Carbon Pitch Applications in Advanced Battery Systems

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https://www.usaenergytech.com/news

A Real-Life Company

Headlines of AETC's Recent Updates

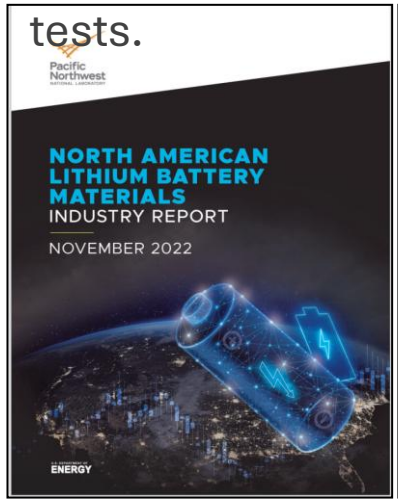
2022: The US Department of Energy released a report which formally featured AETC as a supply chain member of automotive lithium-ion batteries in the US.

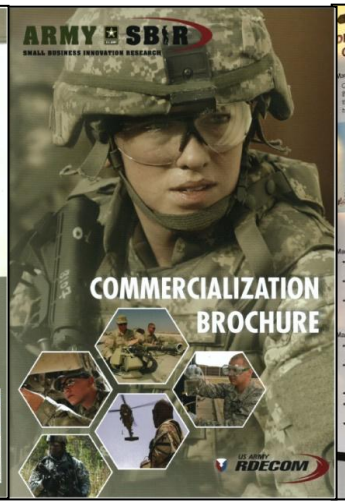
2022: The US Department of Defense Manufacturing Technology Program publication featured AETC's recent advances along the Defense Industrial Base Lines of Business.

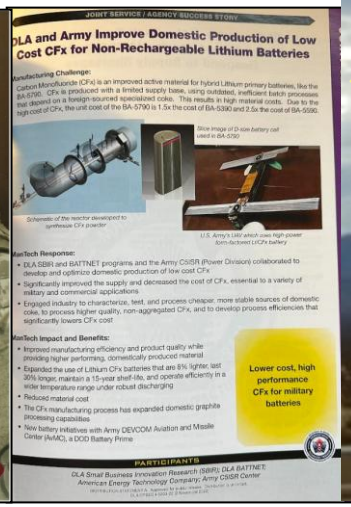
2023: EaglePicher Technologies, a US DOD Battery Prime, constructs the longest lasting primary (non-rechargeable) battery using two battery-grade carbons produced by AETC, while Jet Propulsion Laboratory reports favorable test results comparing these cells with NASA's EPT Build 3 Europa Lander Cells

2024-25: The US Navy approves purchases of products from AETC for the sustainment of Nuclear Enterprise program with valid FAT tests.

- American Energy Technologies Co. (AETC), founded in 2009, is a woman-owned, privately-held small business concern operating out of Justice40 location in Illinois
- At the moment, there are only three organizations which commercially produce Lithium-ion battery-grade graphite in the US. AETC is one of these organizations.
- AETC's new plant has a nameplate capacity of 300







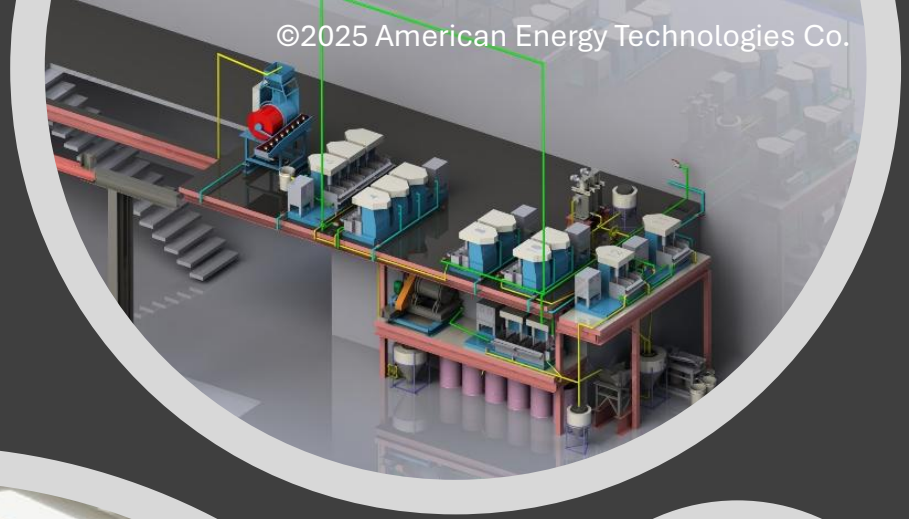
Recent Grand Opening

In late 2021, AETC acquired an industrial building which underwent renovations and new building addition and now became an expansion facility for AETC's operations.

Grand Opening of New American Energy Technologies Co. Facility

I honored to speak at the ribbon cutting for American Energy Technologies Co.'s new facility in Wheeling. American Energy Technologies works in domestic manufacturing in critical minerals, which are essential for the production of batteries, electronics and other advanced technologies. These minerals are essential to our national security and economy, which is why I am proud to have co-sponsored the American Critical Minerals Independence Act, which promotes the domestic development of critical minerals.

The Grand Opening and Ribbon Cutting Ceremony for American Energy Technologies Co., celebrating the new Industrial Carbon and Graphite Processing Plant, as well as our company's 15-year anniversary was featured in IL-10 Congressman Brad Schneider's Newsletter (July 3, 2024): https://schneider.house.gov/contact/newsletter-subscribe



