



***FORGE NANO***

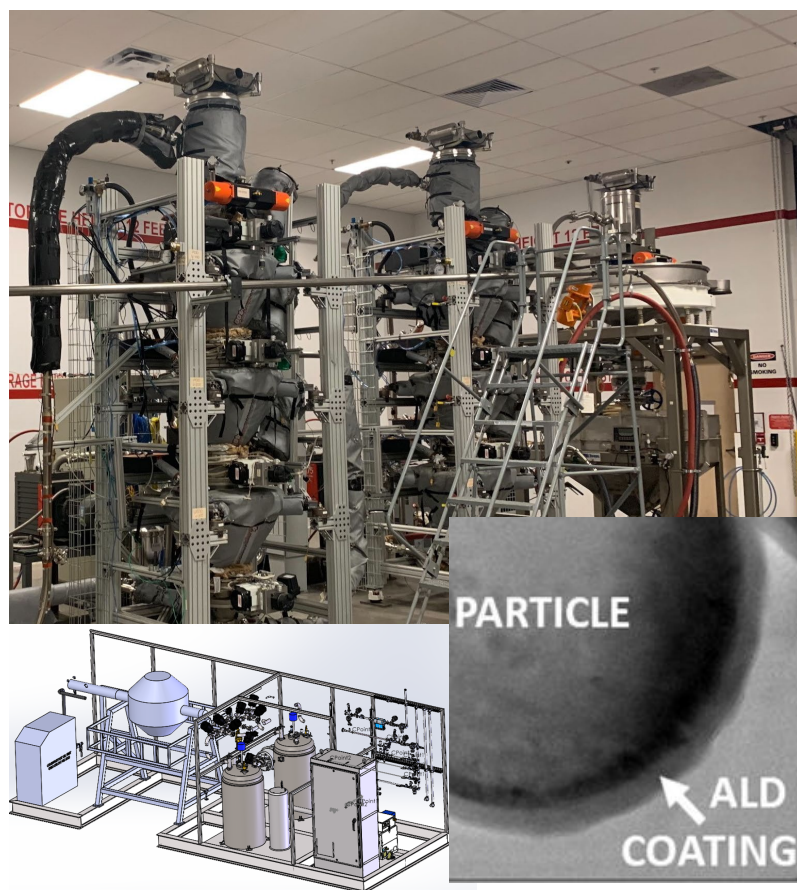
## NAATBatt Member Update

James Trevey Ph.D

CTO

February 2022

# Leading ALD Innovation and Scaling for over 10 years



## Company Snapshot

- 70 employees, >\$10M revenue with 100% YoY growth the past 3 years
- 18 development reactors used for customer trials
- >300 years of combined experience in powder ALD
- Demonstrated at commercial scale ~6,000 Tons/yr
- Working with most fortune 500 materials companies

