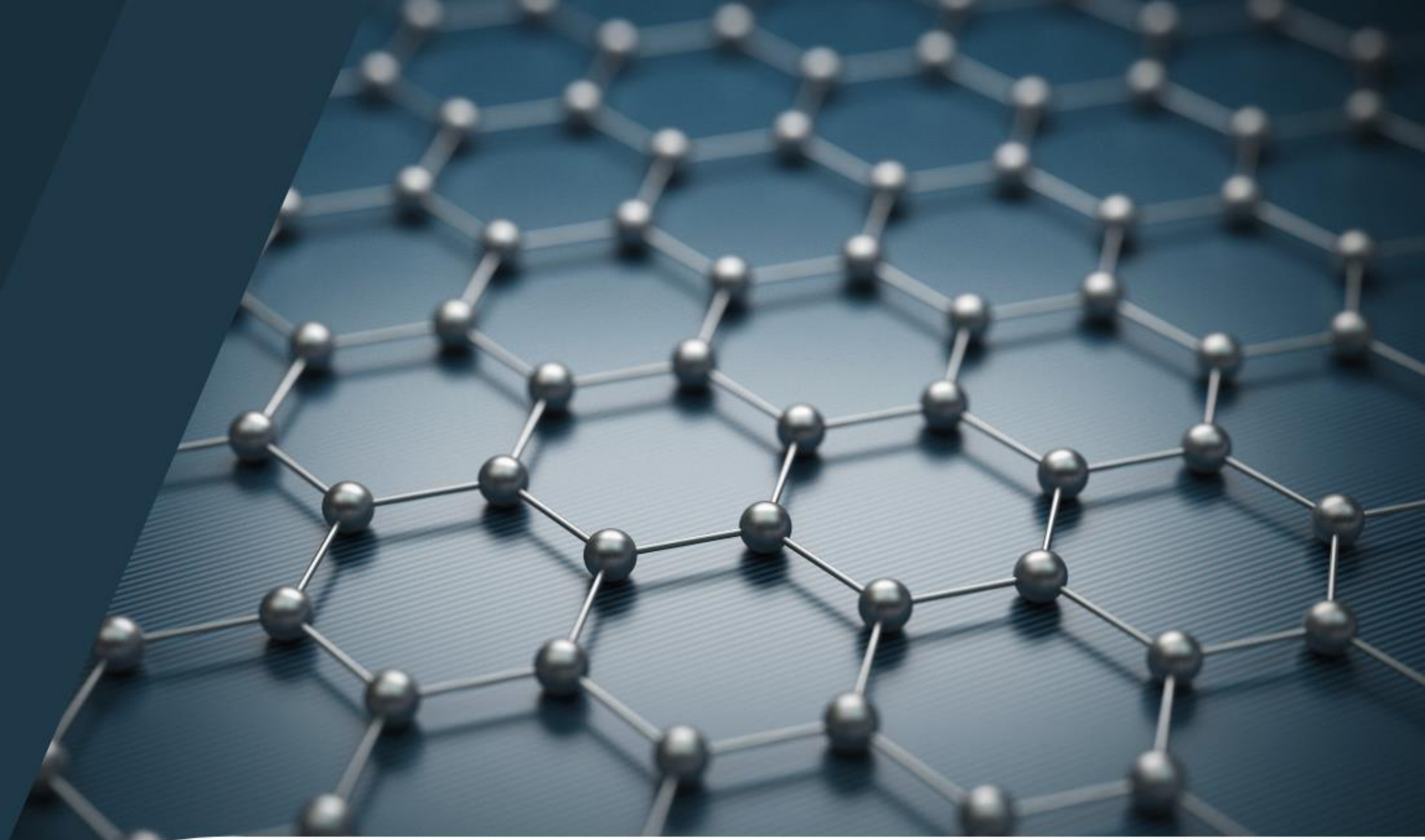
DANISH GRAPHENE



Graphene Additives for Battery Materials

Sustainable Graphene. Superior Performance

danishgraphene.com

Tysklandsvej 7, 7100 Vejle, Denmark

Company Overview

The Company

- Founded in 2020 – Spin-out from Aarhus University
- Danish Graphene is a supplier, developer, and integrator of functional graphene materials.
- The company consists of a dedicated and growing team of 18 people.

Technical Excellence

- Danish Graphene's core strength is scalable and sustainable production of graphene, alongside the development of graphene-enhanced products, ensuring consistently superior material performance.
- With dedicated laboratory facilities and in-house production, the company now has more than 2000 m^2 in Vejle, Denmark for R&D and production.

Graphene Oxide Product Validation

- Trusted by ESA (European Space Agency) and leading companies such as Anteotech, Leonardo, and Airbus, with tested and validated products such as the GGO Battery Additive.

Forward Vision

- Committed to high-quality functional graphene, innovative integration, sustainable production, and the continued development of advanced products for industry with a secure IP structure.

Facilities

Production Facility
A 1,200 m^2 production site in southern Vejle is commissioning Danish Graphene's first commercial production line, designed for safe and scalable manufacturing with future expansion capacity.

