Energy Storage Materials Initiative

Solutions to the pressing challenges of climate change, decarbonization of the energy supply, and power grid modernization require affordable, reliable, and safe energy storage deployed at scale. The ability to store electricity – through better battery technology—is critical to bring significantly more renewable energy resources online, electrifying transportation, and maintaining grid reliability. The cost of grid energy storage technology needs to come down and performance needs to improve to drive widespread adoption. Achieving this outcome will require new scientific approaches that accelerate the identification, testing, and verification of new materials and battery energy storage system design.

Transforming Energy Storage Materials R&D

The Energy Storage Materials Initiative (ESMI) at Pacific Northwest National Laboratory (PNNL) is a five-year, strategic investment to accelerate energy storage R&D. The ESMI team is pioneering the use of digital twin technology in the form of physics-informed, data-based modeling tools to converge the virtual and physical worlds, while more closely integrating experimentation with modeling across different scales. With these innovative approaches, ESMI transforms materials research from a sequential, trial and error approach to a structured, virtual screening that accelerates identification and validation of promising new energy storage materials from tens of millions of potential combinations.

PNNL Leadership in Energy Storage R&D

With support from the Department of Energy, PNNL has established a national leadership position in energy storage R&D. PNNL is home to leading experts in chemistry, physics, and materials science who are improving the fundamental properties of battery materials, while engineers, grid experts, and economists work to design and test new energy storage systems in collaboration with industry. In 2020, seven of PNNL's 17 highly cited researchers were recognized as experts in energy storage. This concentrated scientific expertise, coupled with advanced R&D facilities and distinctive scientific capabilities, enables PNNL to take on ambitious energy storage projects such as ESMI.

Digital Twin Technology

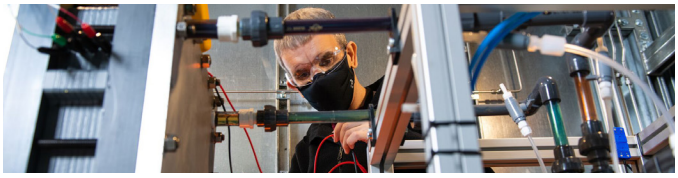
In developing digital twin technology for batteries, ESMI team members are breaking down the barriers between the virtual and physical worlds. This enables them to scale-up a battery design to a commercially relevant size that is able to assess characteristics and performance more quickly and cost effectively compared to traditional battery design and development approaches.

Next-Generation Materials for Redox Flow Batteries

ESMI team members are initially focusing on developing better chemistries for redox flow batteries. Flow battery technology can scale easily for grid energy storage applications because the chemical energy is provided by two chemical components dissolved in liquids that are stored in separate tanks and pumped through the battery system. However, lower cost and safer chemistries are needed for flow batteries to compete with other technologies at scale.

High-Throughput Experimentation

Using a new generation of intelligent robotic systems with multi-function hardware and embedded intelligent software, ESMI team members are achieving high-throughput experimentation of large material groups. Using design of experiment concepts, combined with machine learning, accelerates the material discovery process.



Accelerated Prototyping and Validation

As a changing energy resource portfolio drives increased demand for grid-scale energy storage, ESMI aims to fundamentally transform materials research by achieving predictive material design; rapidly validating prototypes; and bridging conceptual research to an optimized energy storage device using digital twin technology. This approach accelerates the timelines from materials research to device verification.

For more information, contact

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