



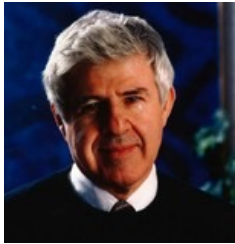
ENABLING NEXT GENERATION BATTERIES

Summer 2020

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- alpha-En was founded in 2013 by **Jerome I. Feldman** (who patented the soft contact lens and surgical staples to name two disruptive products) to bring to market a significant discovery in the world of advanced batteries.



- alpha-En's patented, unique, pioneering and proprietary room temp. process to produce high purity lithium was invented by **Lawrence Swonger** in 2013. By background, Larry is a mechanical engr. with 25 years experience in design of production processes and automation. He proudly served in US navy for 8 yrs. and 2 yrs. on a submarine as a supervisor of nuclear propulsion plant and related systems.

- alpha-En's is listed on OTCQB market under the ticker **ALPE**.
- alpha-En has received a patent for its breakthrough technology of producing pure Lithium Metal (LiM) and since filed for other patents
- alpha-En technology is addressing a market which is growing at an incredible pace. Electric vehicle market, consumer electronics & backup storage is the key to the world's future and alpha-En wants to be a significant part of that future.



alpha-En's TECHNOLOGY

Could be a critical component in next generation batteries:

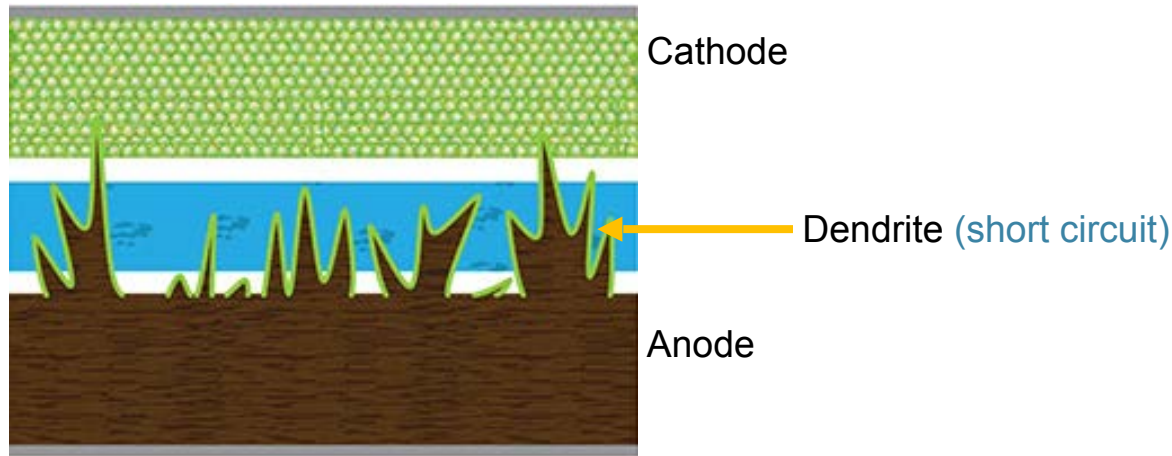
- ➡ Thin Li layers could allow for more precise and efficient battery configurations
- ➡ Low temperature and environmentally friendly production process could lower costs
- ➡ Purity of Li could improve battery performance and life



PURITY - WHY IT MATTERS

dendrite /'dendrīt/, a crystal or crystalline mass with a branching, treelike structure. From Greek dendritēs 'treelike,' from dendron 'tree.*

* Google.



Actual lithium dendrites growing from an anode surface. Image from: R.R. Chianelli, J. Cryst. Growth, 1976, 34, 239-244. **

- Other non-lithium elements (e.g., K, Na, Ca, N) are found in existing battery-grade lithium metal.
SLAC National Accelerator Laboratory *
- Formation of dendrites, which are microscopic fibers that can expand into the electrolyte, in some instances short-circuit the battery causing premature failure or “thermal runaway”.
- Lawrence Livermore National Lab researchers report dendrites nucleate inside a Li-M electrode at the site of impurities. ***
- Reduction of other metallic elements in Li-M may enhance Li-M anodes for advanced batteries.