R&D & Commercialisation
A 900+ m^2 purpose-built headquarters supports:

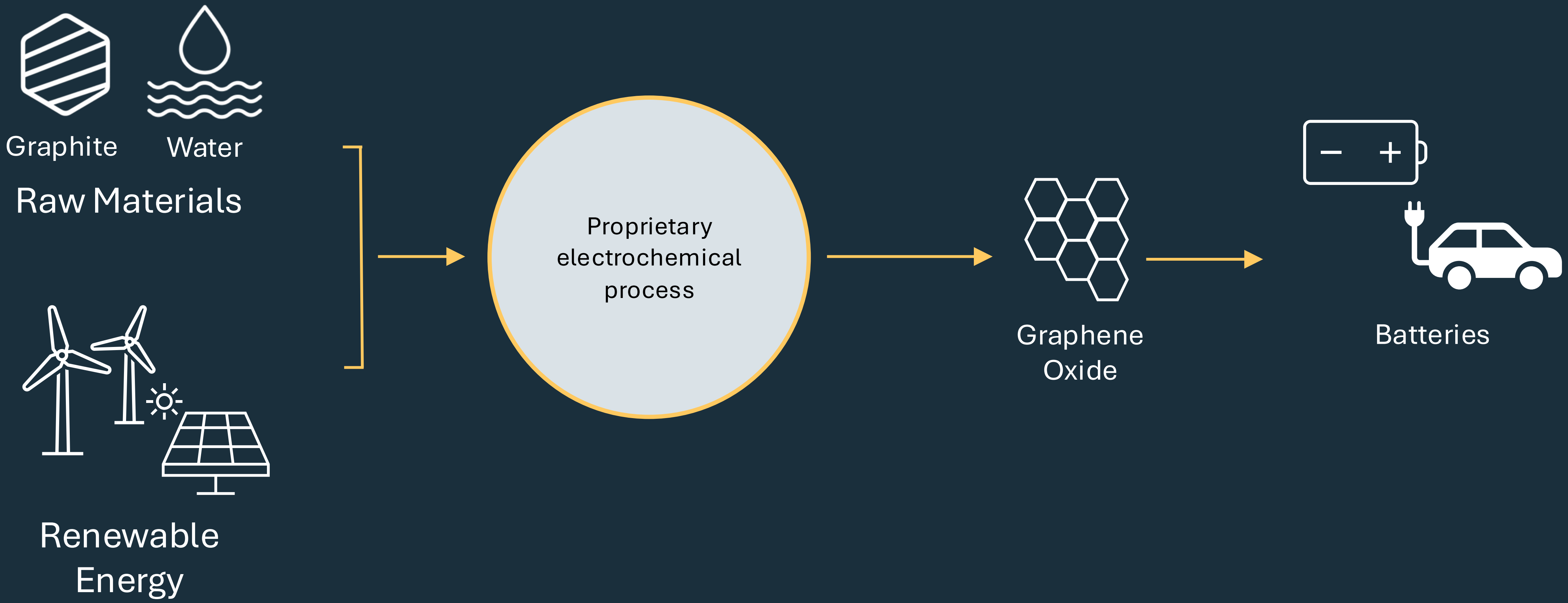
- Advanced graphene characterisation and quality control
- In-house lithium-ion battery testing and validation
- Process development and electrochemical scale-up
- Integrated technical, management, and commercial operations

Quality & Engineering Expertise

- Continuous on-site quality assurance with full batch traceability
- Engineering team with 50+ years of combined industrial production line experience
- Dedicated operations and site management ensuring reliable, scalable production

Growth Ready
Both facilities are designed to support continued scale-up, increasing production capacity, and team expansion.

Sustainable Production of Graphene Oxide



The Problem – Non-Dispersible Carbon Nanomaterials for Battery Materials

Battery materials, such as, silicon, hard carbon, LMNO, etc. gain a significant performance increase when adding a graphene or carbon nanotube additive. However, many carbon nanomaterials face several issues in industrial processes which has limited the use.

1 Dispersion Stability

When added to a media carbon nanomaterials are very hard to disperse and keep suspended in solution.

2 Low Dispersibility

Most carbon nanomaterials can only be dispersed in very low concentrations (< 1 wt%) limiting the use.

3 Additives and Stabilizers

Due to the low dispersibility and stability most carbon nanomaterial solutions contain high amounts of additives/stabilizers.

4 Agglomeration

Even though pre-dispersed carbon nanomaterial solutions can be bought agglomeration remains as a problem when used in industrial battery processes.

5 High Viscosities

Due to additives and stabilizers and the nature of many carbon nanomaterials the viscosity of electrode slurries are significantly increased, even when used in very low concentrations.

6 High Toxicity

Carbon Nanotubes behaves like asbestos fibers causing lung inflammation and membrane/cell disruption.

The Solution – Graded Graphene Oxide (GGO) from Danish Graphene

Danish Graphene manufacture a graphene paste highly suitable as carbon additive for battery materials. The drop-in paste, readily disperses, and can be directly added to industrial process lines without introducing new steps or processes in production.

1 High Stability

GGO solutions/pastes has a high stability. Can be stored for > 6 months without any precipitation/agglomeration.

2 High Dispersibility

GGO solutions/pastes can be produced in higher weight percentages (> 1 wt%).

3 No Additives and Stabilizers

No additives or stabilizers are added to GGO products thus they only contain water and graphene material.

4 No Agglomeration

GGO solutions/pastes readily disperses using standard process equipment, and do not agglomerate during processing, even when used in high concentrations.

5 Low Viscosity

GGO can be added to electrode slurries with only a small impact to the viscosity. Therefore, higher concentrations can be added compared to other carbon nanomaterials.

6 Low Toxicity

Graphene oxide does not impose any server health issues to humans. Requires less exposure control in a production setting.

