

# Develop Better Batteries With Shimadzu's Solutions







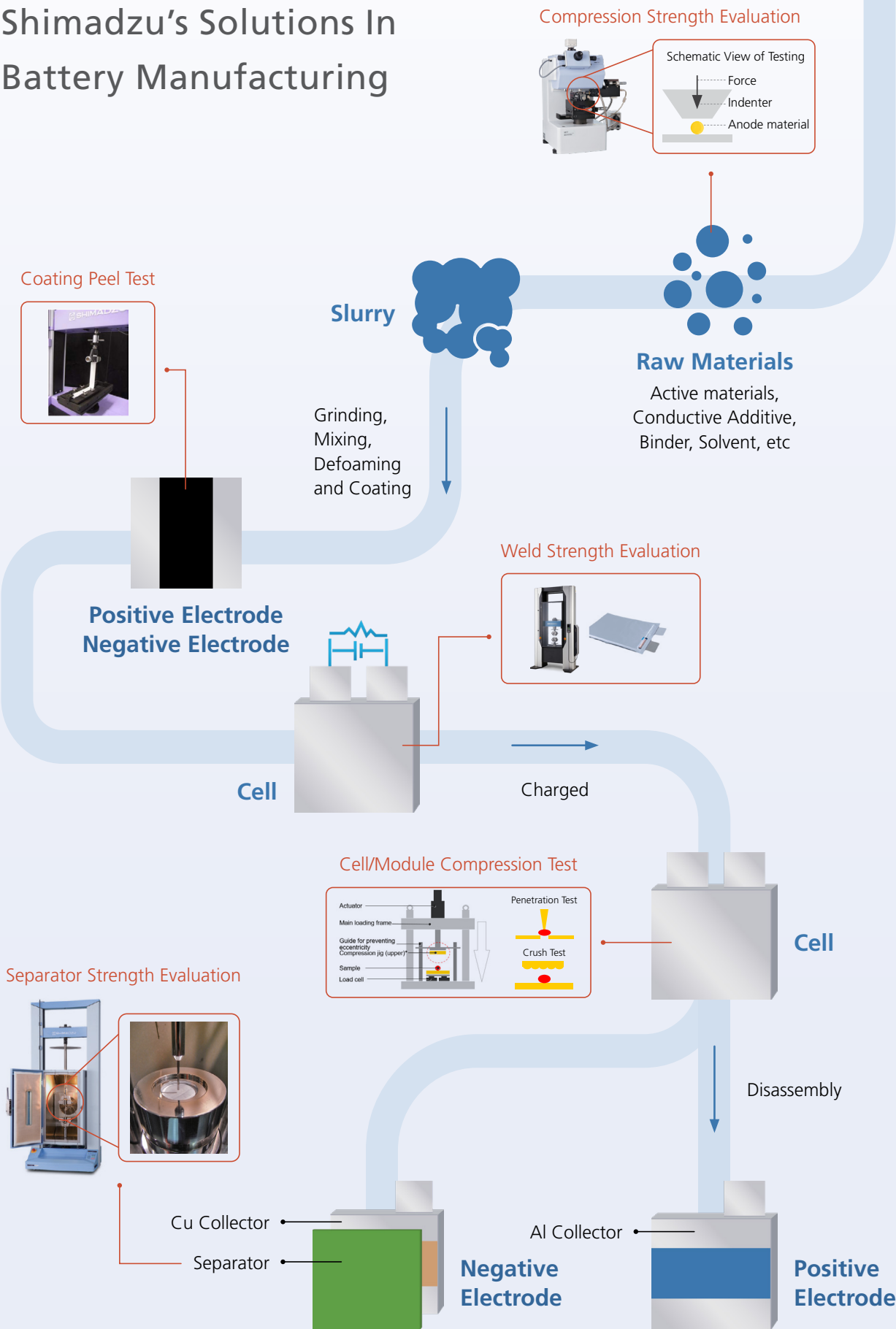
## Evaluation of Lithium-ion Batteries (LiBs)

Battery demand is surging, and so is the need for innovative solutions to optimize its performance and safeguard its safety. From electric vehicles (EVs) to renewable energy storage, LiBs are crucial in creating a sustainable future.