* [HTTP://ein.iconnect007.com/index.php/article/90840/next-gen-lithium-batteries-that-prevent-fires/90843/?skin=ein](http://ein.iconnect007.com/index.php/article/90840/next-gen-lithium-batteries-that-prevent-fires/90843/?skin=ein)

* [HTTPS://areweanycloser.wordpress.com/2013/06/21/dendritic-lithium-and-battery-fires/](https://areweanycloser.wordpress.com/2013/06/21/dendritic-lithium-and-battery-fires/)

* Dendrites of Substance structures underneath dendrites formed on cycled lithium metal electrodes, Nitash P Balsata et. al. Nature Material published online
* 24 November 2013.



alpha-En's PROCESS

alpha-En has developed a patented process to refine naturally occurring lithium compounds into:

- Pure lithium with a highly consistent morphology
- In very thin films (< 10 microns)
- Using a scalable green production technology

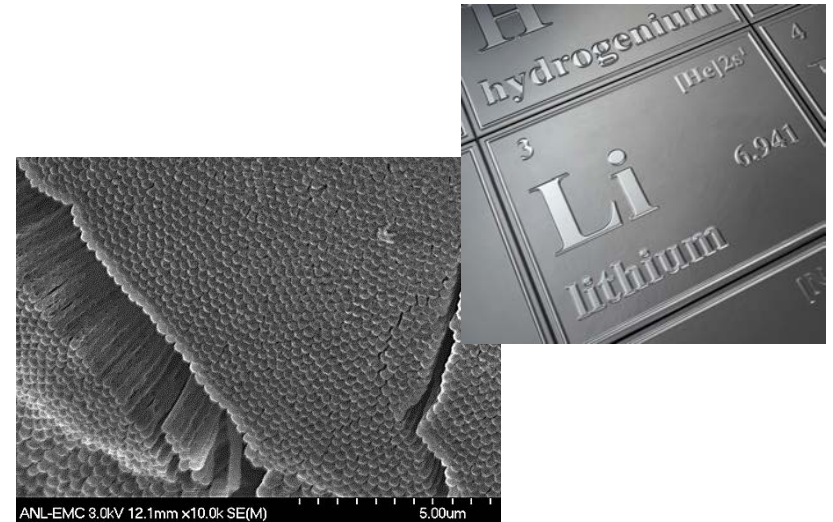
alpha-En'S PROCESS	EXISTING PROCESS
Higher Purity 99.996%	Lower Purity 99.90%
LiM Produced at Room Temperature Process conducted at 20°-30°C	Li-M Produced at Very High Temperatures Electrolysis of molten salts at ~450°C
Chlorine Gas Free No toxic byproduct	Chloride Process Step Chlorine gas byproduct adds cost
Feedstock Flexibility Uses Low Grades of Lithium Carbonate	Requires battery grade feedstock Higher raw material cost

From a report in June 2017 by Argonne National Lab:

ABSTRACT

Novel room-temperature electrodeposition method

- A layer of Li-metal onto a conductive substrate from an aqueous lithium source through a Li-ion conducting separator
- Control of process parameters yields uniform, densely-packed dendrite-free lithium metal nanorods
- Precise control over lithium morphology is expected to improve battery performance as a result of uniform Li-metal dissolution during the battery discharge