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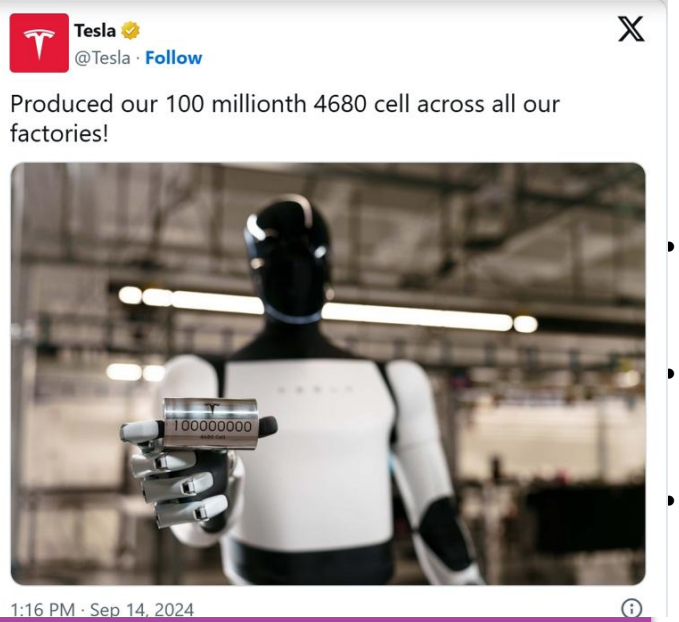
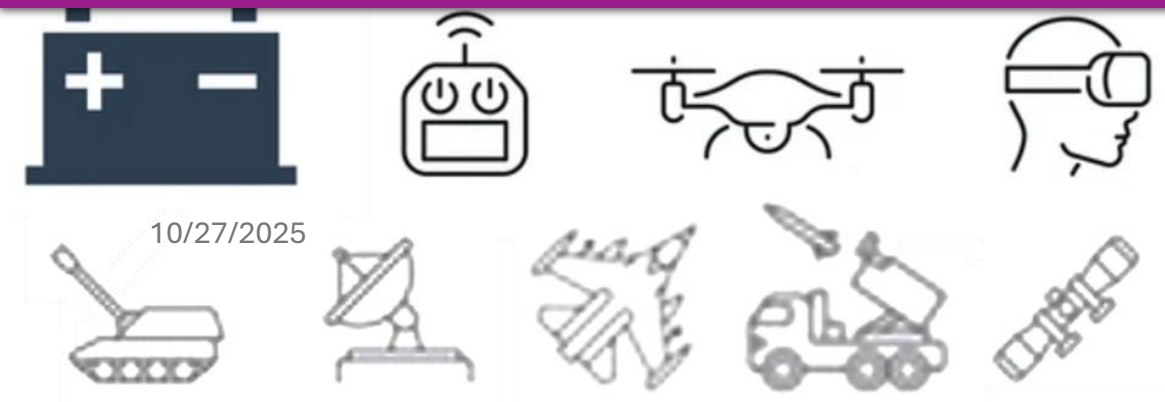
In 2024 AETC Stood up and Now Constantly Runs **US Only** Fully Functional Continuous Primary Beneficiation Line for Upstream Processing of Natural Graphite



2025 Fastest growing US market outside of BEVs: BESS.

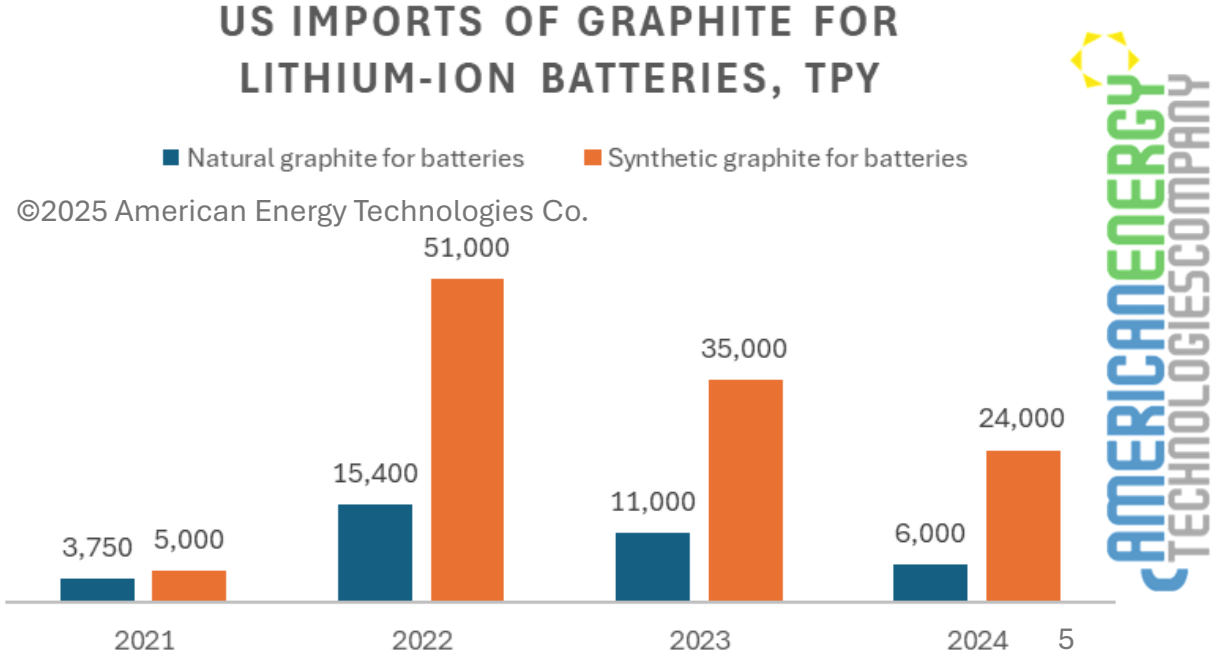
2025 2nd fastest growing US market outside of BEVs: DOD.

