



Building a US supply chain in a world of bespoke materials

Brian Pennington VP Supply Chain/Product Engineering

James Trevey, Ph.D Chief Technology Officer

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ALD Equipment, Materials, & Services

Scaled a nanocoating technology for materials called Atomic Armor (Atomic Layer Deposition (ALD))



Materials: high-nickel cathode, graphite, silicon

Product Benefits: Lifetime, energy density, safety, cost, calendar life

Process Benefits: Viscosity, moisture sensitivity, reduced formation and aging

FORGE NANO ATOMICAR MOR

<u>High-Energy 21700</u> 300 Wh/kg, 800 Wh/L US Sourced

Investor Base



Gigafactory



3 GWh/year Gigafactory in Morrisville, NC, producing best-in-class cylindrical cells using Atomic Armor

Made In America

Produced at Scale in North Carolina

Forge Battery is offering 3 GWh/yr of high-performance cells powered by American innovation. The Forge Nano Atomic Armor™ technology inside the Forge Battery SC58 21700 cell allows us to achieve industry leading energy at a lower weight than the competition.

Sourced In America US Battery Supply Chain

While Atomic Armor™ differentiates the performance of Forge Battery cells, U.S.-sourced materials are the backbone. Forge Battery products are designed in, manufactured in, and powered by the U.S.







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• Forge Nano serves as technology and development partner through:

> Battery Design/Materials validation, Supplier qualification, and New Product R&D

ALD Materials Processing





Commercial Scale Cell Production for Niche Li-Ion Battery Markets





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Key Steps in Scaling



- **A-sample:** usually functional samples that are fit for purpose with limitations and have a low degree of maturity (including manually produced samples)
- **B-sample:** basic sample, fit for purpose, with a high degree of maturity (can be produced on auxiliary tools)
- C-sample: fully functional samples from series tools
- **D-sample:** like C-samples, are provided by the supplier for the purpose of type approval

md-elektronik.com







Another way of looking at it

Level	Pre-A Sample	A-Sample	B-Sample	C-Sample	D-Sample
TRL Capability @Cell Level	2-3	4	5-6	7	8-9
Cell Design Intent	Basic electrochemistry selected but not finalized. May be different form factor, smaller capacity or size. Ingredients ~80% finalized	Cell design, electrode, tabs, etc. finalized. Ingredients 90+% finalized including all critical additives	Cell Design and Recipe 98% finalized including all materials 100% finalized	Cell design finalized (same as B unless issues in DV test). Confirmation of full performance of B or C if different	Final cell design and hig- volume materials used
Testing/Quality Level Demonstrated	Basic performance testing (scale to intended target cell size/capacity/power)	Basic performance eval. Basic life testing, abuse testing	Full DV suite. UN testing, full life testing multiple points for DV, abuse testing. Full mapping for SOC and Temp.	Verification of performance based on critical testing. Life testing for final PV started.	Sampling plan for conformity of production
Cell Production Processes	Materials from batch process	Scaled larger batch processes for coating, calendaring, drying, filling, formation and control	Same processes for coating, calendaring, drying, filling, formation and control.	High speed assembly processes on full production equipment and at intended site	Ramp up of speed and demonstrated Run@Rate on full production equipment and processes
Equipment Produced on	Lab or manual build	Pre-pilot or contracted assembly (toll provider)	Pilot level production or Pilot Level capable toll provider	High volume production equipment	High volume production equipment
Material Supply Level	pCAM/CAM/AAM at Small batch scale. Grams to Tens of KG	Larger batch scale with CoC 10s to 100 kg	Production Scale ideally. 100 kg to 1000 kg	Large scale CoC . Min 1000 kg level	Large scale production with CoC. Min 1000 kg level
Scale of Build	10-100 cells	100-1000 cells	10000 cells	100 k cells	200K to 1M cells (GWh scale)
Application Level Suitable for:	Basic capability or electrochemical verification of performance	Concept Build level pack products (a few)	Design Validation level pack products (10-50)	Production Ramp Up products on production tools (pre-run at rate to full run at rate)	Full Volume Production products at target line rates (full PPAP)
	Non-final format	Final format, low maturity	Final format, high maturity	Final format, final line	Final format, final process