**VOLKSWAGEN**  
GROUP OF AMERICA

**AIR LIQUIDE**  
**ALIAD**  
Venture Capital

 **LG Technology Ventures**

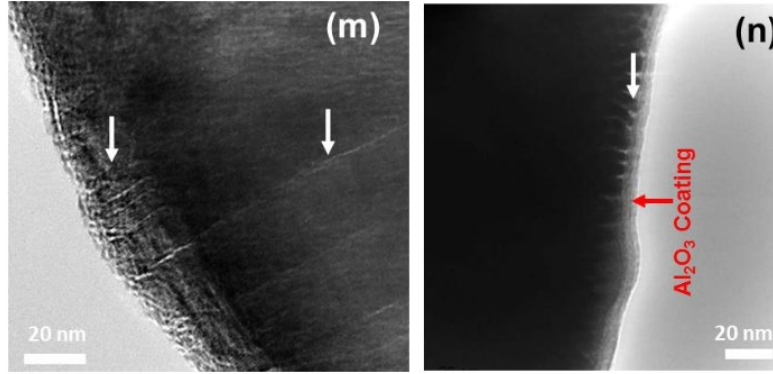
 **SCG**

 **MITSUBI KINZOKU**

# ALD Coatings Improve every part of the Lithium-Ion Battery

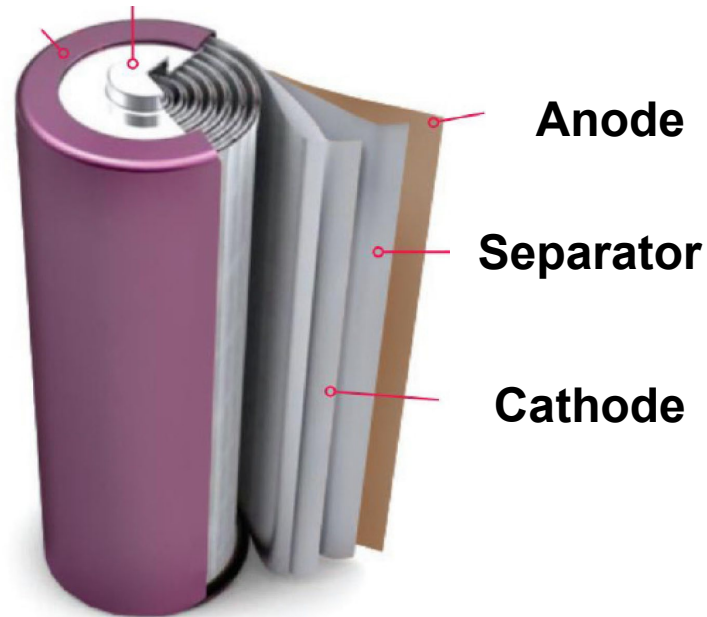
## Benefits of an engineered SEI

- Prevents unwanted reactions
  - Keeps low resistance
  - Reduces the occurrence of key exothermic reactions
- Improves conductivity



Uncoated NCA

Al<sub>2</sub>O<sub>3</sub>-coated NCA



## Anode performance with ALD coating

- ✓ Lower cost
- ✓ Enables fast charge
- ✓ Reduced need for formation
- ✓ Enable increased silicon loading

