Overview of Battery R&D Activities

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2019 NAATBatt INTERNATIONAL ANNUAL MEETING & CONFERENCE

Litchfield Park, AZ
March 12-14, 2019

NREL Snapshot

NREL focuses on creative answers to clean energy challenges, from breakthroughs in fundamental science to new clean technologies to integrated energy systems.

World-Class Staff

2,200

Including postdocs interns, and visiting professionals

Recognition

61

R&D 100 awards

Partnerships

750

With government, industry, and academia

Campus

Operates as a living laboratory with world-class facilities and capabilities

Impact

$872M

Annual national economic impact

Sustainable Mobility

NREL's sustainable transportation research focuses on new, innovative, and integrated mobility strategies with the potential to:

- Transform the movement of people and goods
- Enhance national energy security
- Boost the domestic economy
- Save individuals and businesses time and money

Battery R&D Program

NREL's energy storage program develops & enhances battery technologies

Working to meet key targets:

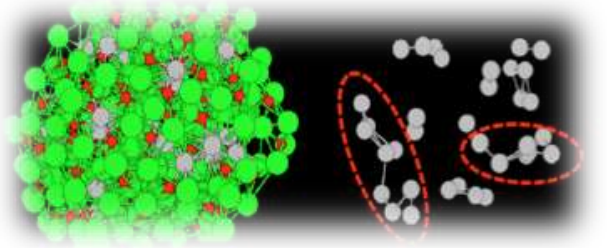
- Energy and power densities
- Cost
- Life
- Safety
- Extreme fast charging
- Sustainability

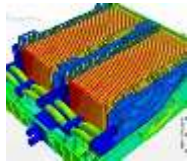
Working on transportation and stationary applications:

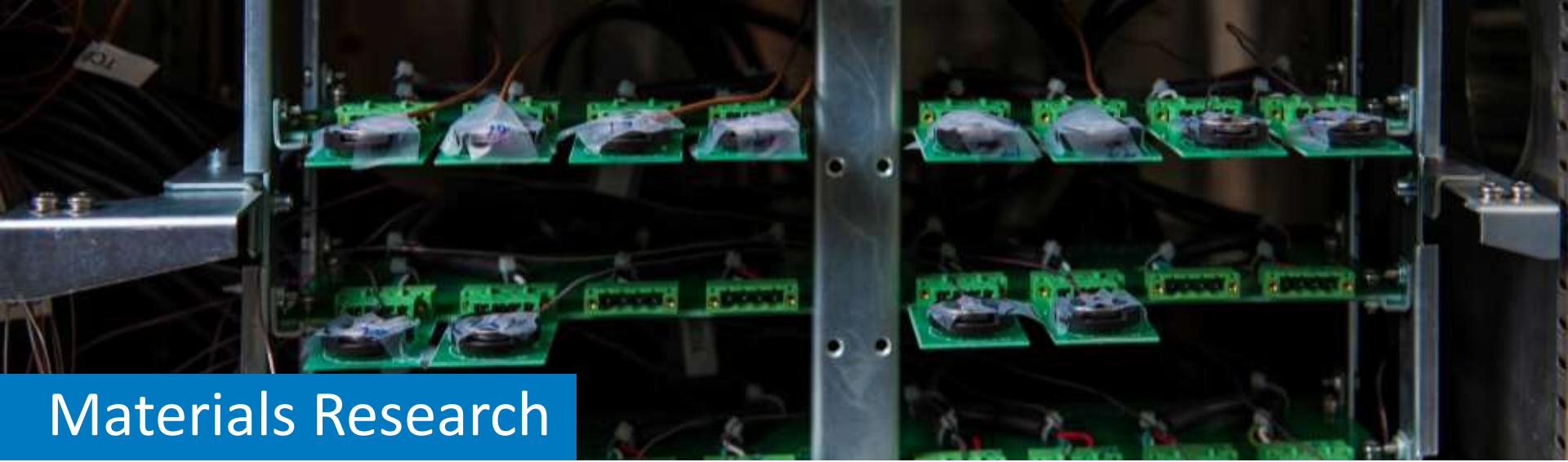
- Materials science
- Modeling
- Engineering
- System integration of energy storage

Energy Storage R&D Activities

1. Materials Research
2. Thermal Characterization and Evaluation
3. ECT Performance and Life Modeling
4. Extreme Fast Charging
5. Safety Modeling and Characterization
6. Battery Recycling
7. Strategic Partnerships







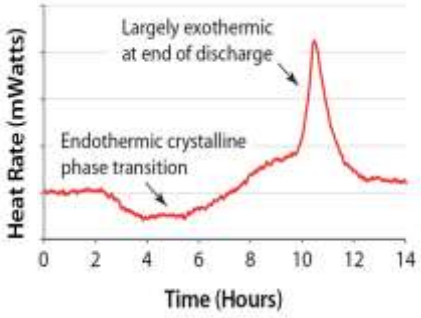
Materials Research

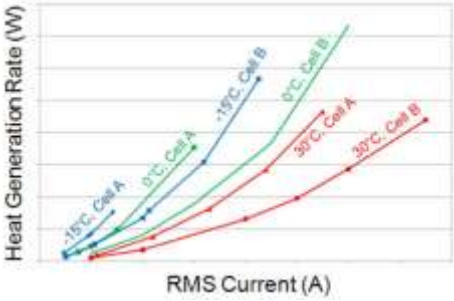
- Stabilization studies to enhance cyclability of high-energy silicon-based anodes
- Atomic layer deposition for improving life and safety of electrodes
- Development and evaluation of high-nickel, low-cobalt cathodes
- The Cell Fabrication, Analysis and Breakdown (CFAB) laboratory