Graded Graphene Oxide: Drop-In Graphene Product for Battery Materials

Aqueous Drop-In Solution

GGO can be added directly to existing manufacturing processes and disperses easily.

Tested and Validated

The drop-in additive has been evaluated by five different silicon manufacturers all validating the positive effects of the products.

Sustainable Production

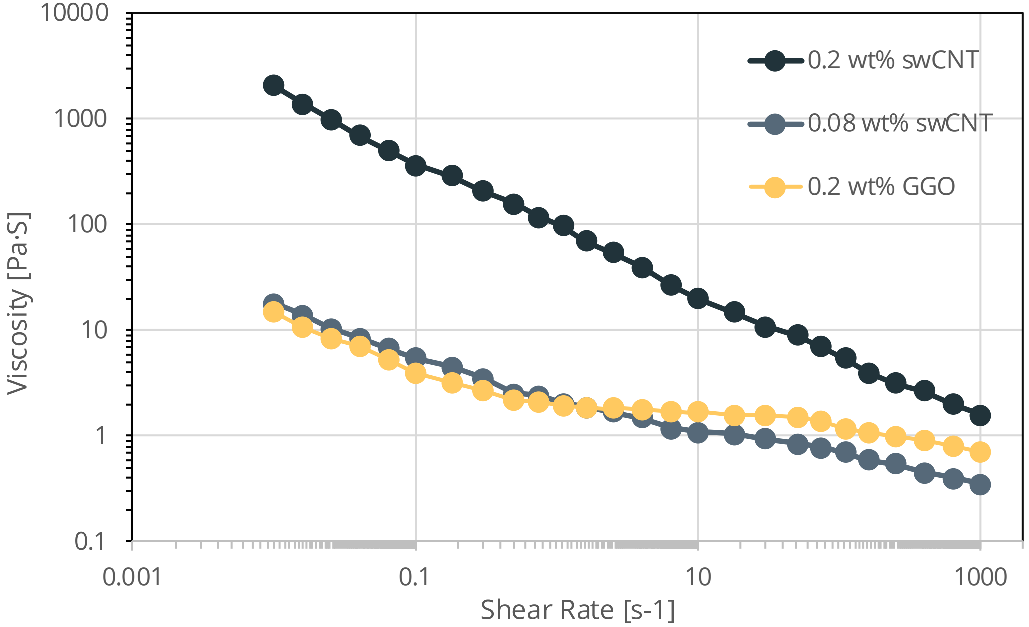
Renewable electrochemical production method mainly relying on water and sustainable energy.

High Consistent Quality

Reliable production method that gives consistent high-quality products validated by advanced characterization protocols.

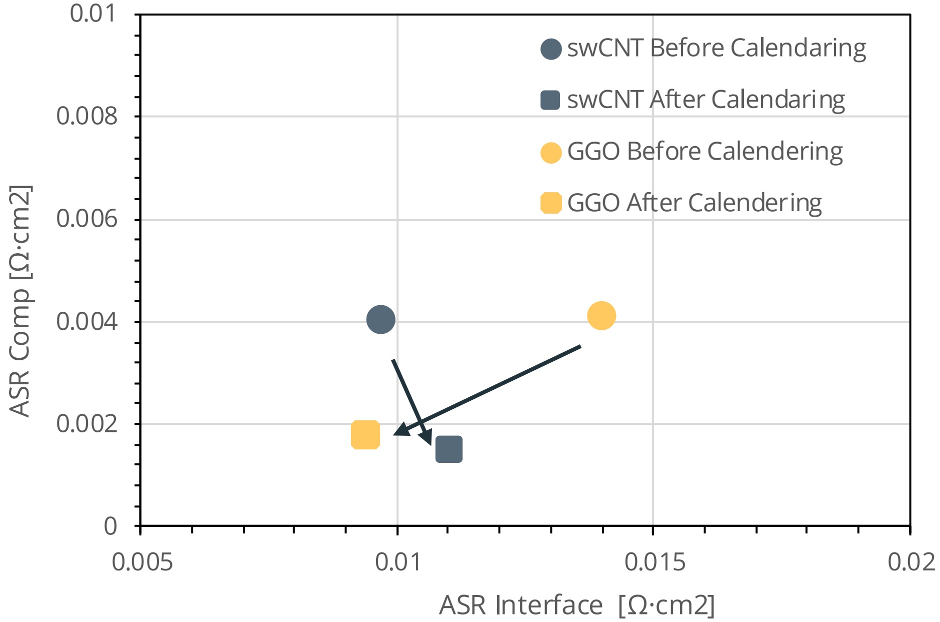
Electrode Slurry Viscosity and Electrode Resistivity

GGO only induce a minor increase in viscosity compared to swCNT.



The figure shows the viscosity as a function of shear rate for three different electrode slurries containing either swCNT or GGO at different concentrations in a silicon anode formulation.