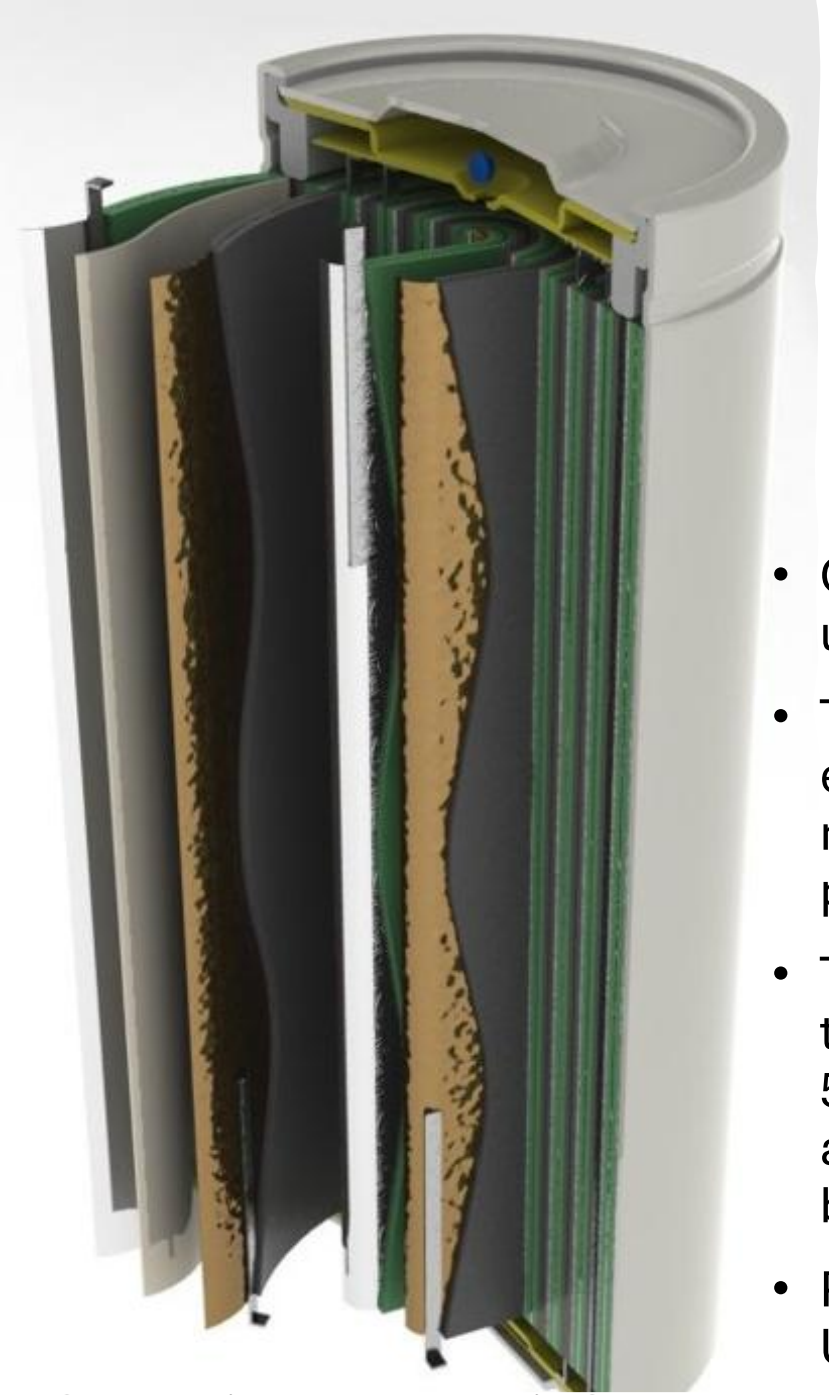


10/27/2025

Graphite use in the US advanced battery systems

- Domestic BEVs: The actual consumption of graphite by Tesla manufactured battery cells in the US (imported batteries are not included) is estimated at 1,567 metric tons over a 15.5 months period.
- Non-BEV lithium-ion battery production in NA was estimated at approximately 3,300 tons of the anode-grade graphite, at least 70% of which was synthetic graphite.
- Besides this, in 2024 the North American market used at least 10,000 TPY of non-spherical graphite in alkaline, lithium primary, metal-air and lead-acid batteries. At least 75% of this was natural graphite.
- A path forward for a US graphite producer is to diversify their production from EV-only grades to a portfolio of grades that addresses potentially more lucrative and easier-entry markets in North America.