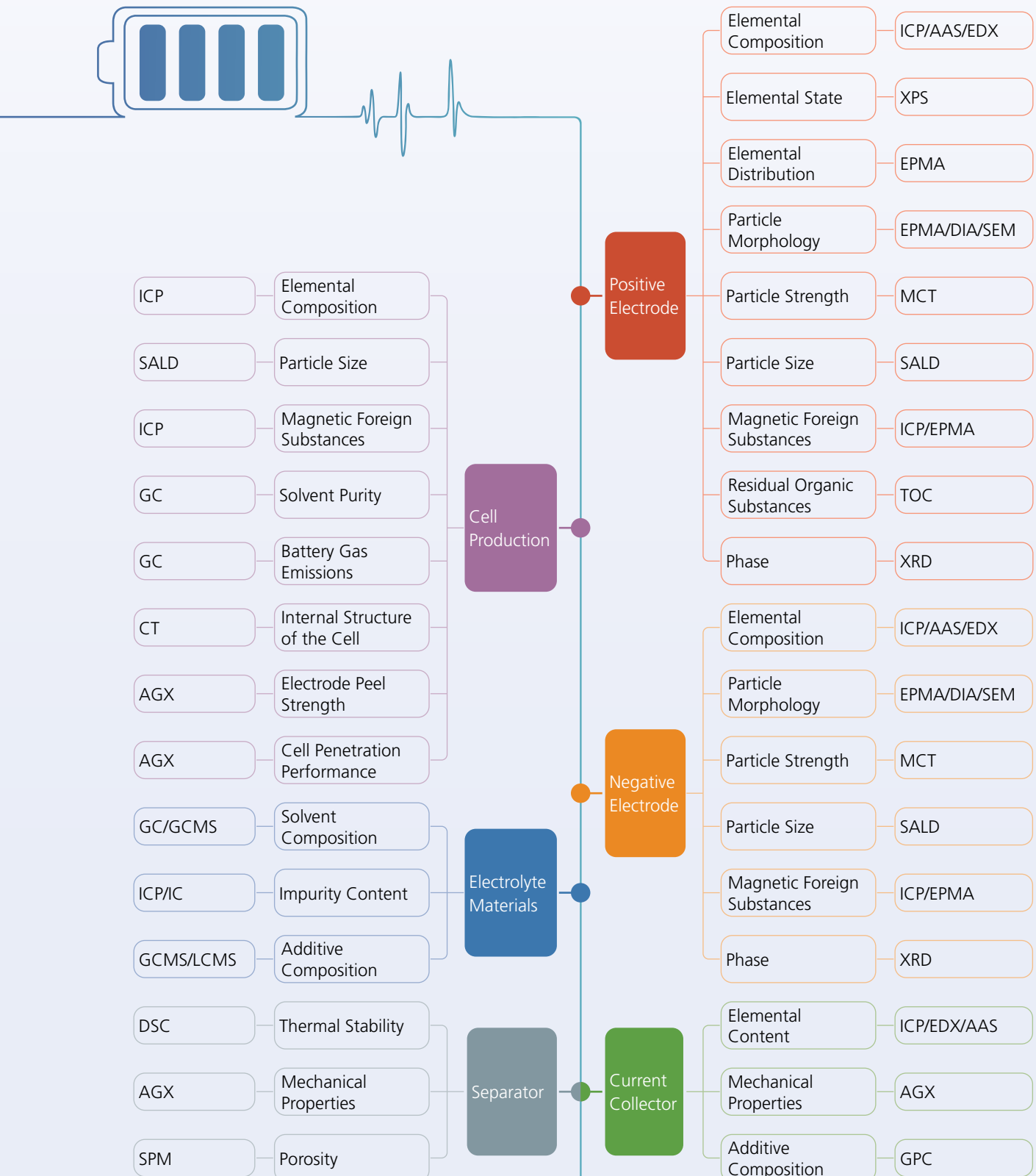
Shimadzu offers both analytical and mechanical testing as a **Total Solution** to develop better batteries.