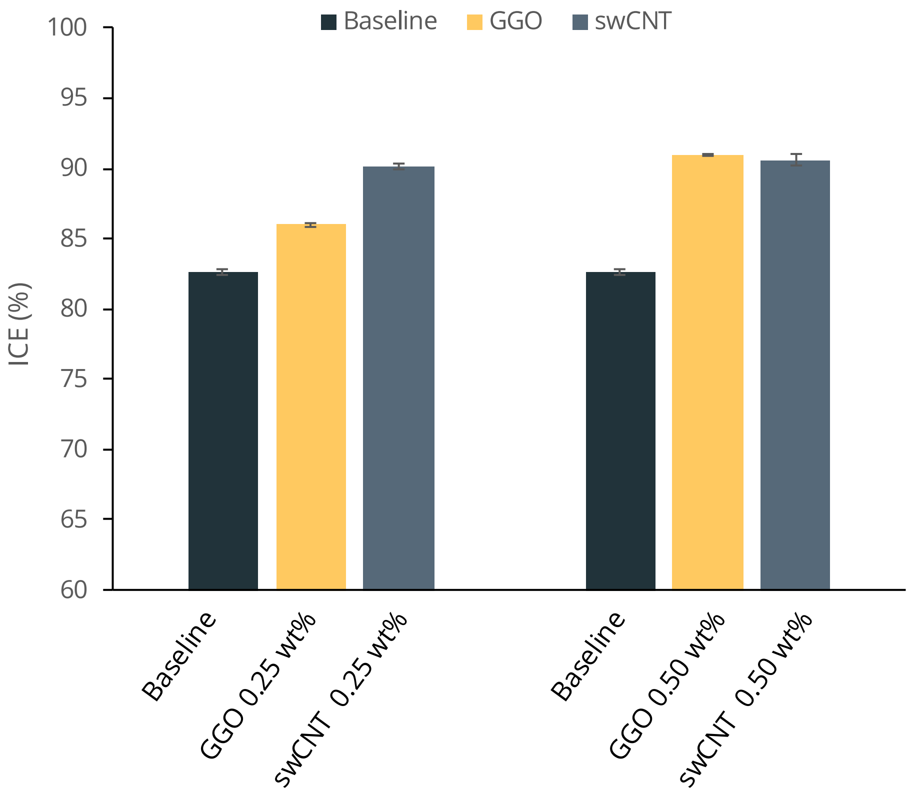
GGO induce a similar low resistivity as swCNT and experiences an improved interfacial resistivity after calendaring.

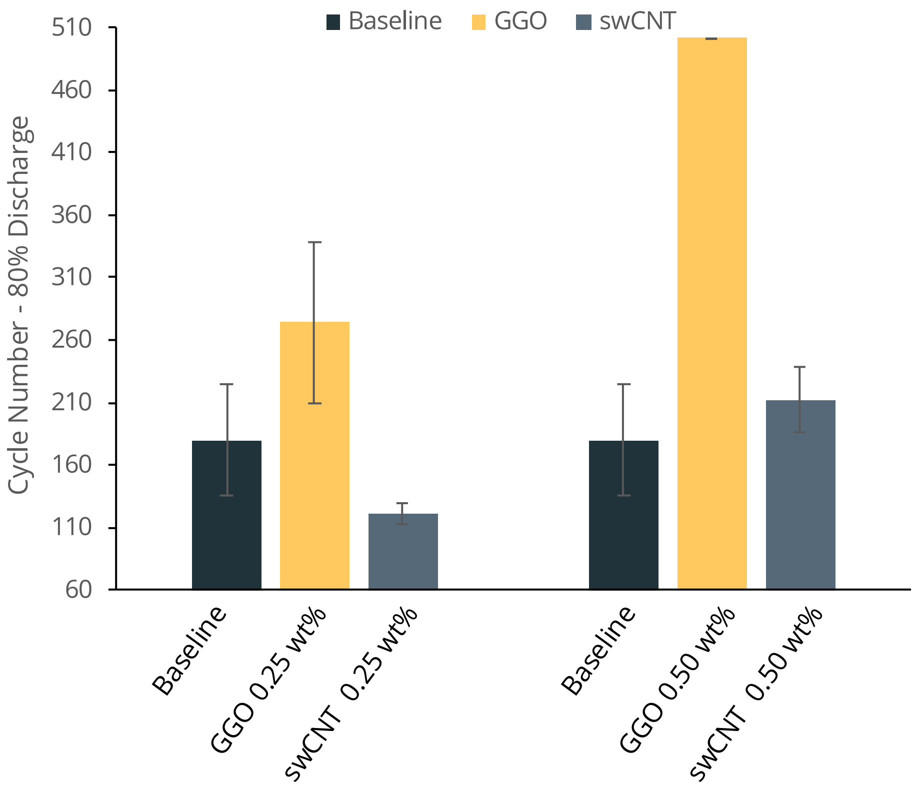


The graph shows the area specific resistance (ARS) of the composition (R_s) plotted against the ARS interface (R_{ct}) of two electrodes containing swCNT and GGO, respectively, before and after calendaring.