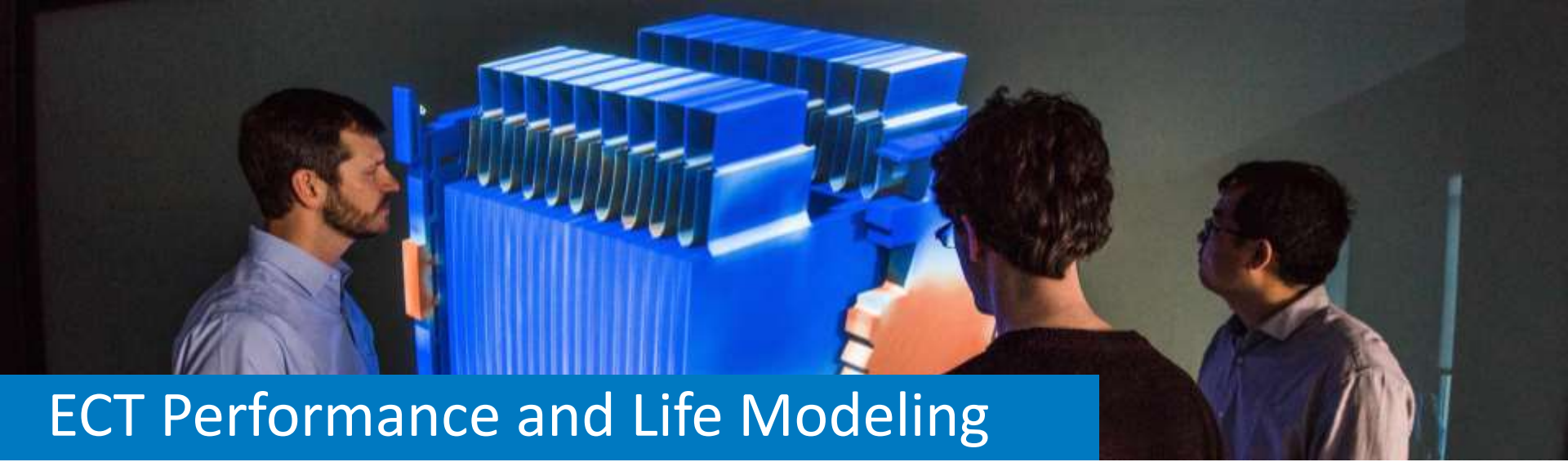
Thermal Characterization and Evaluation

Thermal characterization of cells and batteries to design improved thermal management systems

- Calorimetry
- Infrared thermal imaging
- Thermal conductivity measurements
- System thermal evaluation testing







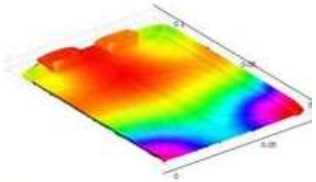
ECT Performance and Life Modeling

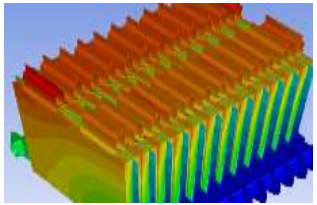
CAEBAT: Computer-Aided Engineering for Electric-Drive Vehicle Batteries

Accelerating design of high-performance lithium-ion batteries through the development of multi-scale, multi-physics modeling tools

- Three commercial software tools developed
- Developing microstructure models to design better electrodes

Life Models: Cell-level capacity fade and resistance growth capturing various degradation mechanisms





Extreme Fast Charging (XFC)

Using CAEBAT tools, NREL is developing 3D microstructure models to increase rate of charging

- Simulate tortuosity
- Simulate morphology and particle alignments
- Modify electrode design for faster Li transport
- Validate with experiments and advanced diagnostics

Safety Modeling and Characterization

- NREL has developed models to predict thermal runaway under overheating, internal short circuit, nail penetration, and mechanical crush
- NREL has developed a patented **Internal Short Circuit Device** that induces a true internal short within a lithium-ion battery cell – licensed with KULR

Battery Recycling

Performing research as part of U.S. Department of Energy (DOE)'s program with Argonne National Laboratory and Oak Ridge National Laboratory

- Refurbishing and rejuvenating electrodes
- Design for recycling
- Materials and powder modeling

Administering the U.S. DOE's Lithium-Ion Battery Recycling Prize

- Increase collection, sorting, storing, and transporting of all Li-ion batteries

AMERICAN MADE
BATTERY RECYCLING PRIZE
U.S. DEPARTMENT OF ENERGY

Strategic Partnerships

Thank You

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www.nrel.gov

www.nrel.gov/transportation/energy-storage.html

PR-5400-73434