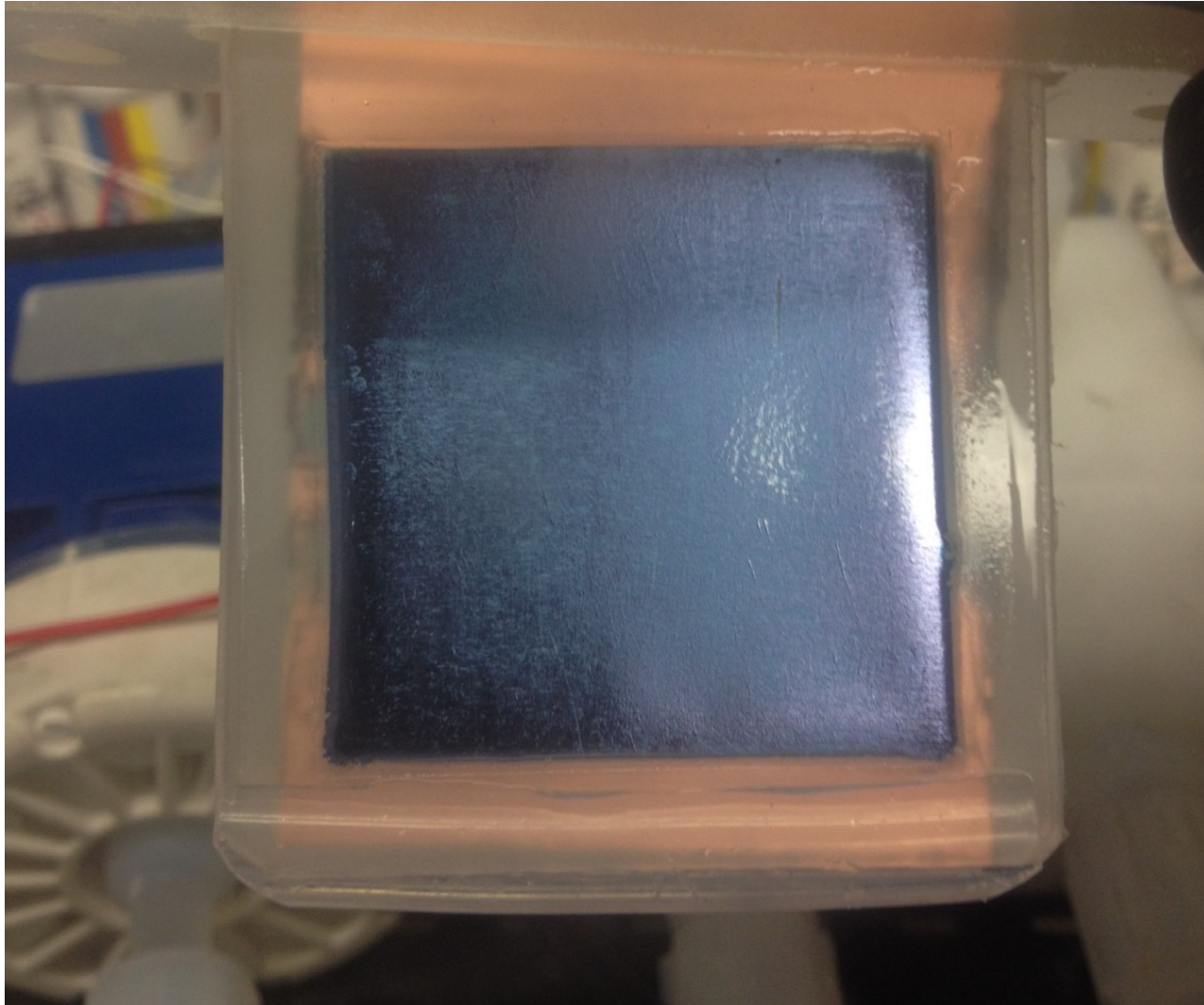
CONCLUSION

- We produce high-purity lithium metal via room-temperature electrodeposition in a process that eliminates energy-intensive steps and does not require or release noxious chemicals (i.e. chlorine).
- This clean technology is instrumental for the profitability of battery companies by reducing raw material and energy cost in the lithium metal anode production process