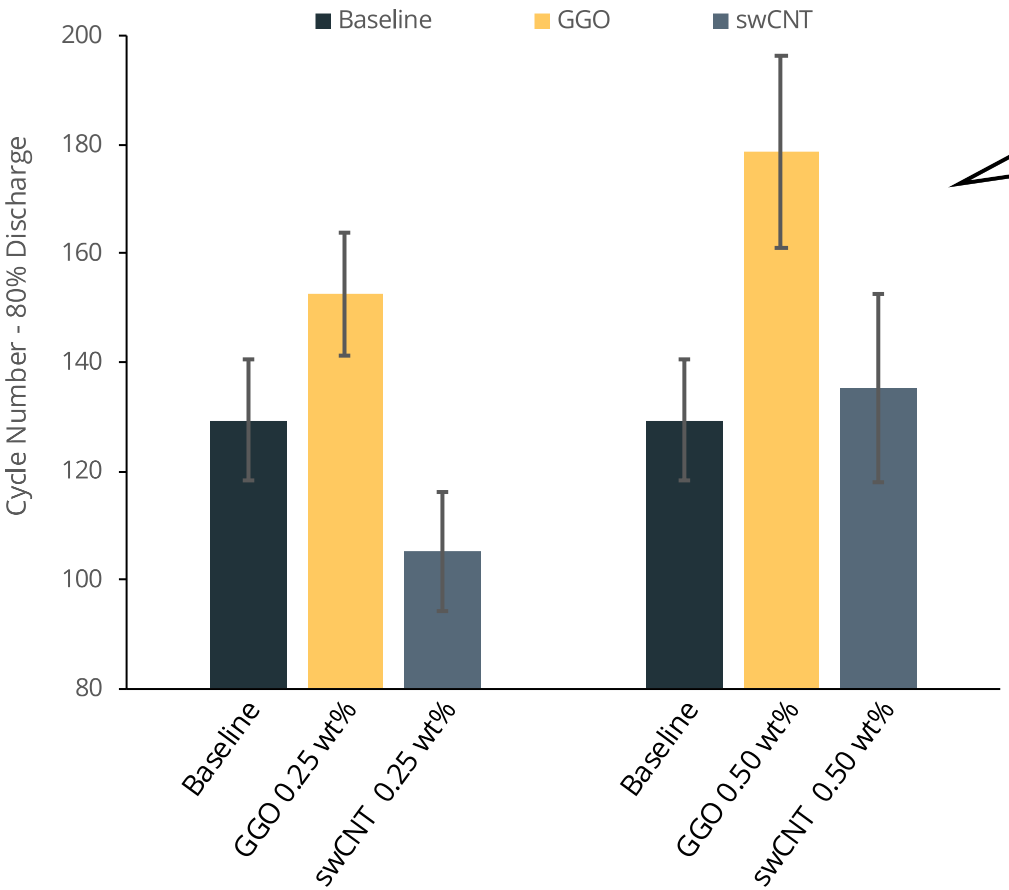
High Loading Silicon Anode Electrodes – Half Cells

GGO Battery Additive added to electrodes with 85% silicon loading improves the ICE and the cycle life. Interestingly, the cycle life is significantly improved compared to electrodes carrying swCNT, though the ICE is comparable between the two systems.

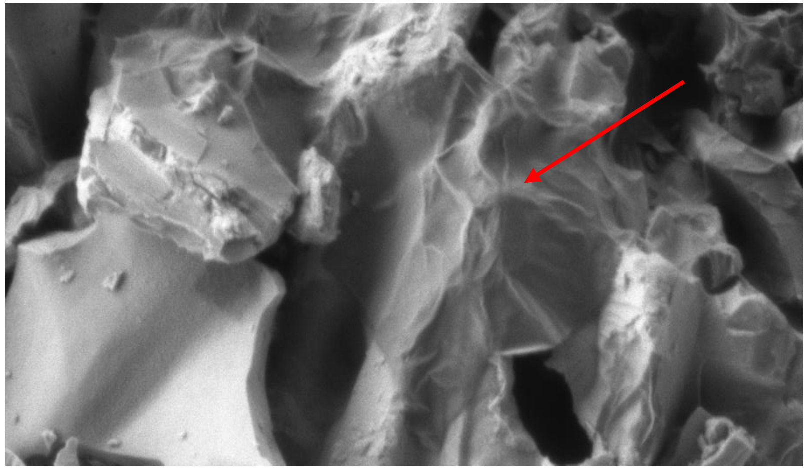




High Loading Silicon Anode Electrodes – Full Cells



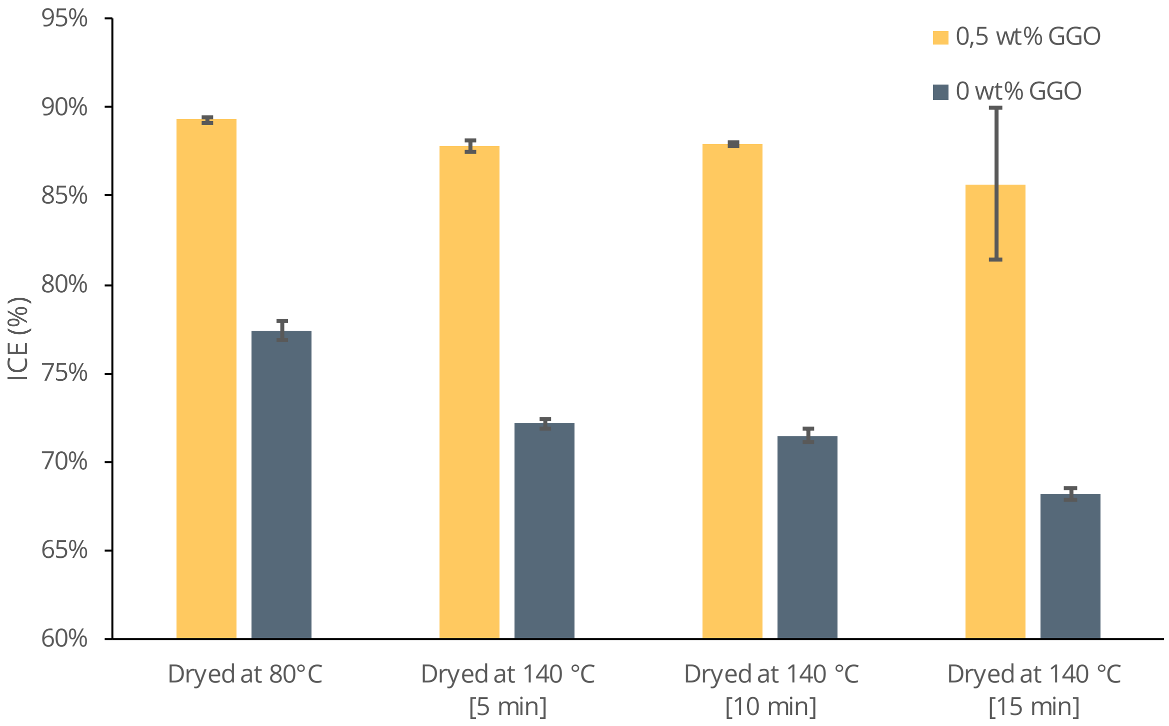
Drop-in addition of GGO Battery Additive to high loading silicon anode slurries significantly increases the cycle life of the corresponding battery. GGO containing electrodes also show superior performance when directly compared to electrodes with swCNT.

