Argonne NATIONAL LABORATORY

INVESTIGATING HOW TO INCREASE THE LIFE OF BATTERIES

Argonne's state-of-the-art Battery Post-Test Facility

Argonne scientist Nancy Dietz Rago analyzes results in the Post-Test Facility. After a battery sample is characterized in the large glove box, it is transferred without exposure to air to the scanning electron microscope for detailed, microstructure characterization.

Questions that the Post-Test Facility can answer:

- What happens to batteries as they age?
- How do chemistries and materials change and degrade?
- How can we lengthen battery life?
- How can we ensure safe use of battery materials?

The Battery Post-Test Facility's (PTF) capability to identify physical and chemical changes in aged batteries answers questions on how to improve performance, safety and life.

Battery testing provides a lot of information about how battery performance changes under a given set of conditions. Until recently, based on these results, the cause(s) of performance degradation could only be inferred. The PTF allows materials from used or tested batteries to be analyzed. The analysis helps us elucidate the mechanisms for performance degradation. For example, the PTF can characterize electrode capacity, changes in surface and electrolyte chemistry and electrode morphology, composition and phase distribution.

The materials that are handled at PTF are air-sensitive, meaning that they will degrade or decompose on contact with air or moisture. To combat this issue, the PTF is unique in that all the work, from dismantling the cells to harvesting and analyzing components, is performed in large, connected gloveboxes. This keeps air-sensitive battery materials pristine and intact, yielding information free from artifacts.

An X-ray photoelectron spectrometer (XPS) is integrated into the Post-Test Facility's large, central glove box. The XPS is used to determine the chemical environments present on the surface of a material. This helps researchers learn what chemical and physical changes have occurred during the aging of battery materials.

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U.S. DEPARTMENT OF ENERGY
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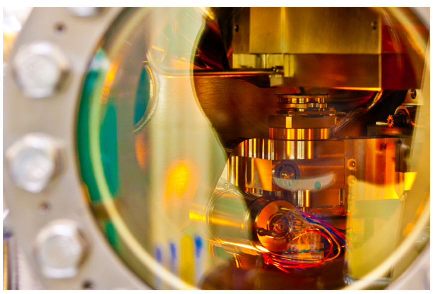
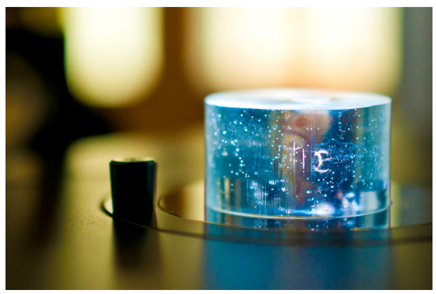
Argonne scientist Ira Bloom prepares to open a lithium-ion cell. Prior to opening the cell, a thermocouple is attached to provide information on cell temperature.

Loading a sample into the antechamber of the XPS.



A view of the heart of the X-ray photoelectron spectrometer unit, showing the servo-motor and the stage that it moves.



A sample, mounted in epoxy, is being examined using a light microscope to determine its morphology.

Argonne's PTF is one of the few facilities in the world capable of conducting this type of research. While other facilities are typically limited to about 1–2 ampere hour (Ah), Argonne can handle up to 300Ah — the only facility able to do work at this scale. While its current focus is lithium-ion batteries, the PTF is highly flexible and is equipped to characterize materials from lead-acid batteries, lithium air, solar cells, and other materials where surface chemistry is important.

The PTF complements Argonne's Electrochemical Analysis and Diagnostics Laboratory where batteries from both private and government-funded initiatives have been tested for more than three decades. Funding for this work is provided by the United States Department of Energy's Vehicle Technologies Program.

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