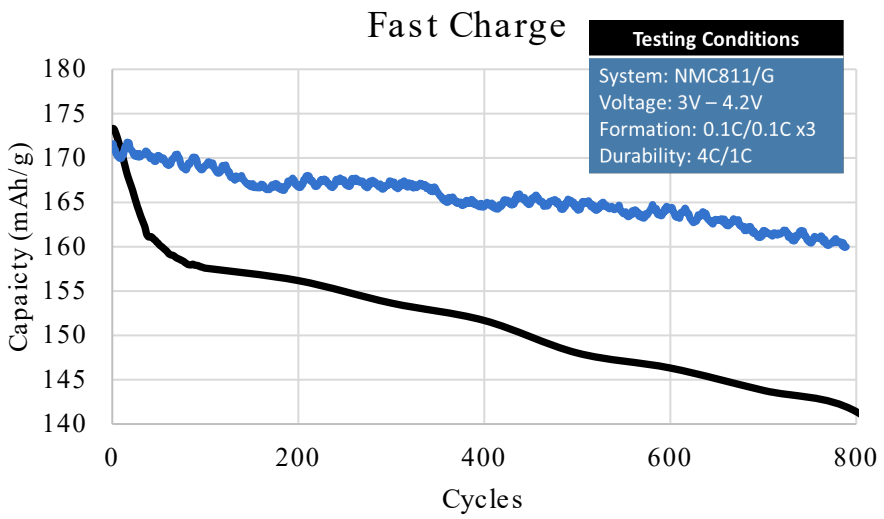
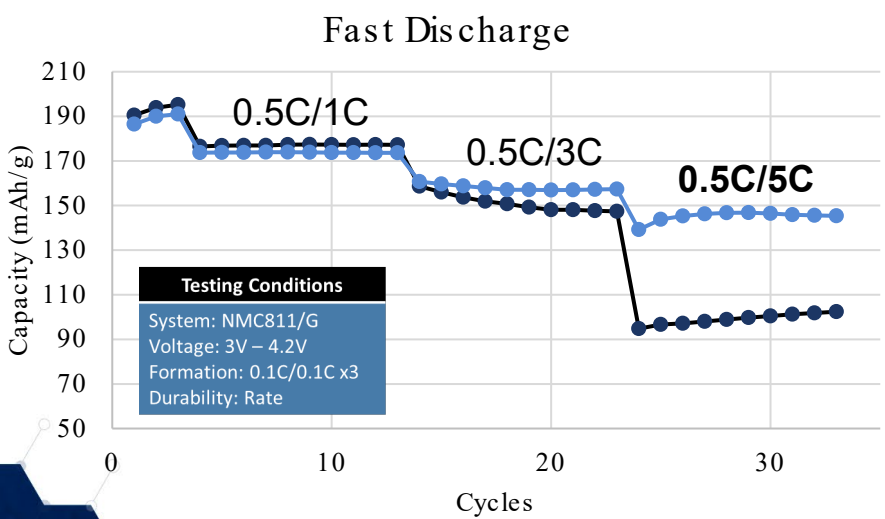
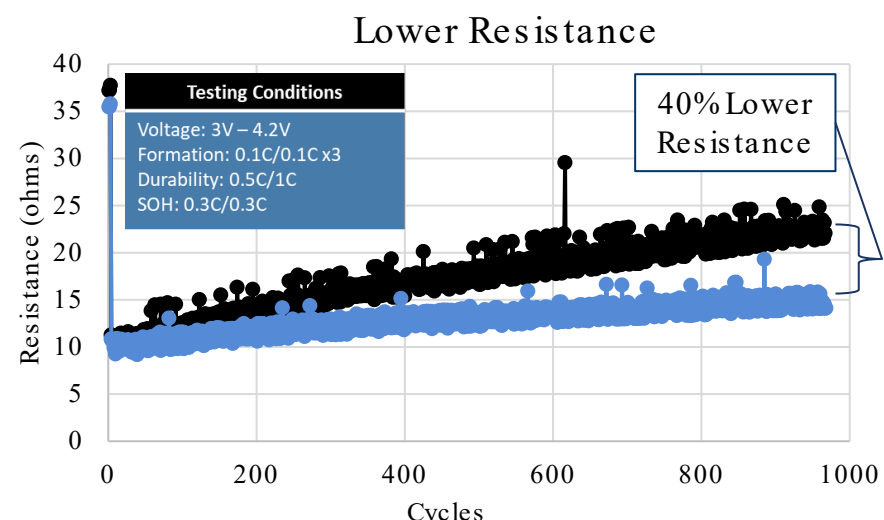
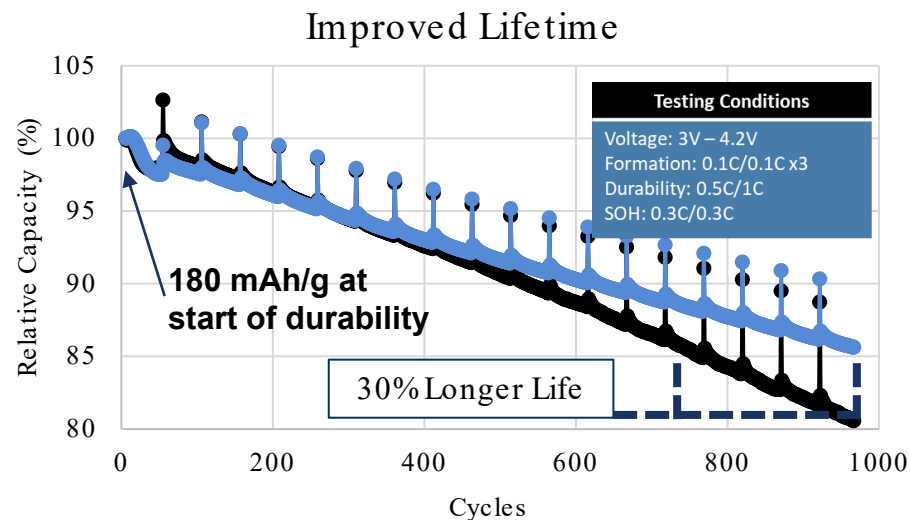
## Separator performance with ALD coating