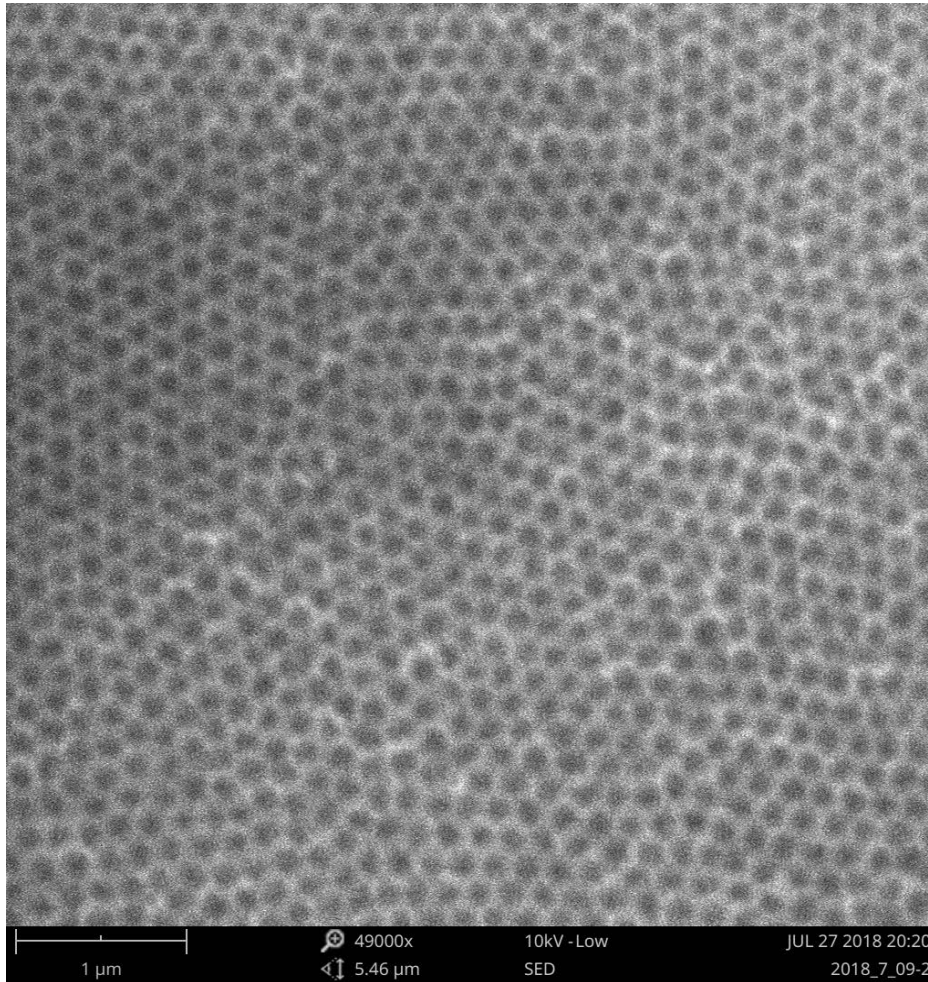


alpha-En's PRODUCT

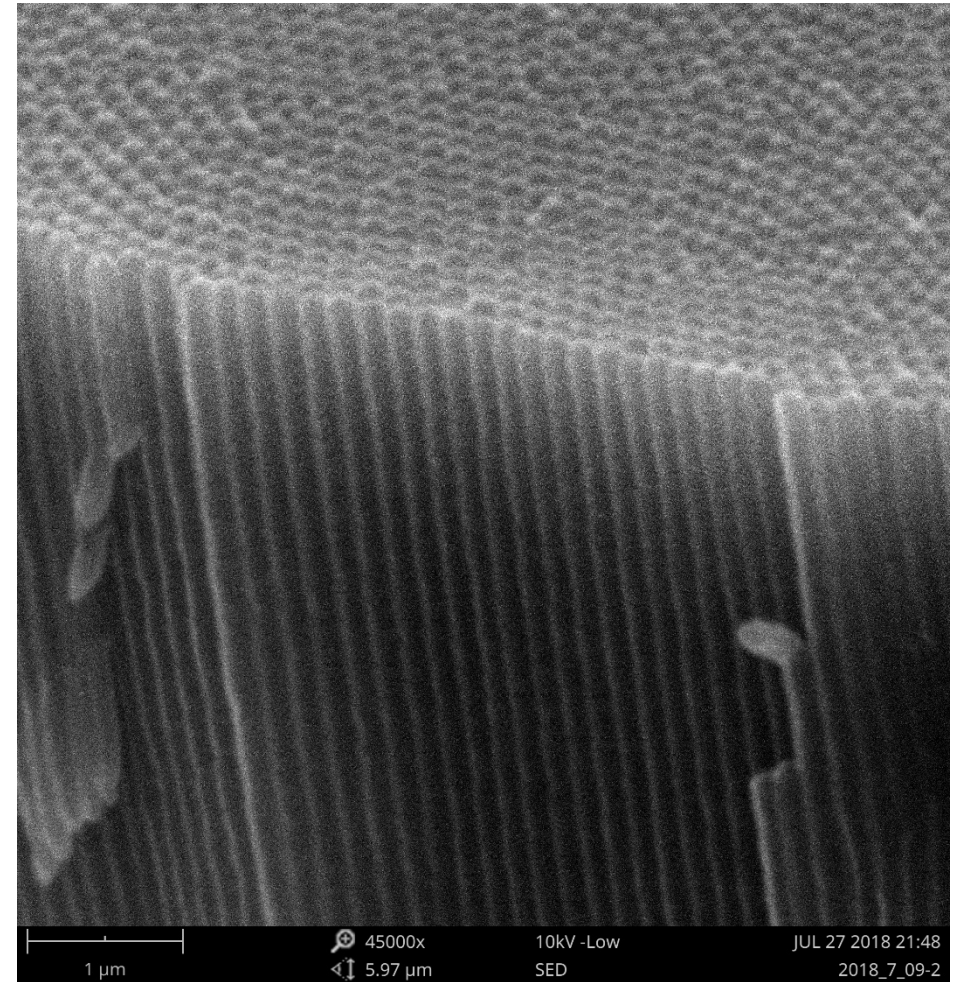
A Key Application of alpha-En's process is to produce nano-engineered Li Metal anodes