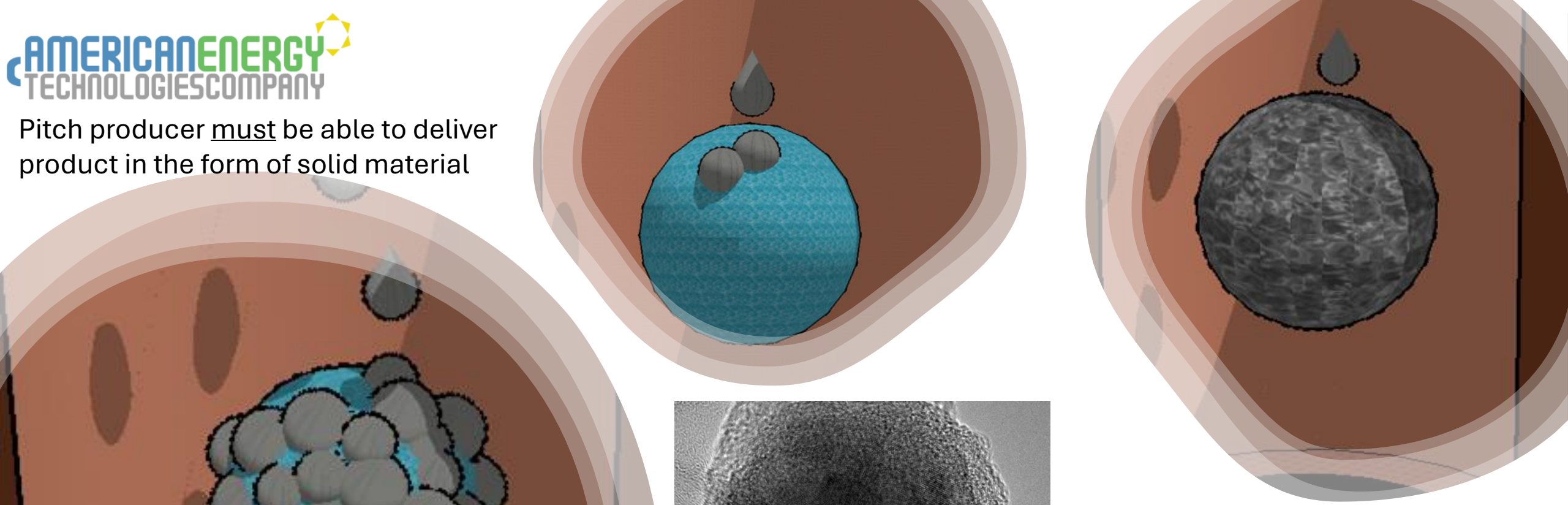


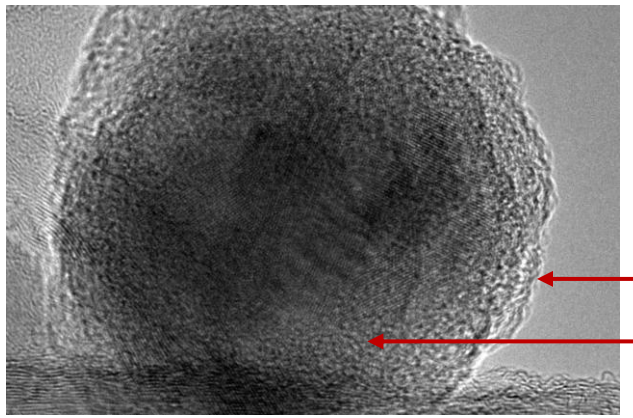


Carbon pitch used for surface coating of battery-grade graphite

- Global lithium-ion battery cell production in 2024 surpassed 10 billion units, with some estimates suggesting the total reached 11 billion units.
- This production increase was driven by significant growth in the EV and energy storage sectors and resulted in oversupply and cost reductions. China accounted for a significant portion of the global production.
- These cells consumed net 110,000 metric tons of battery-ready graphite in the anodes (230,000+ metric tons in raw material) and an estimated net 5,500 – 6,000 metric tons of petroleum and coal tar pitch in the assortment of grades. The total revenue of pitch sales into lithium-ion batteries was up to $35M/year.
- Prices for battery-grade pitch for coating range between USD1,500/ton to USD7,000/ton, depending on specific application in the battery anode.

Pitch producer must be able to deliver product in the form of solid material





Nanothick amorphous coating

Graphitic core

Pitch Delivery Methods on Graphite:

Organic Solvent – Water – Dry Powder

Special case: granular pitch if synthetic graphite for lithium-ion batteries is made from billets

Key market segments for pitch in lithium-ion batteries

Surface coating on spheroidal natural graphite (BESS, Defense)

Surface coating on Silicon-enhanced spheroidal graphite (BEV, Defense)

Surface coating on rounded edge needle-coke-derived synthetic graphite (BEV, BESS, Consumer electronics, Defense)

Surface coating on rounded edge mesophase pitch-derived synthetic graphite (BEV, Defense, NASA/ESA)

Surface coating on spheroidal hybridized natural-synthetic graphite composite (BEV, Defense)

Surface coating on recycled and healed needle-coke-derived synthetic graphite (emerging: BESS, BEV)

Surface coatings on recombined synthetic graphite fines (BEV, Defense)

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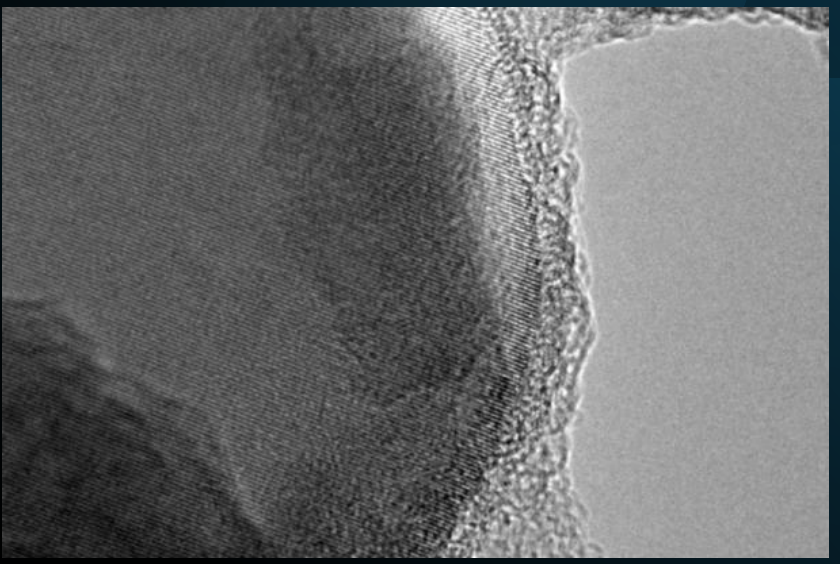
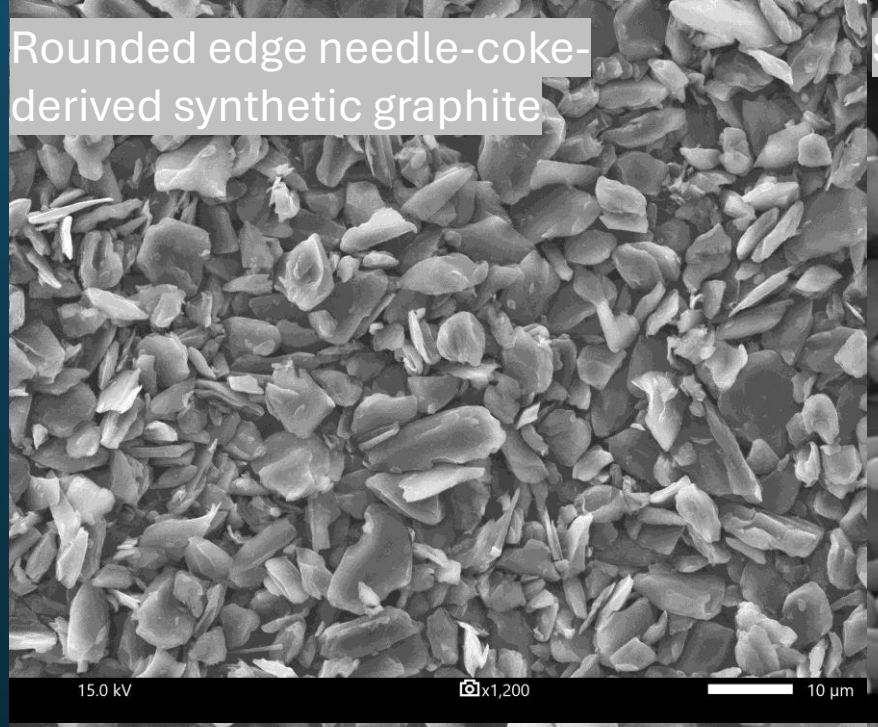
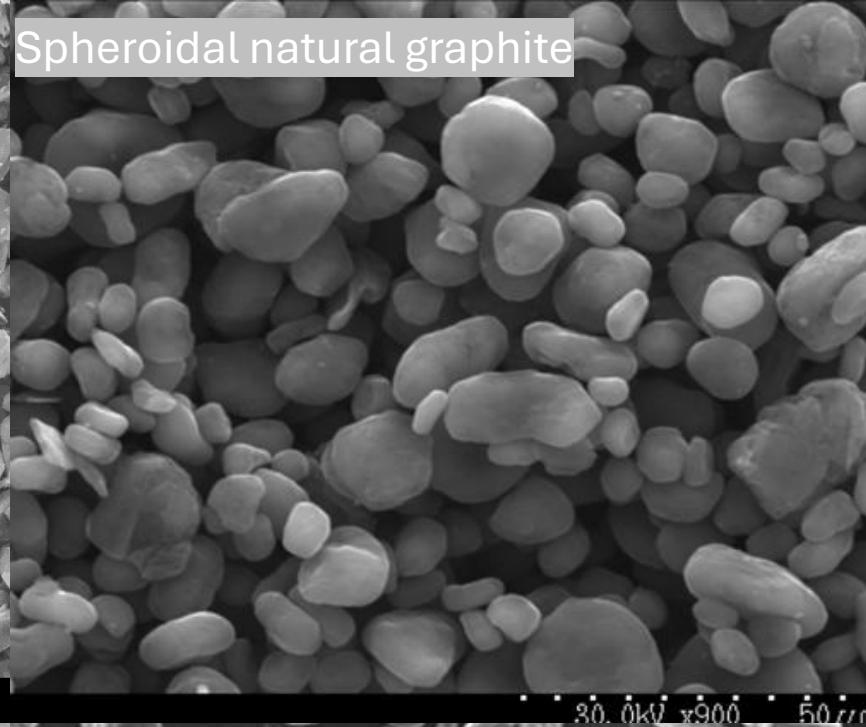
Examples of Surface coated graphite by type