- ✓ Improved safety
- ✓ Thinner separator
- ✓ Faster formation
- ✓ Higher temperature stability

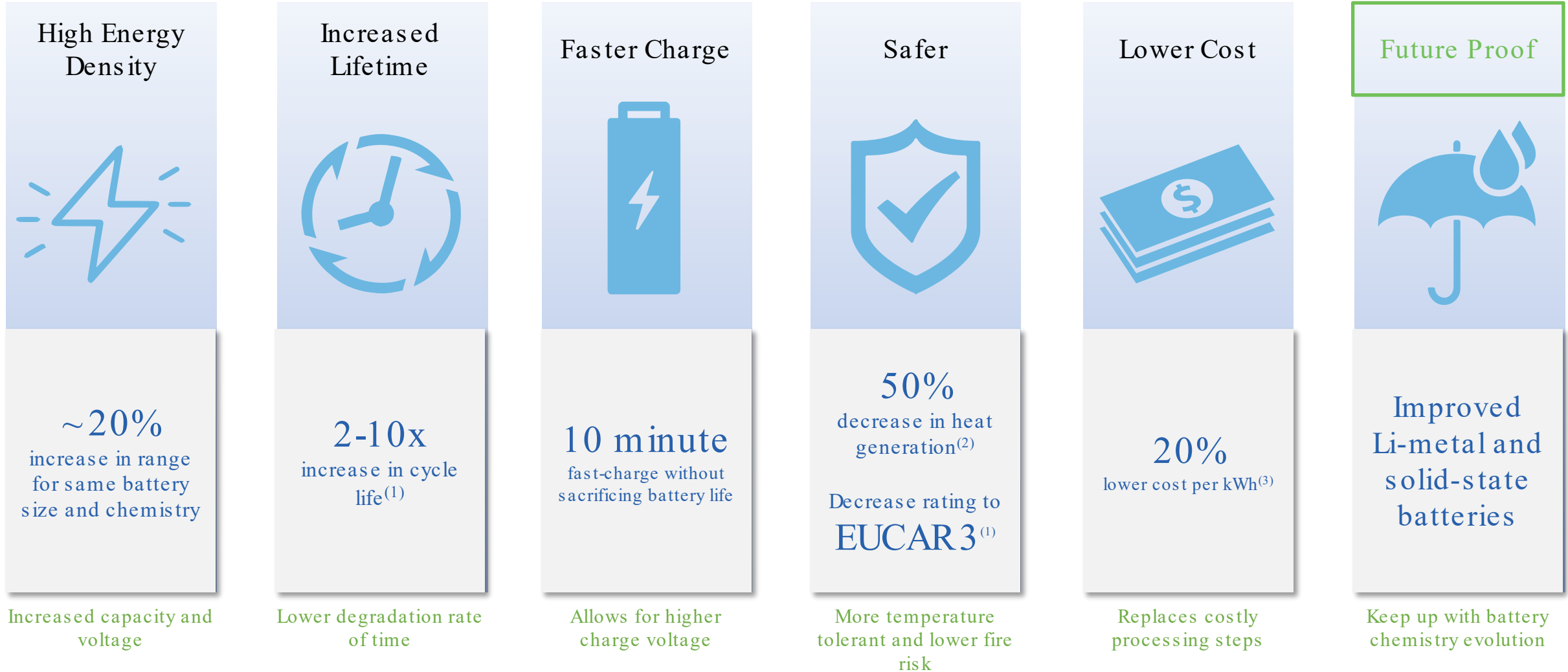
## Cathode performance with ALD coating

- ✓ Improved energy density
- ✓ Improved cycle life
- ✓ Lower raw material cost
- ✓ Enables low-cost recycling