4cm x 4cm Li-M anode on a copper substrate



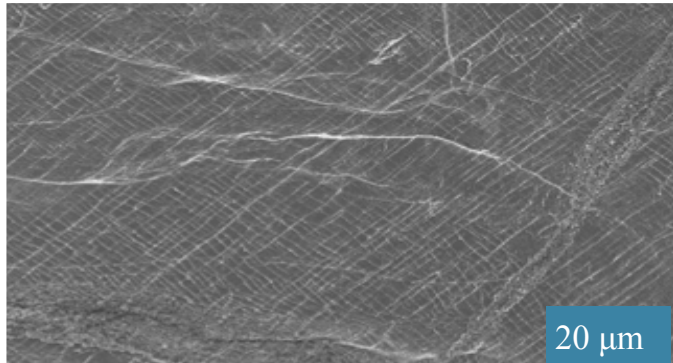
Top view at 49000x



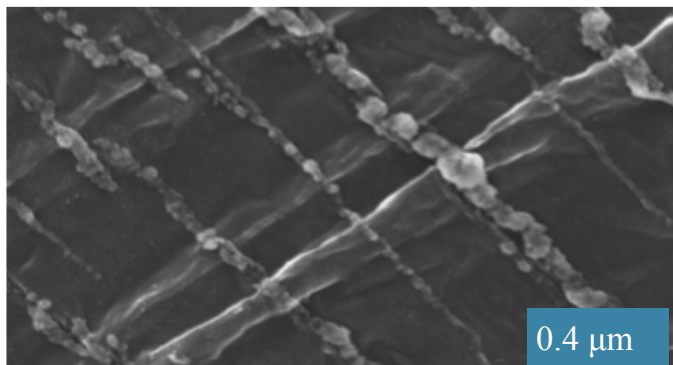
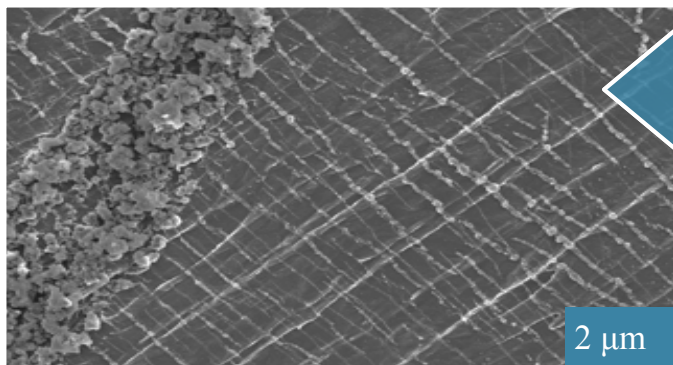
Side view at 45000x

MORPHOLOGY OF EXISTING Li FOILS VS α -En's Li-M

Commercially available lithium foils



99.90%
750 μm thick

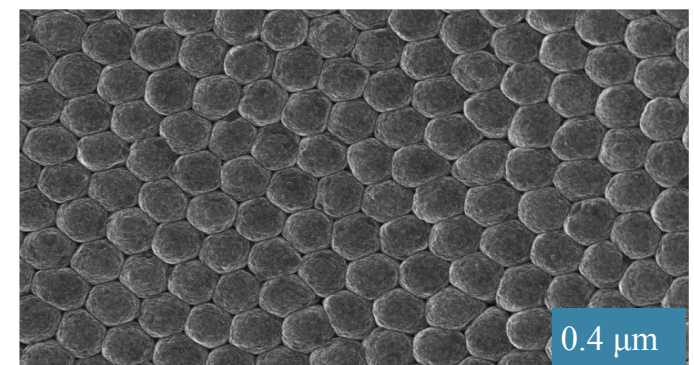
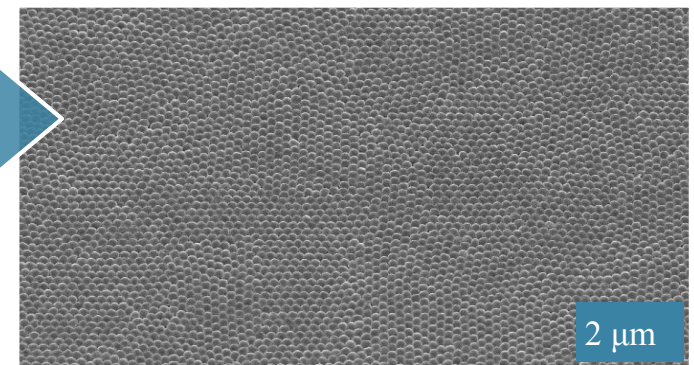
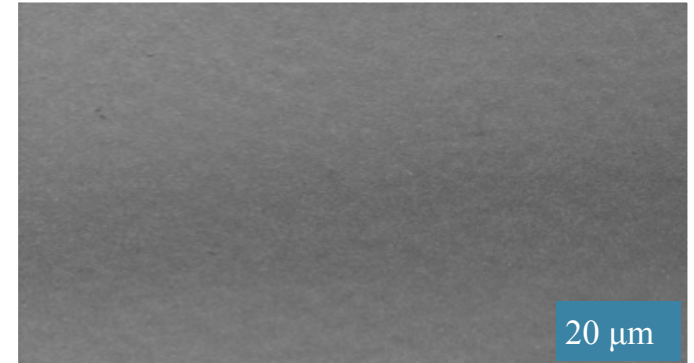


COMMERCIAL

α -En

99.996%
10 μm thick

α -En's Li-M on copper





alpha-En's DEVELOPMENT



alpha-En's Partners

From 2014 through 2018 alpha-En partnered with several universities and labs to develop its process.