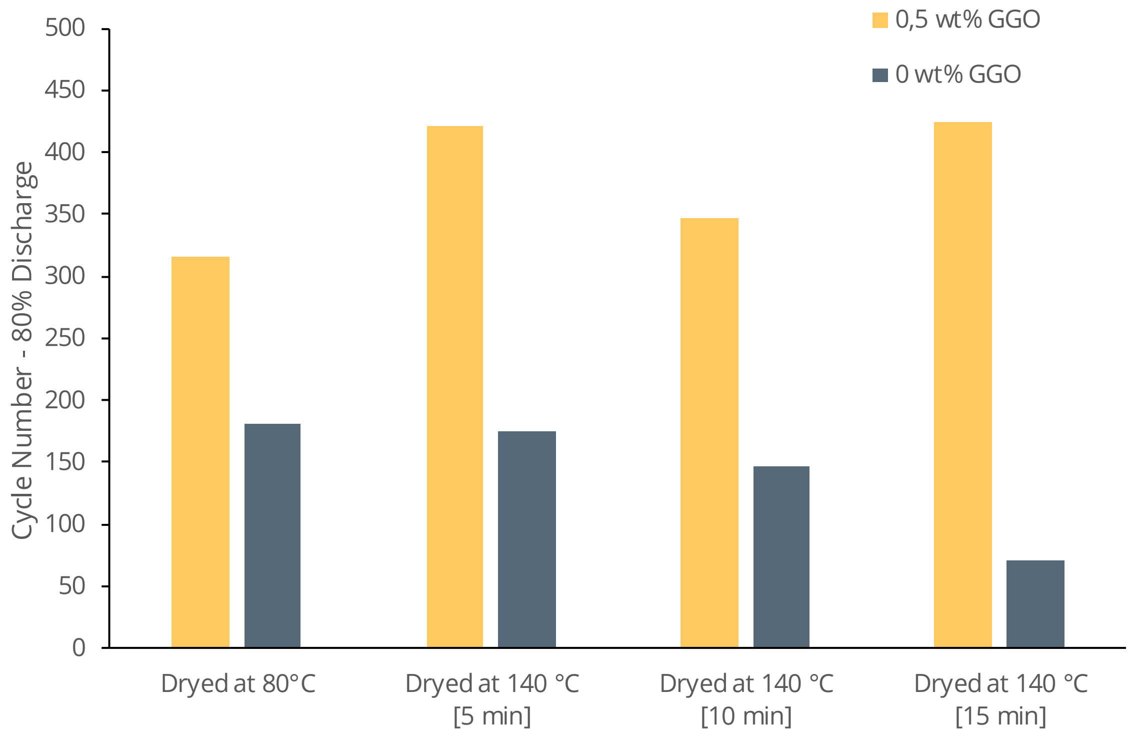


The SEM image show how GGO flakes partly coat the active silicon materials. GGO typically have a high affinity to silicon which induce a partial wrapping of the particles. Secondly the GGO is introduced to the carbon binder domain (see slide 12)

