Predicting Microstructure and Performance for Optimal Cell Fabrication

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

PI/Co-PI: D.R. Wheeler / B.A. Mazzeo (BYU)

Technical Approach:

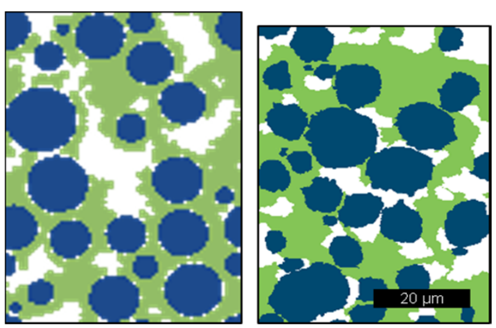
- Construct a novel *n*-line surface probe that can sample local conductivity of intact battery electrodes.
- Construct a particle-dynamics model that can predict electrode microstructure and conductive pathways. Validate model with extensive experiments.

Status:

- Third-generation electronic probe completed and tested. Technology transfer with A123 completed. Transfer with Bosch R&T Center in progress.
- Computer model of coating and drying process matches a range of physical metrics, successfully passing Go/No-Go decision point (Q4-FY15).

Technology:

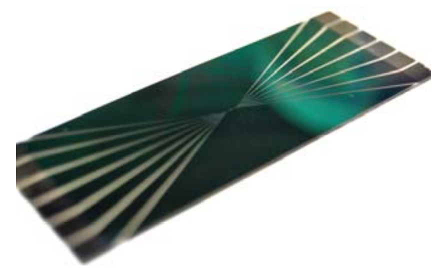
In addition to the probe technology, a physics-based particle model (left) imitates the fabrication process to match experimental micro-structure of a Li-ion battery cathode (right).



Objectives:

- Develop rapid and reliable tools for measuring and predicting electronic and ionic conductivities and 3D microstructure of particle-based electrodes.
- Understand tradeoffs and relationships between fabrication parameters and performance.

Deliverables: (1) Robust system for measuring local conductivities of electrodes (6-line probe shown below). (2) Particle-based computer model for predicting electrode microstructure and performance.



Funding:

Duration: 4 yrs (Yr 4)
FY16 Budget: $229K (DOE)

Milestones:

- **Q1:** Demonstrate that the DPP model can accurately imitate the mechanical calendering process for a representative electrode film.
- **Q2:** Develop a robust numerical routine for interpreting N-line conductivity measurements.
- **Q3:** Go/No-Go: Continue work on N-line probe and inversion routine. Criteria: Demonstrate that the N-line probe and inversion routine can accurately determine anisotropic conductivity for test materials.
- **Q4:** Demonstrate correlations between DPP modeled conductivities and those determined by FIB/SEM and N-line probe.