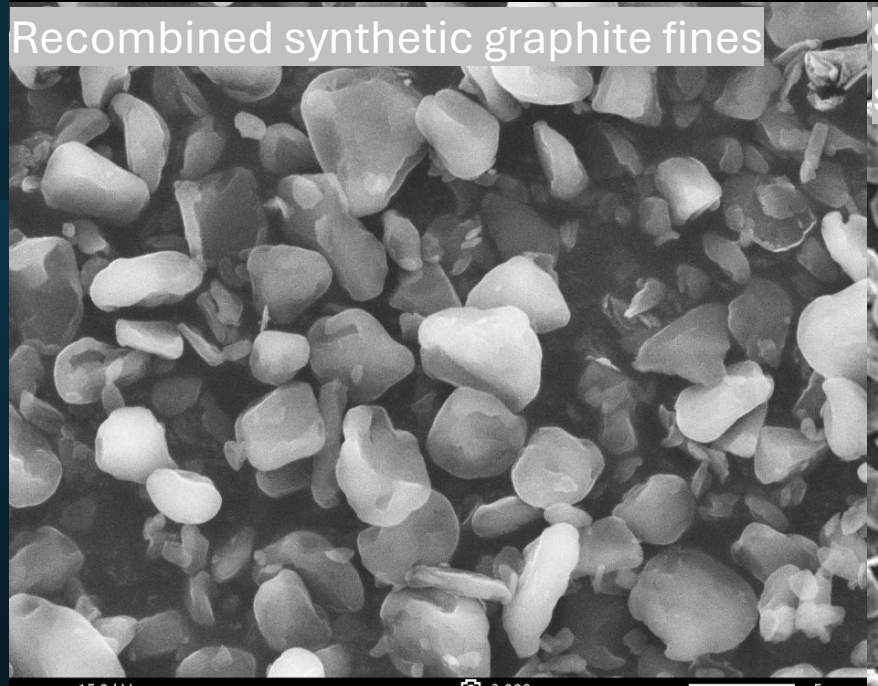
Rounded edge needle-coke-derived synthetic graphite