Thermal Stability at High Drying Temperatures

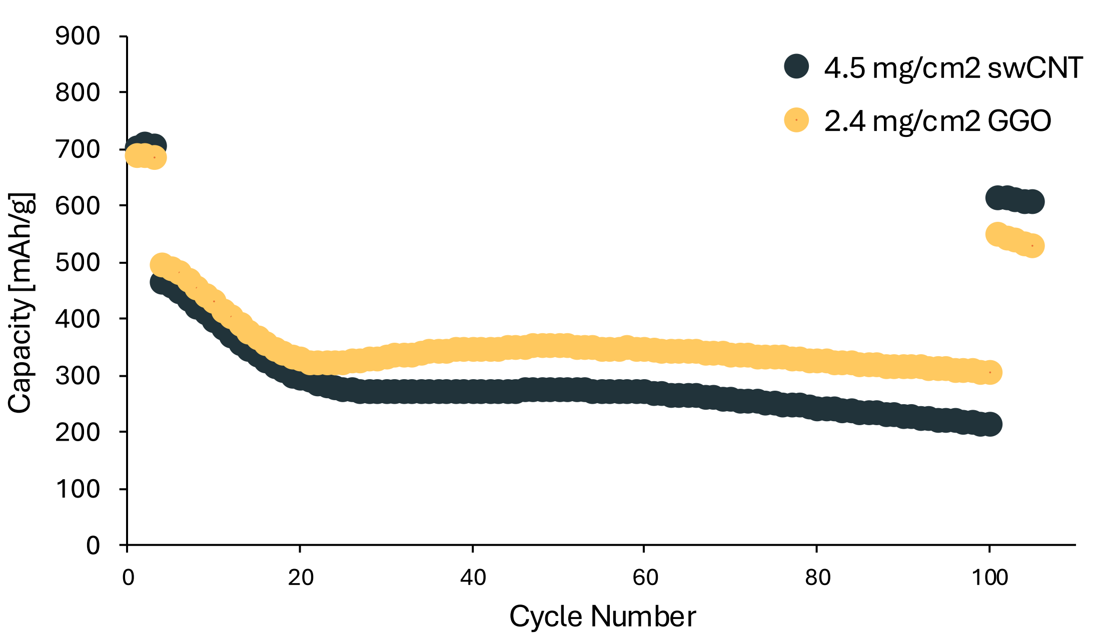
Adding GGO can stabilize silicon electrodes when dried at high temperatures. The relative chance in ICE is significant smaller for GGO containing electrodes than baseline systems. Additionally, cycle life is improved for electrodes with GGO.





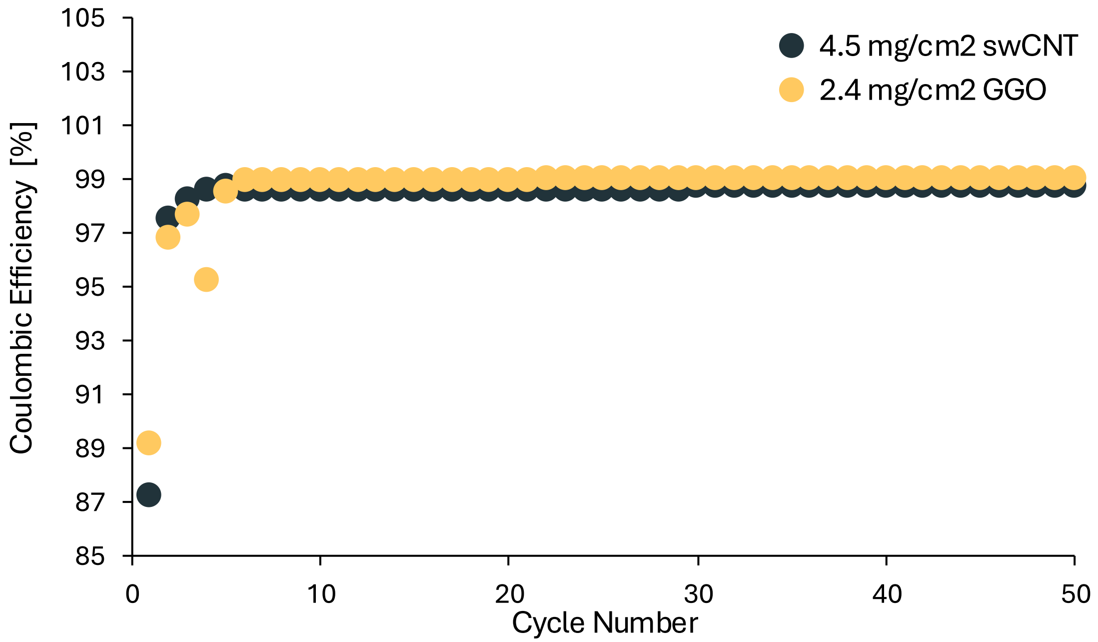
Silicon/Graphite Anode Electrodes

GGO induce a higher capacity retention than swCNT at lower concentrations.



The figure shows the capacity plotted against the cycle-life of a graphite/silicon anode with 95% active material (85% graphite, 15% silicon).

GGO improve the initial coulombic efficiency compared to swCNT at lower concentrations.

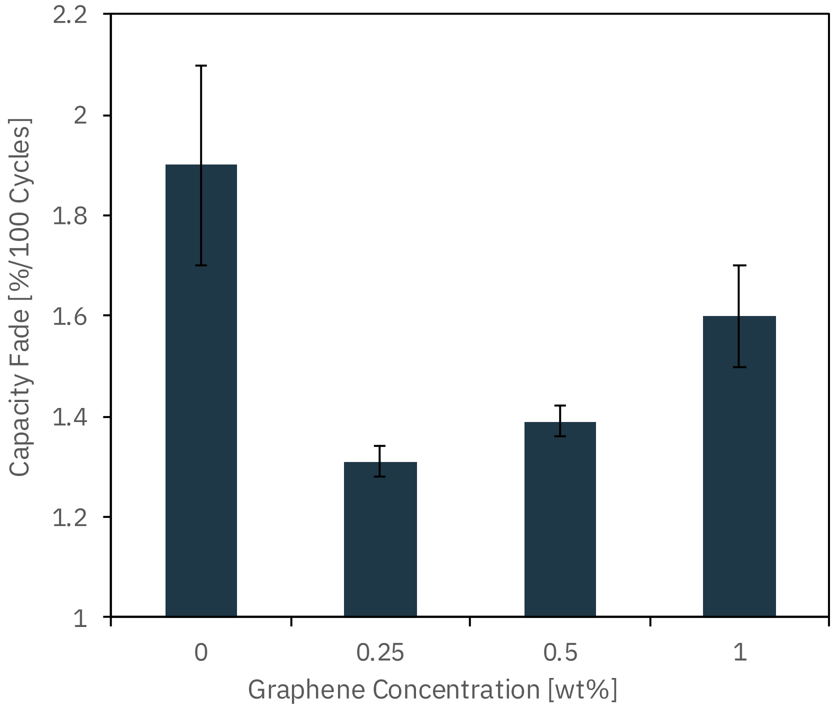


The figure shows the coulombic efficiency plotted against the cycle-life of a graphite/silicon anode with 95% active material (85% graphite, 15% silicon).

