

## Real-Time Measuring Method Extends Lifespan and Enhances Safety of Batteries

An innovative measurement method enables optimized battery management in electric vehicles, helping to make them safer and extend their lifespans. Impedance spectroscopy from the Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM analyzes detailed measurement data on the battery's state in real time during operation. This means batteries can also be used for safety-critical applications.

Fraunhofer IFAM has developed a dynamic impedance spectroscopy technique that enables live analysis of a battery's internal state while it is operating, instead of only at rest. Unlike traditional methods that pause battery operation and take up to 20 minutes to compile data, this system continuously overlays the battery's charge or discharge current with a multi-frequency test signal. The result: high-resolution data (up to 1 million samples/sec) for direct insight into internal electrochemical and thermal processes.

- **Extends Lifespan:** By understanding real-time changes in internal battery impedance - an indicator of State of Charge (SoC) and State of Health (SoH) - battery management systems can optimize charging/discharging strategies that reduce wear and prolong usable life.
- **Enhances Safety:** Immediate impedance data allows rapid detection of local overheating events or other stress indicators, enabling the system to deactivate or throttle affected cells before damage or failure occurs - without relying solely on slower surface temperature sensors.
- **Enables Safety-Critical Applications:** With accurate live monitoring, batteries become suitable for applications requiring high reliability, such as aviation, grid energy storage, or emergency-response vehicles.



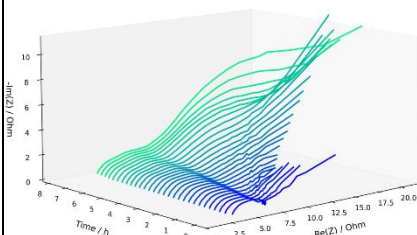
### Key Features:

- **Dynamic operation:** Measures battery health during live charge/discharge
- **High-frequency resolution:** Records signals up to 1 MHz for detailed internal profiling
- **Algorithmic efficiency:** Data-reduction methods keep real-time processing rapid
- **Predictive insights:** Enables informed decisions for charging protocols
- **Applicability:** Works across battery chemistries including solid-state and next-gen systems

*Image: The graph shows how the impedance curves change dynamically during a charging cycle. The curves provide information on the physical and chemical processes taking place inside the battery cell. [Lab setup for computer-assisted real-time measurement of impedance in a lithium-ion battery cell to analyze its state.]*

### Applications:

- **Electric mobility:** Optimized EV battery management with enhanced safety
- **Renewable storage:** Intelligent control for PV and wind energy batteries
- **Aviation & marine:** Monitoring for future electric aircraft or vessels
- **Grid & microgrids:** Reliable energy storage with extended lifetime and safety
- **Industrial backup systems:** High-confidence power backup solutions



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Thanks and Regards,

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