

# Pre-Lithiation of Silicon Anode for High Energy Li Ion Batteries

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## Objective:

Developing facile and practical prelithiation methods to increase first-cycle Coulombic efficiency of Si anodes and synthesizing lithiated Si to pair with high capacity cathode materials.

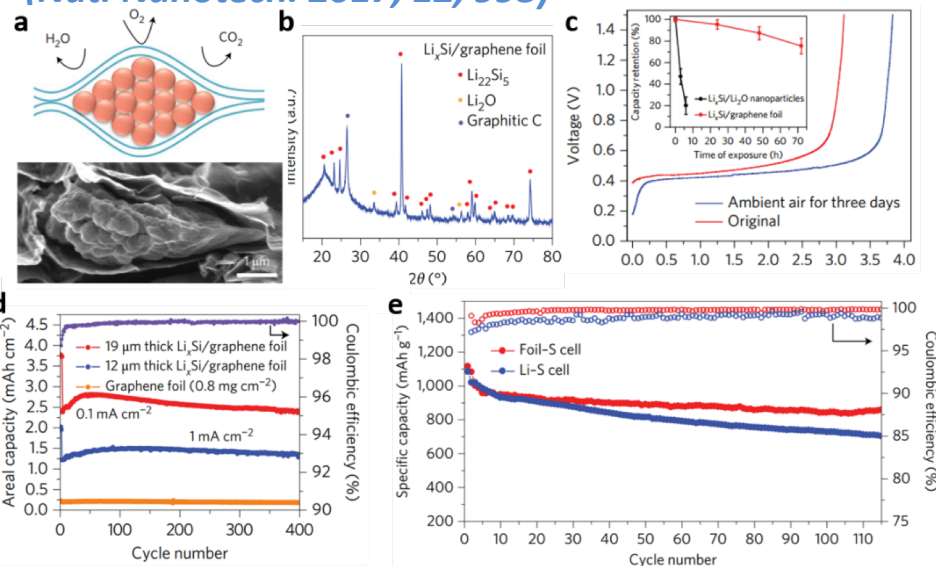
## Impact:

- Compensate for the first cycle lithium loss can improve the energy density of batteries for electric vehicles.
- Pre-storage of lithium can also help compensate for later cycle lithium loss and extend the life time of batteries.

## Accomplishments: (FY18)

- Develop Li-containing anodes with excellent electrochemical and environmental stability
- Develop Li-containing anodes with excellent rate capability
- Develop Li-containing anodes with excellent cycling stability for Li-S full cell
- Fabricate other free-standing Li alloy/graphene such as  $\text{Li}_x\text{Sn}$ /graphene or  $\text{Li}_x\text{Al}$ /graphene foil as an alternative to lithium metal anodes

## $\text{Li}_x\text{M}$ ( $M = \text{Si}, \text{Sn}, \text{or Al}$ ) nanoparticles/graphene foils (Nat. Nanotech. 2017, 12, 993)



## FY 19 Milestones:

- Anode prelithiation reagents stable in dry air for two weeks and in humid air (20-60% RH) for three days.
- Pre-lithiated anodes exhibit high Coulombic efficiency and long-term cycling life (400 cycles with over 90% capacity retention).
- Pre-lithiated anodes paired with sulfur cathode deliver a high energy density of  $\sim 500 \text{ Wh kg}^{-1}$ .

**FY19 Deliverables:** Quarterly reports, battery cells meeting the desired deliverables

## Funding:

— FY19: \$500,000, FY18: \$300,000, FY17: \$300,000, FY16: \$300,000