# ALD Battery data examples (up to 100Ah)



# ALD is a Customer Validated Technology Platform that Enhances Battery Performance

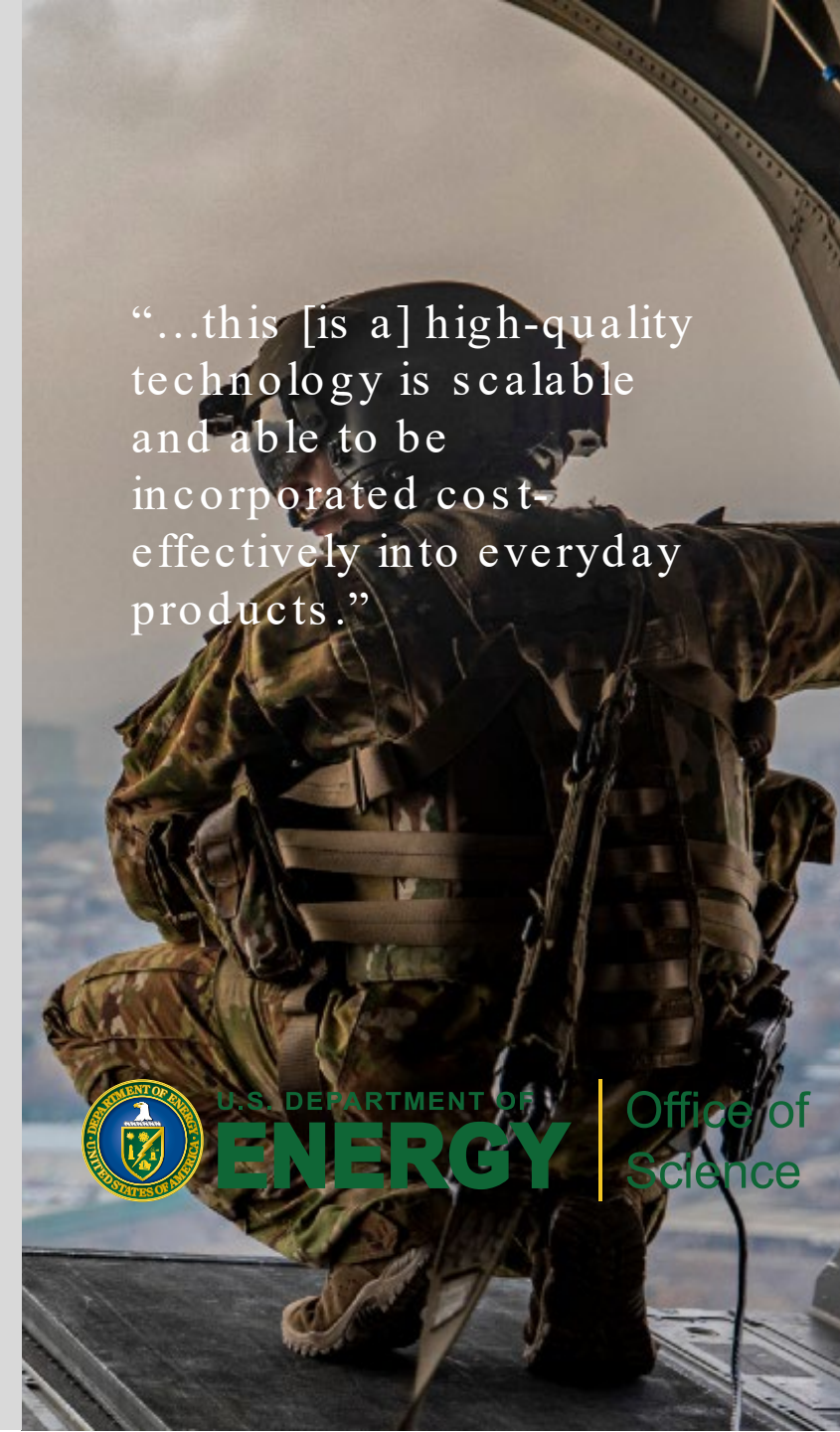


(1) Independently validated by major auto manufacturer.  
(2) Quantified by % reduction in exothermic energy from arc test.  
(3) Projected for full-scale production based on detailed cost modeling.