First Pass Sample Definitions

- TRL vs. MRL
- Material level vs. Cell Level
- Market Size

FORGE NANO



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			MRI		Specialty and High		Volumes		Volumes		Commercial Readiness
	Level Description		Level	Description	5000.2	Process	Specialty	Materials	Main M	faterials	
	TRL 0	Idea. Unproven concept, no testing has been performed			Sample Level	Sample Level	Material Quantities	Cell Quantities	Material Quantities	Cells Quantities	Commercial Progress
ر چ) ل	TRL 1	Basic Research, principles postulated and observed but no experimental proof available	MRL 1	Basic concept but no proof available							DPD Compling Lougle
Concept	TRL 2	Technology formulation Concept and application have been formulated		Basic production model avaialble with grounded data	Pre - MSA	Demonstration	gr - 1 Kg cm - 1 m	10 - 100 all formats	gr - 1 Kg cm - 1 m	10 - 100 all formats	JDA Engagements IP Landscape, FTO and
	TRL 3	Applied research. First laboratory tests completed; proof of concept	MRL 2	Identify production concept, cost model meets equipment/facility model							Plan
	TRL 4	Small Scale prototype, Built in a laboratory environment ("ugly" prototype)	MRL 3	Verify correctness of production concept	Material Solutions Analysis						Prototype Pricing
Prototype	TRL 5	Large scale prototype Tested in intended environment	MRL 4	Immitate prodcution steps from identified concept with expected quality	Technology Maturation and Risk Reduction	Concept Validation	1 - 100 Kg 1 - 100 m	100 - 1000 all formats	1 - 100 Kg 1 - 100 m	100 - 1000 all formats	Early Adoption Commitments
	TRL 6	Prototype manufactured and tested in intended environment with close to expected performance	MRL 5	Test manufacturing prototypes in production- related circumstances		B A					
	TRL 7	Demonstration system. Operating in operational environment at pre commercial scale	MRL 6	Collect and analyze statistical data, plan steps of raw material supply	Engineering & Manufacturing Development	Design B	100 +Kg	Low Volume Manufacturin	100 Kg - 1KT	Pilot Manufacturing	
Develop & Test	TRL 8	First of a Kind commercial system. Manufacturing issues solved	MRL 7	Test manufacturing prototypes and access quality risks	C	Validation	100+m	Production Format	100 km - 1Mm	Production Format	
			MRL 8	Test in manufacturing real circumstance and test examine production quality						Low-Medium Volume	Large Scale Pricing and
*	TRL 9	Full commercial application. Technology available for customers	MRL 9	Achieve the required quantity and standard required utilizing production system, assets and resources	Production & Development	Product Validation	Quantitiy As Needed	Quantities As Needed Production Format	1 - 20 KT or Mm	Manufacturing 10-1000 MWhr Production Format with 1 Qtr Production	Volume Agreements Product Line P&L Established
Commercialize			MRL 10	Develop dynamic and effective product capability utilizing production system assets and resources		High Volume Manufacturing			20 - 100s KT or Mm	High Volume 1 GWh/yr - 100 GWh/yr or as needed	
										Production Format	

Materials Challenges

Scaling

- Known steps (samples)
- Capability (equipment/lines)
- Battery Challenges
 - Product and Process
 - Materials
 - Commodity vs. Bespoke





Recipe for Success

Start with Specifications

- Know the critical performance metrics
 - Requires a target market
- Let the smart people do what they do
 - Budget
 - Timeline

Battery	-		
Energy Density	290 Wh/kg		
Continuous Discharge Rate	2C		
Pulse Discharge Rate	5C		
Continuous Charge Rate	1C		
Cycle Life (-3C/1C)	300		
Operable Discharge Temperature	High: 55°C		
Charge Temperature	0°C to 45°C		
Discharge at Temperature (Low)	60% SOC at -40°C		
Internal Resistance (mOhms)	8		
Temperature Rise for 2C Discharge (°C)	10		

DIU FASTBAT-U







3GWh/yr Li-ion cell capacity by 2028
\$100M BIL Winner

SC58: High-energy 21700 Cell

- 300 Wh/kg and 800 Wh/L
- US Supply Chain







Comparison of Class Leading Energy Cells										
Manufacturer	Name	Origin	Supply Chain	Capacity (Min. Ah)	Energy Density (Wh/kg) / (Wh/L)	Weight (g)	Width (mm)			
Forge Battery	SC58	USA	USA	5.65	301 / 804	65.5	21.1			
Samsung	53G1	Korea	China	5.14	273 / 782	70.5	21.1			
LG	M52V	China	China	5.00	282 / 774	70.4	21.1			
Panasonic	М	USA	China	5.00	271 / 755	66.9	21.0			
LG	M58T	China	China	5.57	285 / 795	73.2	21.5			
Samsung	58E	Korea	China	5.33	270 / 756	74.0	21.8			

Secure future sourcing and access to IRA tax credits

FB has highest capacity and lowest weight

FB achieves high capacity without forcing redesign





Thank you

Brian Pennington VP Supply Chain <u>bpennington@forgebattery.com</u>

James Trevey Ph.D Chief Technology Officer jtrevey@forgenano.com Interested in Cells? www.forgebattery.com

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