Spheroidal natural graphite



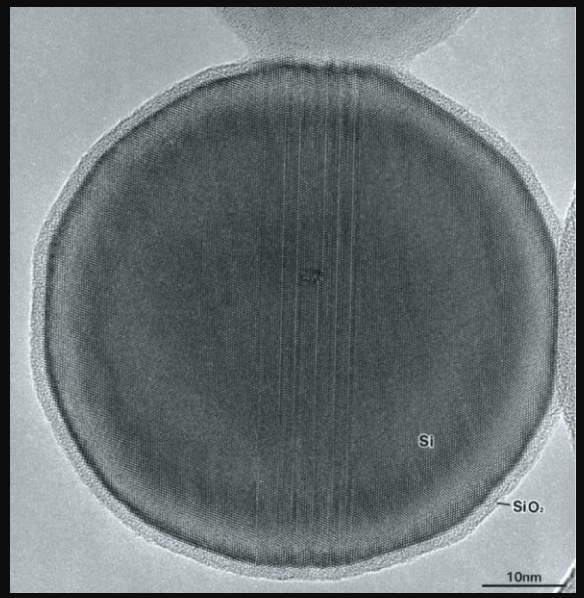
Recombined synthetic graphite fines

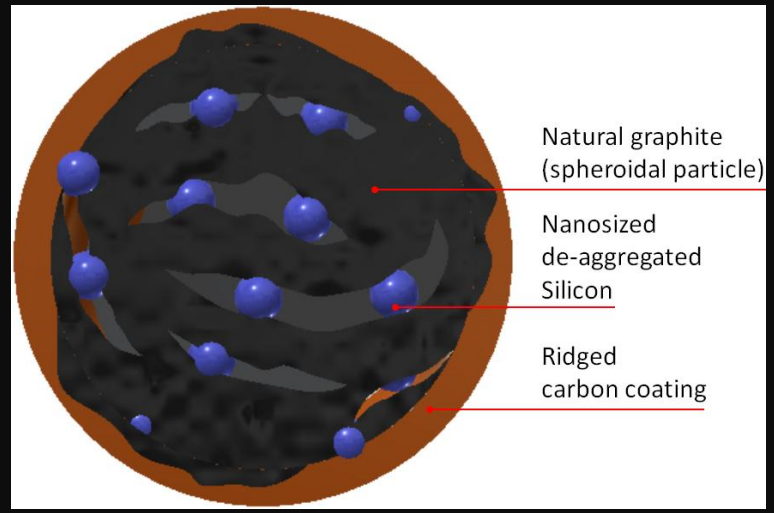


Spheroidal hybridized natural-synthetic graphite composite

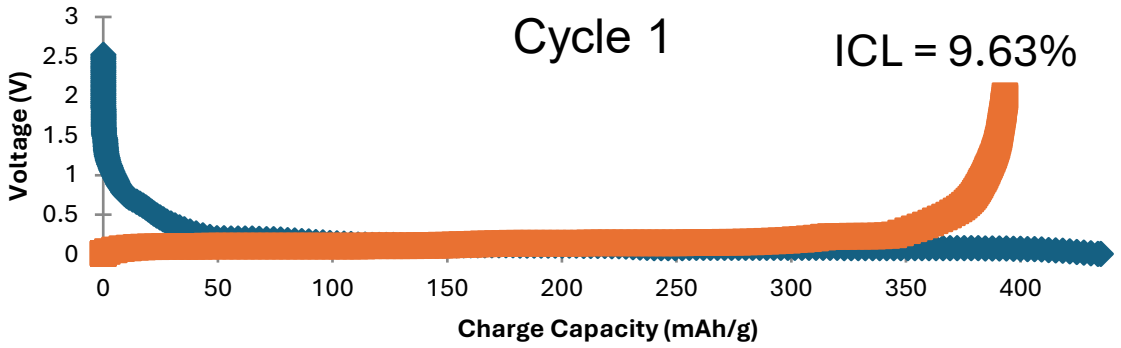
Si-Enhanced Anode Active Material

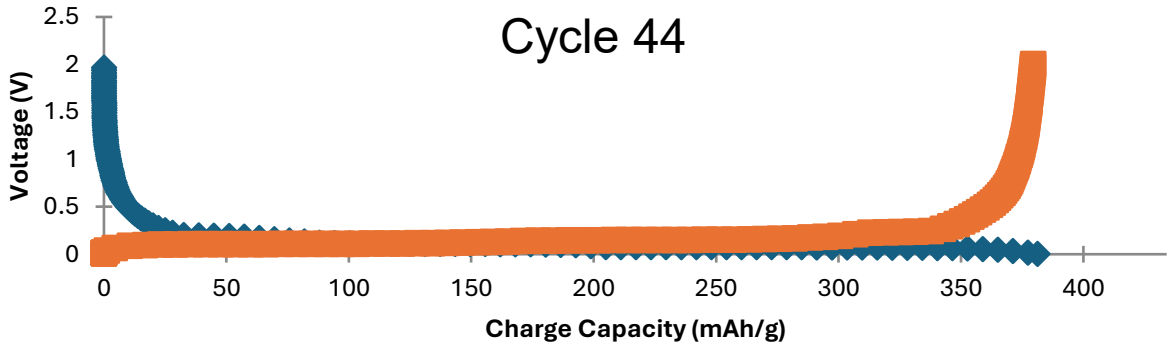
- Silicon has to be composed of discrete nanoparticles
- Primary particle size 20-80 nm
- The amount of nascent oxide has to be less than 0.5 wt% to the weight of Silicon
- Silicon has to be carbon coated
- Graphite, which contains Si/SiOx has to be coated with at least 9 wt.% of carbon pitch.
- The amount of added Silicon to graphite has to be limited to less than 5 wt%
- Anode optimization has to take place on the electrode preparation level (more binder, lower active loading).
- Results could be excellent

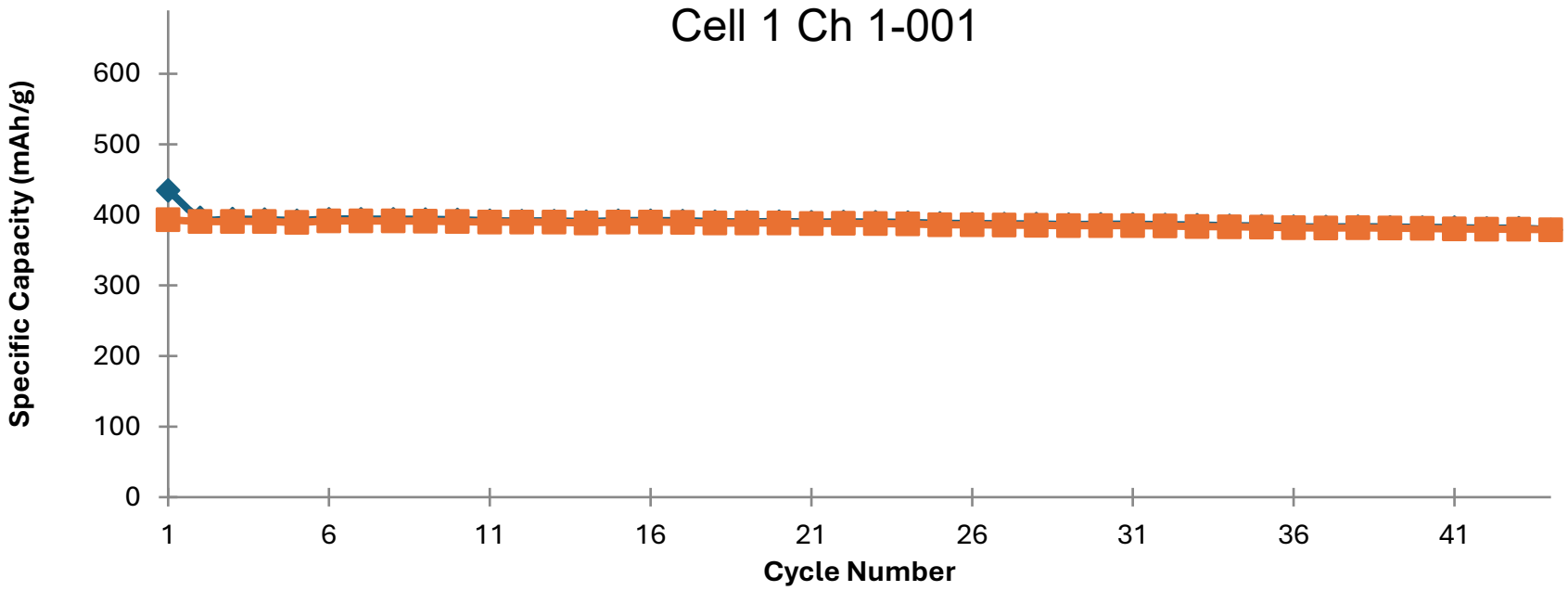




Natural Graphite w/Carbon Coated Si from the French Alternative Energies and Atomic Energy Commission (CEA)