“...We are acting as a partner to Forge Nano and intend to provide the team with opportunities to carry out industrial trials with its innovative technology.”



“...Forge Nano has developed the technologies that enable scale-up production and commercialization of this innovation for both automotive and non-automotive applications.”







“...this [is a] high-quality technology is scalable and able to be incorporated cost-effectively into everyday products.”



U.S. DEPARTMENT OF  
**ENERGY**

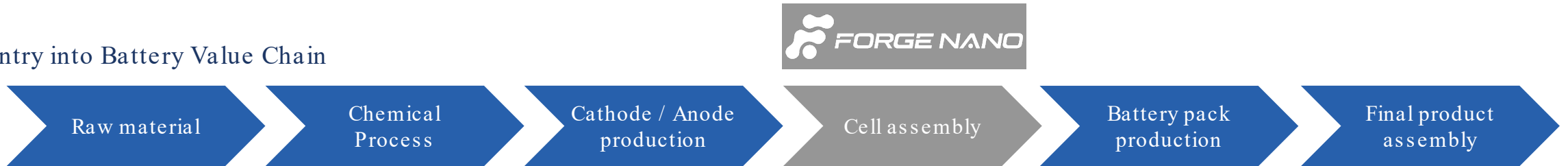
Office of  
Science

# Thrust #1: Disrupting production of Graphite Anodes for LiB's

	Forge Nano coatings	Traditional Petroleum (Pitch) coatings	
Process overview	 Single step, continuous Low temp 150C operation	 Multi-step batch process >1200C post processing	
Material loading	 0.001 weight %	 5-30 weight %	<b>&gt;100x lower CO<sub>2</sub> emissions</b>
Processing time	Hours	Days	<b>~4x faster throughput</b>
Operating cost	~\$0.5 – 1 / kg	~\$1 – 2 / kg	<b>Much lower OPEX cost</b>
Capital cost	\$10M	>\$20M	<b>50% lower CAPEX</b>
Quality	Consistent quality from high-purity chemicals	Risk of contamination from Tar	

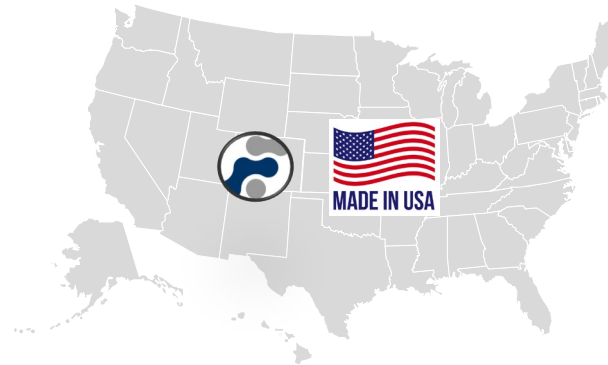
# Thrust #2: Forge Nano is Building a Battery Demonstration Facility

## Entry into Battery Value Chain



## Cell Manufacturing

- Leading Li-ion battery formulation enabled by ALD
- Safest and highest quality cells
- Lower cost with higher performance
- Unlimited future roadmap
- America-only supply chain possible
- Active Supply and Development Agreements



**Phased approach  
for up to 500MWh**

Intent to Directly Serve a Broad Range of Niche Applications and Partner/License for Large Applications

### Auto



EV OEMs

### Defense



Airforce, DOD,  
Federal fleet  
electrification

### Consumer



Power tools  
Consumer durables

### Industrial



ESS,  
Marine,  
IoT



Questions

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