- alpha-En's own laboratory in its 8,000 sq. foot facility in Yonkers, NY began operations on May 31, 2018
- alpha-En's state of the art research laboratory includes equipment for Li-M anode fabrication and testing
- alpha-En's own staff of scientists and lab technicians now conduct almost all of its R&D activities.



➤ Anode Development

- Currently developing LiM anodes up to 70mm x 70mm, Intermediate goal to pioneer 100mm X 100mm deposition
- Li thickness: focusing on thin lithium films from 1um to 35 um
- Uniformity – typically for a 20 um thick film ~ 15%
- Dual sided Li-M Anodes
- Dev on Li-ion anode replacement, Li-metal w/ solid electrolyte and Li-Sulphur battery technologies with partners

➤ Electrolyte Improvement

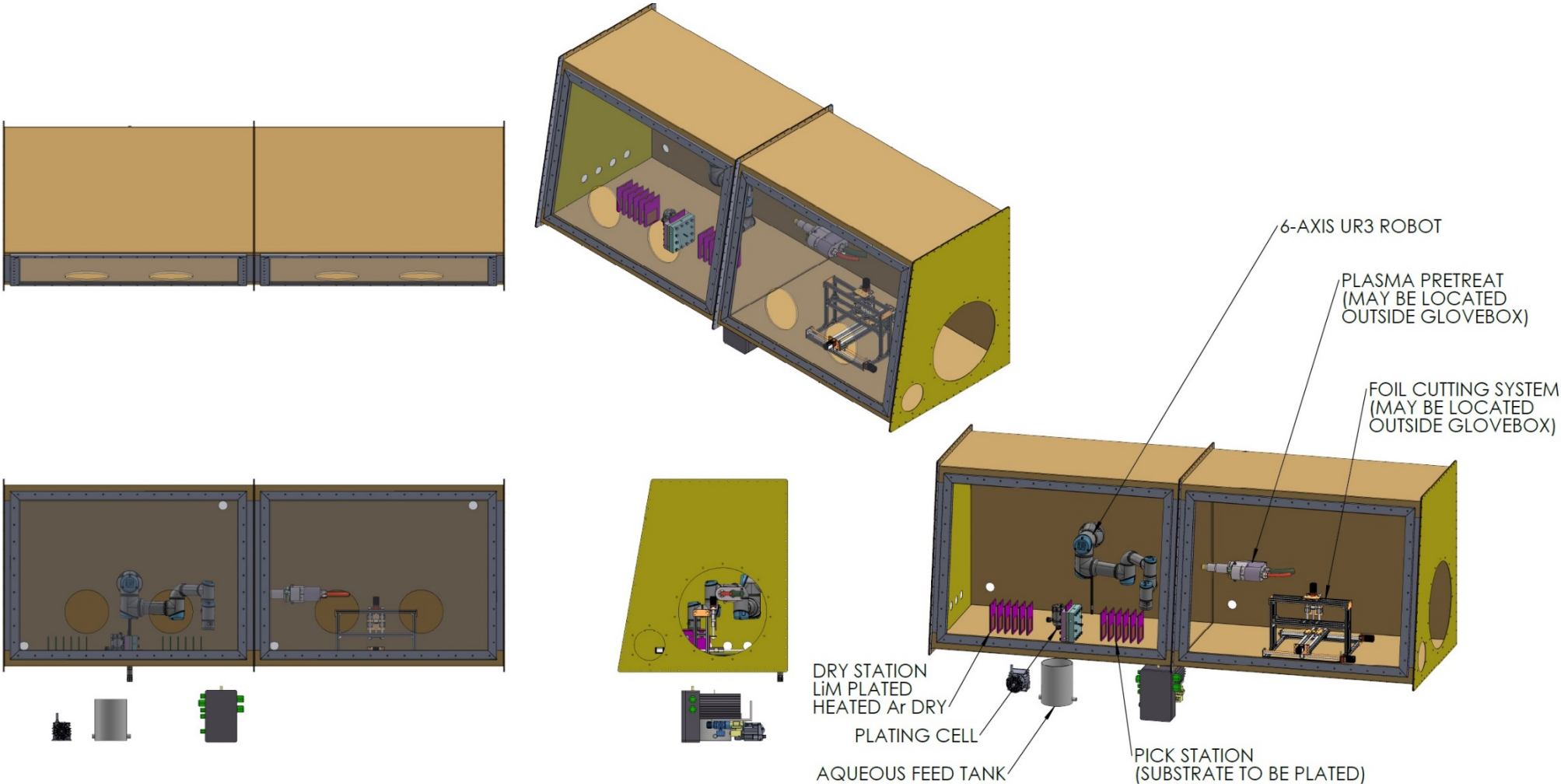
- Trying with different electrolytes for faster deposition – Currently 5-12 um/hr
- Morphologies – exclusive control over morphology (rods, etc) of the deposited Lithium
- Surface chemistry/composition control - SEI layers
- Trying new additives with existing electrolytes during deposition and cell cycling
- Add electrolyte monitoring for electrolyte maintenance