# Overview of Shimadzu's Solutions In Battery Manufacturing



# Overview of Shimadzu's Solutions For Battery Components



# Material Evaluation For Lithium-Ion Battery

When it comes to battery performance, typical degradation issues include capacity fading and increased internal resistance. Battery failure can also raise safety concerns such as thermal runaway and overcharging. Material evaluation is hence crucial to improve both battery performance and battery safety.







Evaluate  
battery performance



Evaluate  
battery safety



## Raw Material Analysis

### Compression Strength Evaluation on Active Materials

As charging and discharging cause the active materials to expand and contract in volume, it's important for these materials to have a certain level of strength to prevent them from being damaged or crushed. This test hence evaluates the structural integrity of active materials under various conditions. It also helps understand how these materials react to stress and deformation.



## Electrode Analysis

### Peel Test of Electrode and Electrode Coating

Evaluates the adhesion strength between different layers of materials in a battery. By conducting peel tests, weak points in the battery structure can be identified, preventing delamination or reduced performance.



## Separator Analysis

### Temperature-Dependent Tensile Strength Evaluation

Determines how the separator responds to thermal fluctuations and mechanical strain typical in battery applications. This information is crucial to understand their structural integrity under different operating conditions, thus reducing risks of short circuits or thermal runaway in the battery.



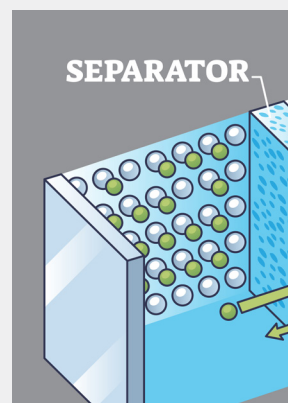
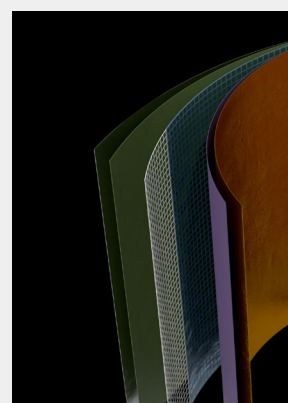
### Temperature-Dependent Piercing Strength Evaluation

Measures whether the battery separators can withstand mechanical stresses, such as piercing forces, under different temperature conditions to ensure its safety. Changes in temperature can affect the material properties, including strength and flexibility, which in turn impact the separator's ability to resist piercing or penetration.



### Durability Test

Simulates the real-world conditions that the battery will face, such as temperature cycling and mechanical vibrations. By subjecting the separator to these tests, manufacturers can assess how well it maintains its structural integrity and performance over time.

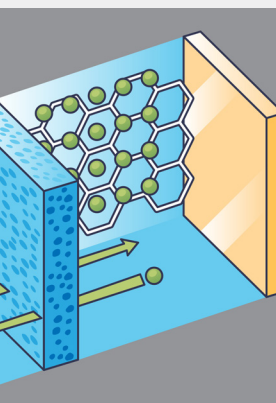




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## Battery Cell/Module/Pack Evaluation

### Ultrasonic/Laser Welding Strength Evaluation

A strong weld ensures low electrical resistance and reliable current flow, which is essential for efficient battery operation. Moreover, proper welding strength prevents issues such as overheating or electrical arcing that could lead to battery malfunctions, fires, or explosions.



### Penetration & Compression/Crushing Test

Assesses how well batteries withstand external forces, such as impacts or pressure, which helps determine their safety under various handling and operating conditions. For example, in electric vehicles or portable electronics, batteries may experience physical impacts, and it is important to know how well they can resist penetration or crushing to prevent leakage or thermal runaway.



### Compression-Constraint Test of Large Battery Pack

Evaluates the battery module or pack's ability to withstand external compressive forces. This is crucial for ensuring the battery's safety in scenarios where modules or packs may experience mechanical pressure, such as in automotive or stationary energy storage systems.