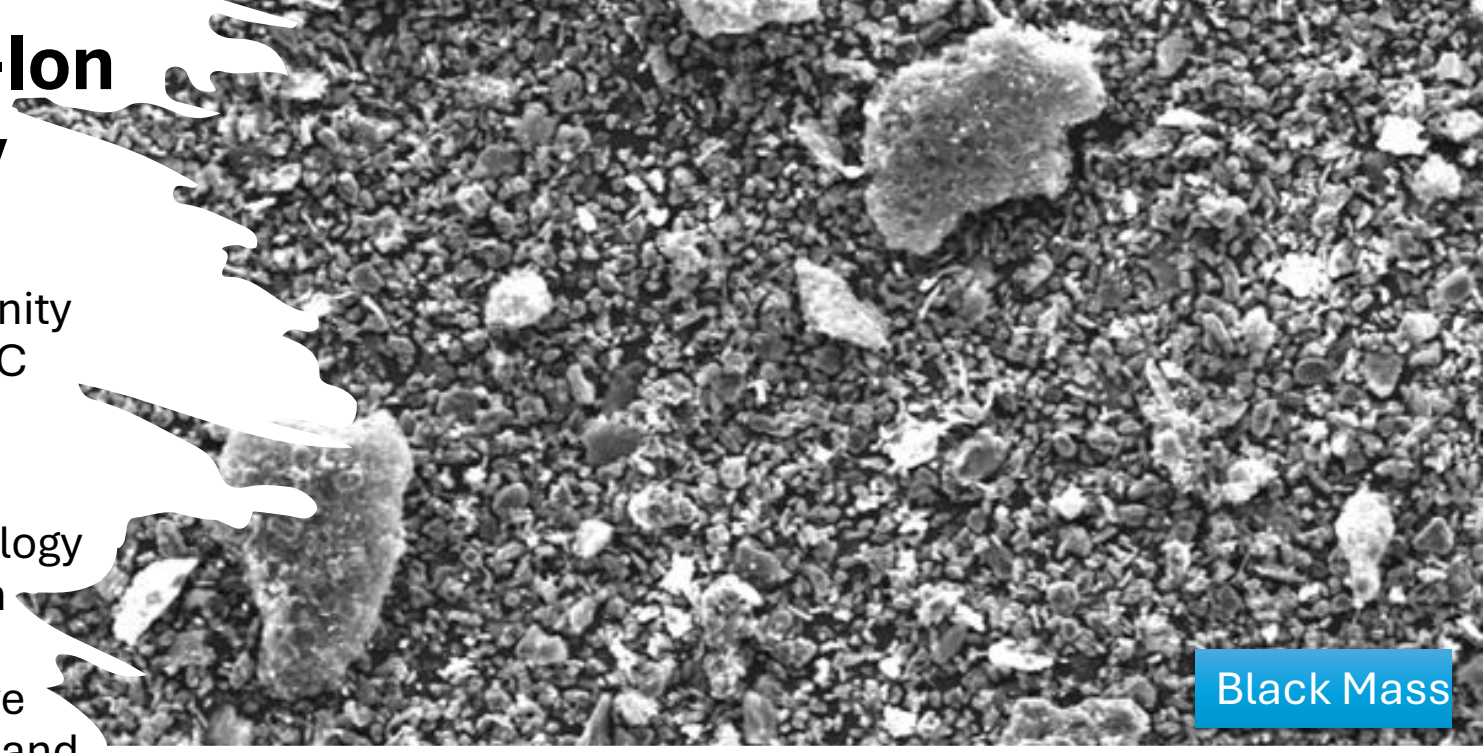




Cycle Numbers	Discharge (mAh/g)	Charge (mAh/g)
1	433.58	391.82
5	390.42	387.79
10	391.34	388.80
15	389.96	387.89
20	388.80	386.70
25	386.57	384.32
30	383.68	381.92
35	381.12	379.24
40	378.32	376.65
44	376.03	374.39

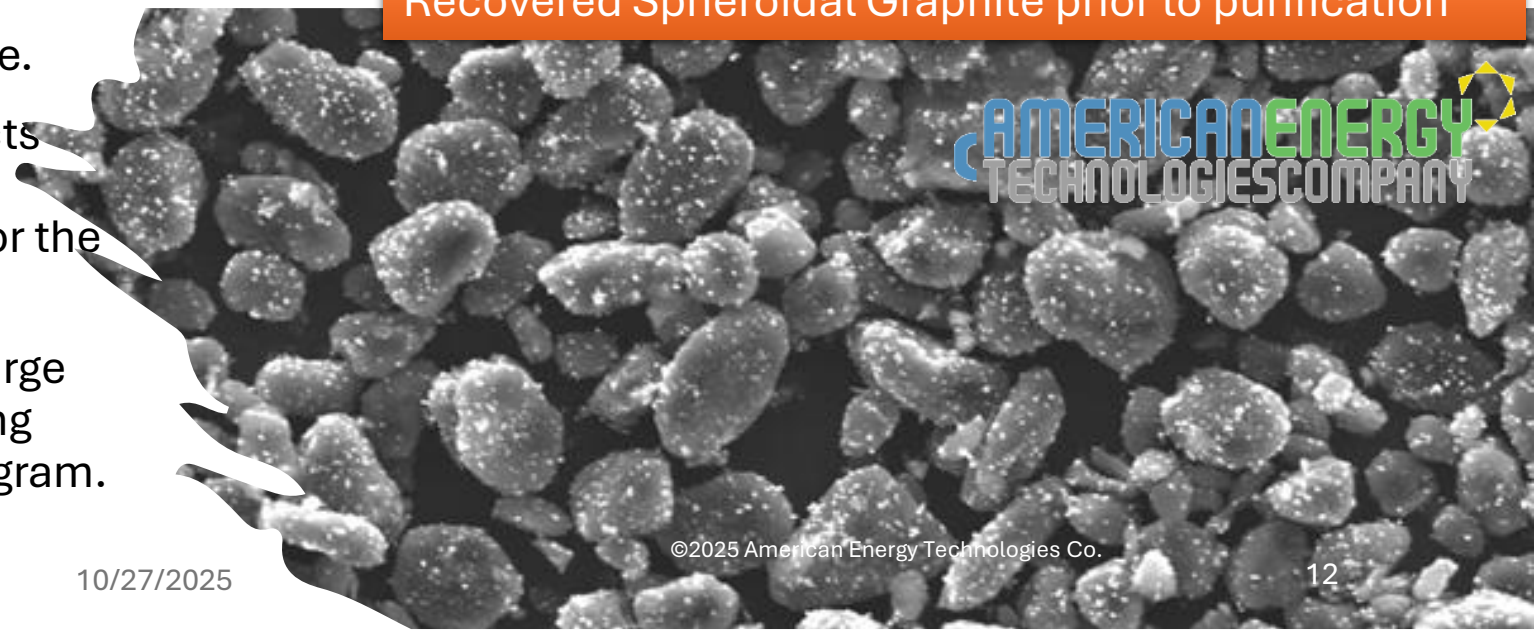
Pitch is the key element of Li-Ion Battery Recycling Technology