➤ Substrates

- Different substrates: current dev with copper & graphite – copper mesh, nickel and others are slated for dev. work.
- Improvements to (and streamlining of) copper cutting and pre-cleaning processes – plasma pretreat

- Lab scale automated deposition (Phase1 - funded) (next 3-5 months)
 - Produce LiM anodes up to 7.5 sq in (49 sq cm - 70mm x 70mm) using automated production method
 - Small robotic system for deposition to increase to 1000 anodes / month for sample production in research phase
 - Key focus on improving deposition with large format, dual sided and multi-cell setup
- Second phase of scale-up is fully automated batch system (9-12-month execution to commission)
 - Key focus on end to end automation which includes substrate preparation, deposition, dry and prep before packaging for storage and shipment OR use in an inline production
 - Variable width capability
 - providing higher capacity to support current development projects with partner battery development programs for goals to 1.5-2M anodes / year (~ 5cm sq./ 10m/ 5 12-cells)
 - Seeking \$5M project in project funding
 - Modular system could be replicated for increased capacity
- Third phase scale-up to a roll-to-roll system , this will enable full-rate production
 - Under review, Development budget of \$2M

alpha-En's SCALE-UP P1 LAYOUT



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THE INFORMATION CONTAINED IN THIS
DRAWING IS THE SOLE PROPERTY OF
alpha-En Corporation. ANY
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<INSERT COMPANY NAME HERE> IS
PROHIBITED.

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE	alpha-En Corp.	
		DIMENSIONS ARE IN INCHES	DRAWN			TITLE: Automated Glovebox System	
		TOLERANCES:	CHECKED				
		FRACTIONAL ±	ENG APPR.				
		ANGULAR: MACH ± BEND ±	MFG APPR.				
		TWO PLACE DECIMAL ±				SIZE DWG. NO. REV B alpha-En Scaleup in Glovebox	
		THREE PLACE DECIMAL ±					
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.			SCALE: 1:20 WEIGHT: SHEET 1 OF 1	
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alpha-En's MARKET

The Opportunity

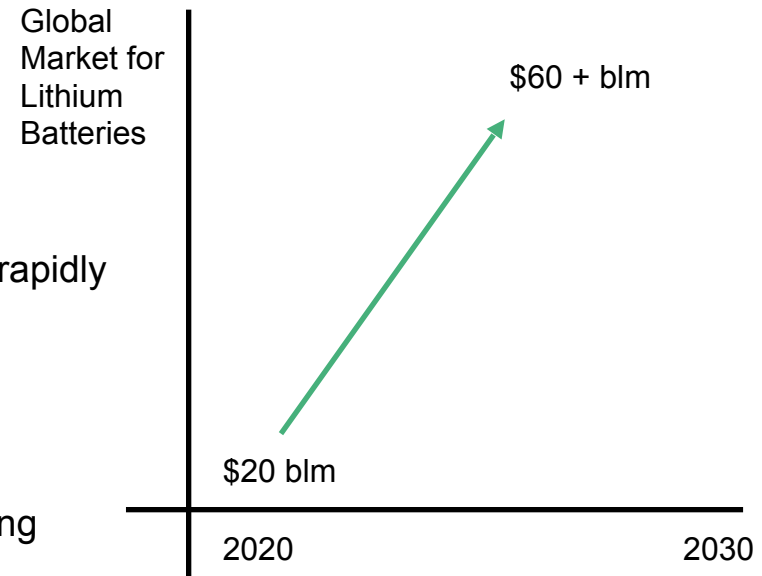
Demand for

- Li-ion and similar batteries is large and growing rapidly

➡ 10x expected use in Electric Vehicles(EV's)

➡ 50 % reduction in cost per kWh

The anode is a critical component of batteries representing approx. 25% of its cost

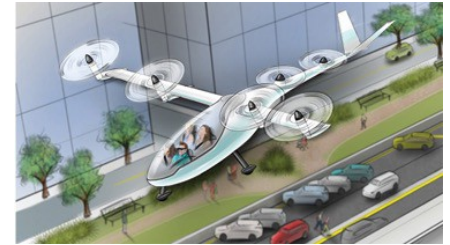


Source: Bloomberg, Avicenne Energy



Industry Evolution (Li batteries)

