Energy Storage

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Research Objectives:

- Sustainability
- Low cost solutions
- Safe battery storage
- High energy density battery pack

Towards next generation battery technologies

- Materials synthesis
- Ionic liquids/alternate chemistries for safety
- Advanced storage (Li-S)/new storage systems (Na and Mg)
Research Activities:

Lithium-ion batteries:
- Synthesis of high capacity cathode and anode materials
- Performance optimization
- Development of new cell chemistries
- Ionic liquid based electrolytes

Lithium-Sulphur batteries:
- Waste to sustainable energy

Sodium-ion batteries:
- Development of cathode and anode materials
- Performance optimization
- Ionic liquid based electrolytes

Magnesium-ion batteries:
- Development of magnesium-ion batteries

Lithium-ion batteries for Renewable energy integration in the state of California, US

www.energy.ca.gov/research/energystorage/tour/lion/
Commercial grade battery production:

1. **Active material + Carbon additive + Binder mixing**
2. **Slurry coating**
3. **Slurry drying**
4. **Electrode cutting**
5. **Electrode stacking**
6. **Anode**
7. **Cathode**
8. **separator**
9. **Welding the tabs, pouch formation, and sealing**
10. **Electrolyte filling inside glove box and vacuum sealing**
11. **Formation (initial charging)**
12. **Final sealing**

Pouch cell after final sealing
Lithium-ion pouch cell fabrication unit:

- Electrode slurry mixer
- Electrode slurry coater
- Electrode die cutter
Lithium-ion pouch cell fabrication unit:

- Calendaring machine
- Pouch forming machine
- Pouch sealing machine
Lithium-ion pouch cell fabrication unit:

- Pouch stacking
- Ultrasonic welding
- Vacuum sealing machine
Lithium-ion pouch cell fabrication unit:

- Glovebox for electrolyte filling
- Battery testing machine
- Lithium-ion pouch cell
Development of new Lithium-ion chemistry: Fe$_2$O$_3$ as conversion anode

Single LED powered by 2016 coin cell

Study lamp powered by a pouch cell

50 ultra bright LED array powered by pouch cells
Nanostructured materials for energy storage: Sn-based, MoS$_2$, Fe$_2$O$_3$, LFP, NVO

- Synthesis through various methods
- Nanostructured materials reduces the diffusion path length for lithium-ions
- Enhances the capacity retention at high rates
NCPRE Phase 2 targets:

- 2.5 Ah pouch cell/18650 cylindrical cell
- 0.6 Ah Na-ion battery
- Modelling for large format cells