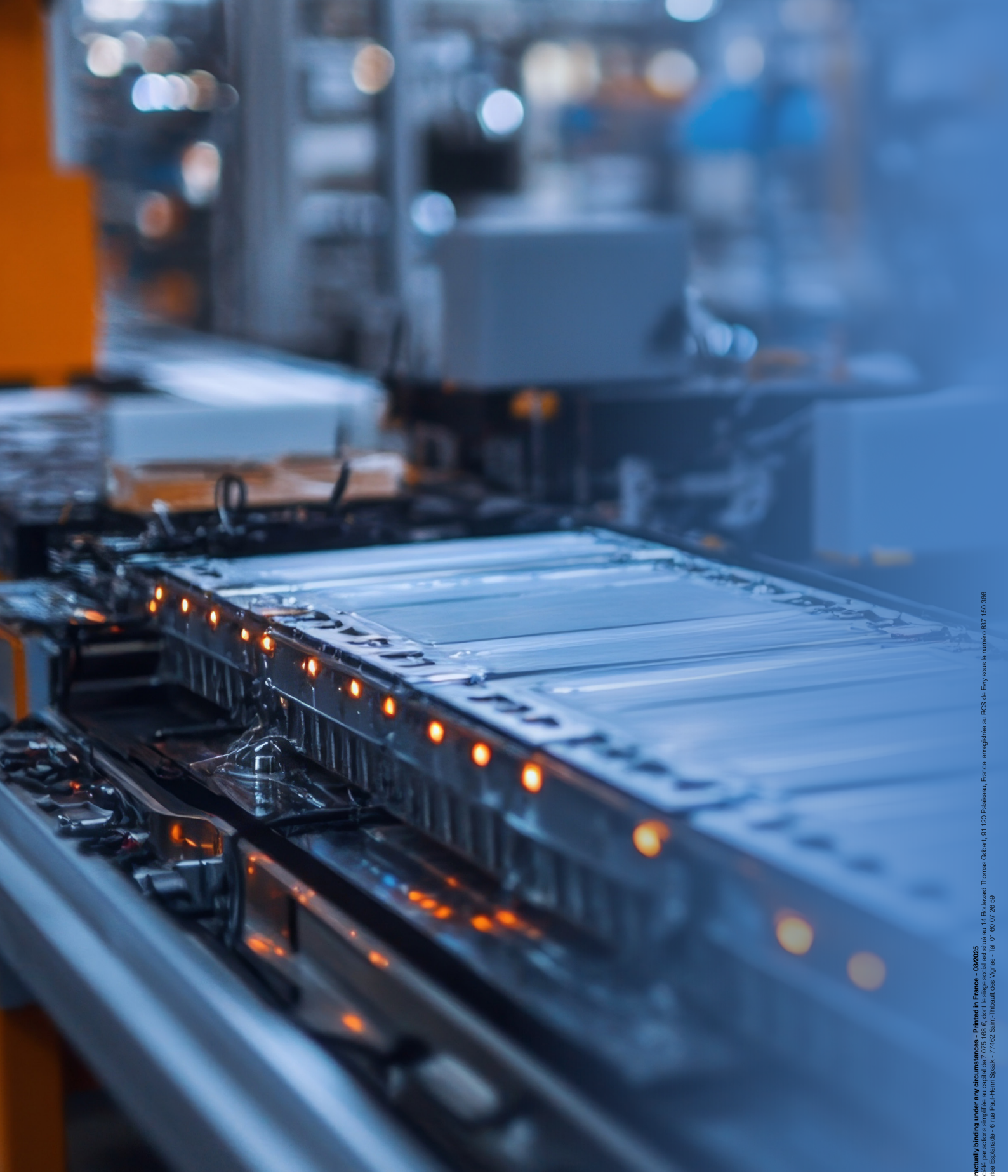
Discover how HORIBA helps turn your battery vision into reality.

One-Stop Solutions
Comprehensive tools for chemical, physical, and electrochemical testing.

Scalability
From lab R&D to full-scale production.

Global Support
Training, consulting, and customer service tailored to your needs.

Let's build a sustainable battery future together.



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