- Li Ion technology is 30 years old
- Next generation technology under development and expected to commercialize over next several years
- Could lead to a “quantum leap” in battery efficiency



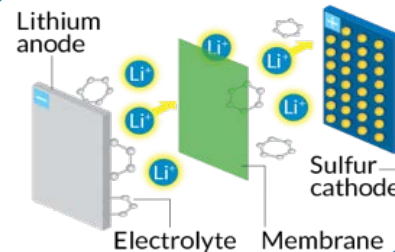
Increased Range



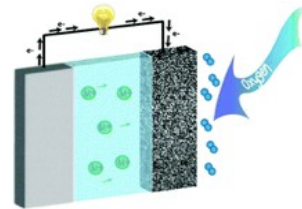
Solid State



Lithium Sulphur



Lithium Air



~10 X Improvement

LAST ~ 30 YEARS

ALPE Li-M Anode



TRANSFORMING SOCIETY

Tomorrow

1990

2000

2010

Today

Manufacturing Pure Li-M Anodes

Primary mandate

- Scalable production of Li-M anodes. Li-M plating of 5 to 50 microns on copper substrates (or other conductive substrate)

Enhancement of Mining Operations

Natural segway of alpha-En's capability

- alpha-En is engaged with the mining industry to apply its technology to directly extract Li prior to production of lithium carbonate, for production of Li-M anodes and other products

Recycling of Li batteries

Successfully tested, under review for investment

- alpha-En is adapting its technology to meet anticipated government regulations for recycling of Li batteries. Our technology would be inserted into existing process streams to recover LiM that is currently discarded by the recyclers

Battery Development

Extending current capability

- alpha-En is pursuing development of next generation batteries with its Li-M anode and various electrolyte and cathode chemistries, and cell configurations



alpha-En's DIRECTION

Revenues

- To date, alpha-En has focused on researching and developing its process and has had no revenues
- During 2020, alpha-En would expect to begin generating revenues from:
 - ✓ Sale of batch-produced Li-M anodes
 - ✓ Contract R&D for bespoke applications of its process
- Over the long-term, alpha-En anticipates a mix of revenues from:
 - ✓ Licensing its process and receiving royalty payments
 - ✓ Partnerships and JVs to manufacture Li-M anodes and other products using alpha-En's process

Expenses

- alpha-En's operating cash flow (cash burn) for the 12 months ended June 30, 2019 was \$2.1 Million or approximately \$175,000 per month.

Funding

- For the past several years, alpha-En has raised funds through the sale of common convertible preferred shares and warrants:

✓ \$3.5 Million in 2018

✓ \$1Million in first half of 2019

NYSERDA Grant



- alpha-En received a grant for \$1M in July 2019 for research and development from the New York state energy research and development authority.

Opportunity Zone Stats

- Located in an Opportunity Zone as per 2017 Tax Act
- Working to be designated as a Qualified Opportunity Zone business
- Would allow favorable tax treatment for future investors

INTELLECTUAL PROPERTY

- In January 2019, the US Patent Office granted alpha-En a patent on “High Purity Lithium and Associated Products and Processes” which covers alpha-En’s process and products made from it.
- alpha-En has filed a number of other US and foreign patent applications to cover its process and refinements and enhancements to it.
- alpha-En continues to work with Barnes and Thornburg, its IP law firm, to insure protection of its intellectual property.





alpha-En's TEAM

SENIOR MANAGEMENT



Lawrence Swonger, CTO

Lead Inventor

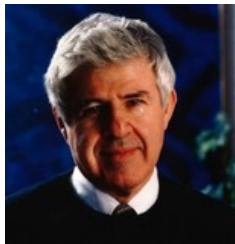
Mechanical engr. with over 20 yrs of process design and automation experience



Tom Suppanz, CFO

Former Investment Banker on Wall Street with over 30 yrs exp. in capital formation for small & micro-cap companies

BOARD OF DIRECTORS



**Jerome I. Feldman,
Chairman Emeritus**

Founder of alpha-En

Founder of National Patent Development and developer of technologies including soft contact lenses and surgical staples



Sam Pitroda, Chairman & CEO

Founder of various technology companies, former Cabinet Minister and Chairman of the Smart Grid task force of the government of India

SCIENTIFIC ADVISORS



Prof. Roald Hoffmann, Chair

Cornell University, Nobel Laureate



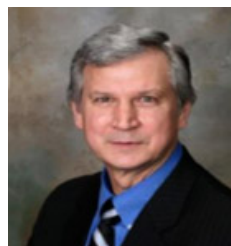
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