### Mechanical Evaluation of Battery During Charging

Monitors mechanical changes, such as swelling, expansion, or contraction, during charging and discharging to detect potential issues that could compromise battery integrity. It also provides insights into how the battery materials and components respond to electrochemical processes. Changes in dimensions or structural integrity can affect battery performance, including capacity retention, cycle life, and efficiency.



# How Shimadzu Can Help

## AGX-V2 AUTOGRAPH Precision Universal Testing Machine

Used for electrode analysis, separator analysis, and battery cell/module/pack evaluation



Universal Testing Machine plays a crucial role in battery testing by providing precise and controlled mechanical testing to ensure the safety, reliability and performance of batteries.

It supports quality control in battery manufacturing and contributes to the advancement of battery technology through research and development.

Key features:

- Ultra-high-speed data sampling for capturing instantaneous changes
- Ultra-high-response crosshead control for high-level simultaneous parallel processing and controlling
- Intelligent crosshead for true safety for both operator and machine
- Thermostatic chamber for evaluation under various temperature conditions, simulating actual battery operating condition



Discover AGX-V2

## MCT Series Micro Compression Tester

Used for raw material (electrode active materials) analysis



There is significant interest in developing lithium-ion battery (LiB) cathodes that are highly resistant to degradation. One of the challenges is that the cathode active material (CAM) can fracture during charging and discharging due to dimensional changes.

This fracture reduces the energy storage capacity over multiple charge/discharge cycles and leads to a shorter service life. As a result, there is a growing interest in measuring the mechanical properties of CAM to understand how they change during charging and cycling.

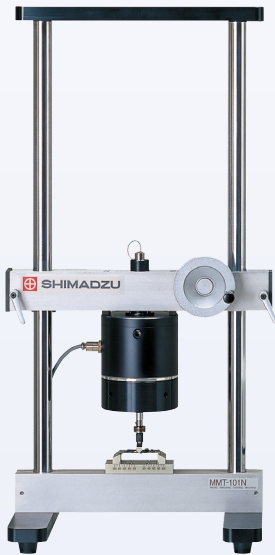
Key Add-Ons:

- Side Observation Kit – Allows monitoring of the sample from the side direction during compression
- High Temperature Kit – Compressive strength evaluation at elevated temperature conditions



Discover MCT-Series





## Microservo MMT Series Electromagnetic Force Micro Testing System

Used for separator analysis

The separator, or electrolyte membrane, is a crucial polymer film in secondary batteries. It ensures safety and performance by preventing direct contact between electrodes while allowing ion flow. Evaluating the fatigue and endurance of this component has become increasingly important, especially considering external forces like electrolyte pressure and temperature fluctuations. These factors can significantly impact the separator's integrity and functionality over time.

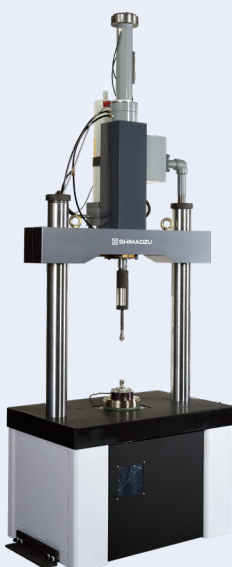
Thorough assessment helps manufacturers develop more robust and reliable batteries, ensuring longer lifespans and better performance under varying conditions.

Key features:

- Evaluating the fatigue and endurance characteristics of micro materials and parts in **clean environments**
- High expandability for various tests setups with flexible actuator mounting position (up and down)



Discover Microservo MMT Series



## HITS-X Series High-Speed Impact Testing Machines

Used for penetration compression/crushing test for battery constituent materials

High-speed impact testing on battery constituent materials is a crucial safety evaluation process. It assesses how materials, especially those in electric vehicles and portable electronic devices, respond to extreme mechanical stresses. This testing helps ensure battery durability and safety under harsh conditions, preventing potential failures and hazards.

Key features:

- Energy-saving operation system that changes the motor speed and supply pressure for the hydraulic power unit depending on the operating status (patented)
- Optional thermostatic chamber for evaluation at elevated temperature conditions



Discover HITS-X Series



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