- Jointly with partners, a team of engineers and scientists at AETC is pursuing a business opportunity with recycling and reuse of battery materials. AETC has a line to perform the recovery, including high temperature furnacing.
- In 2021 AETC undertook a very successful technology demonstration with a well-known North American lithium-ion battery recycler. Among many useful chemicals that were recovered for future reuse, we extracted spherical graphite from the black mass and fully repaired it for reuse. The black mass was generated in a pilot run, far beyond the lab scale.
- Since then, at least three demonstration projects were implemented with our industrial partners, aimed at recovering and "healing" of graphite for the second life use.
- Most recently, AETC became a partner in two large International projects that have received funding from the European Union's Horizon Europe program. Follow the news for STREAMS and SAFELOOP!



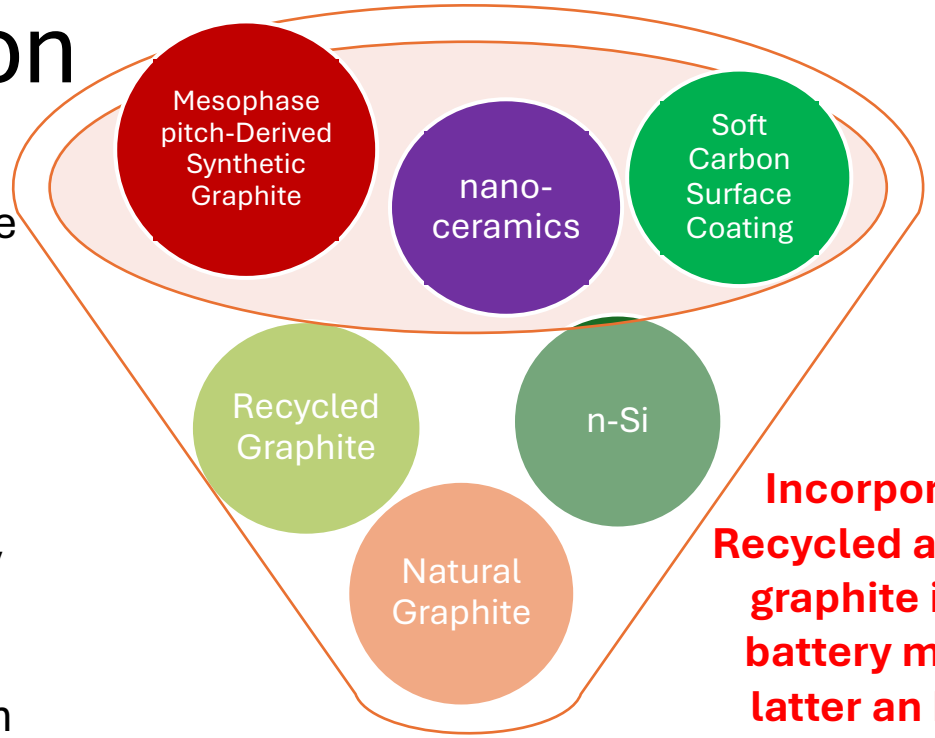
Black Mass

Recovered Spheroidal Graphite prior to purification



STREAMS and SAFELOOP on AETC's EU Supply Chain Horizon

- AETC is the exclusive designated processor of primary and recycled anode active materials, supplying battery-ready active materials, electrical conductivity enhancement carbon materials and nanostructured safety additives to Aspilsan Energy, a European Giga Factory located in Kayseri, Turkey.
- Aspilsan Energy, in turn, will supply tens of thousands of Giga Factory-manufactured 18650 cells for integration aboard 12-meter EV bus passenger technology platform manufactured by BOZANKAYA of Incan, Turkey. The new EV bus will be demonstrated at HHL GEMEINNUTZIGE GMBH in Leipzig, Germany as part of a broader Euro-centric battery supply chain deployment planned by the EU Consortium.



Incorporation of Recycled and Healed graphite into your battery makes the latter an IRA Law-compliant product.

Battery-Ready Anode Active Engineered Composite Material

In Summary

- Battery market is highly technological; it consists of sophisticated sub-segments which need to be well understood by pitch producer; add-hoc sales of pitch are possible but won't last: there is a need for a corporate commitment to become a supplier into the battery market.
- Advanced battery systems employ coal tar and petroleum-derived pitches alike;
- The general guidance is to use 110-130℃ SP for natural graphites and 150-170℃ SP for synthetic graphites; There are elite products on the market with 250℃ SP, but they are not all-inclusive in terms of their market coverage;
- Sulfur in pitch matters as it impacts the cycle life of batteries; anode powder manufacturers have some ability to reduce sulfur during downstream processing;
- Ash in pitch matters a lot: the lower the better;
- Pricing for surface coating pitch should not be reduced any lower than USD 3,000 – 5,000 per ton, considering that pitch is the enabling technology for ensuring battery safety and considering fairly small market size of up to 6,000 TPY.

Thank you for your attention!

End-to-end graphite processing for battery, coatings, parts, friction, iron & steel, forging, semiconductor, synthetic diamond, fire retardant & fire suppressant and many other industrial applications at the lab, pilot and full-scale bankable feasibility / production levels

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