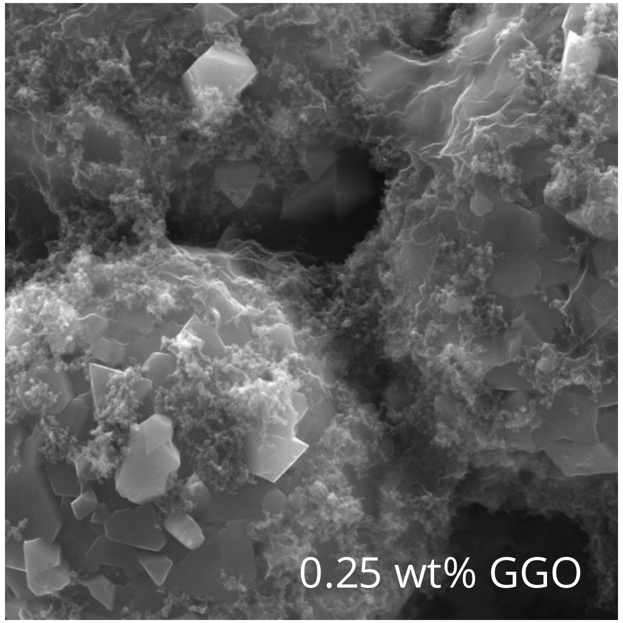
Graphene for Cathode Materials

Graphene added, in low concentrations, to a slurry containing LNMO active material shows that the corresponding electrode experiences a significant decrease in the capacity fade extending the cycle life of the LNMO active material.

1 C Capacity Fade

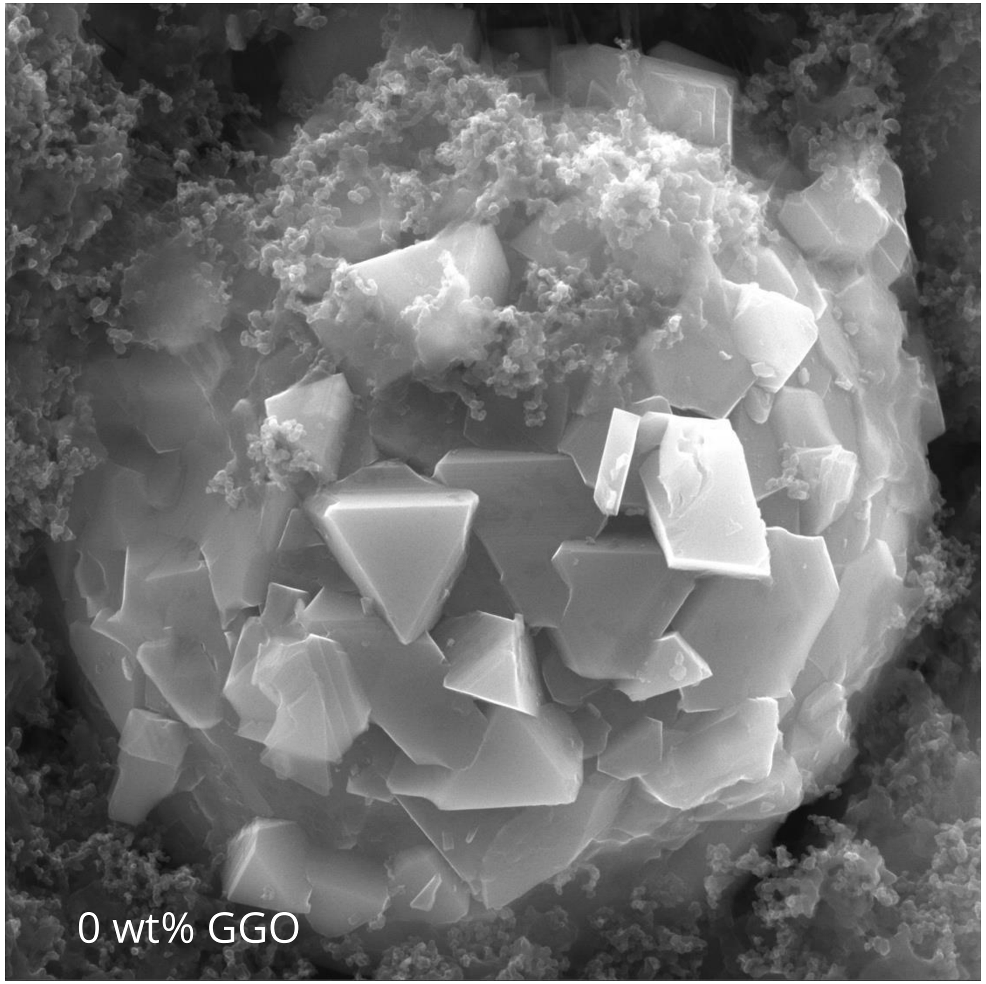


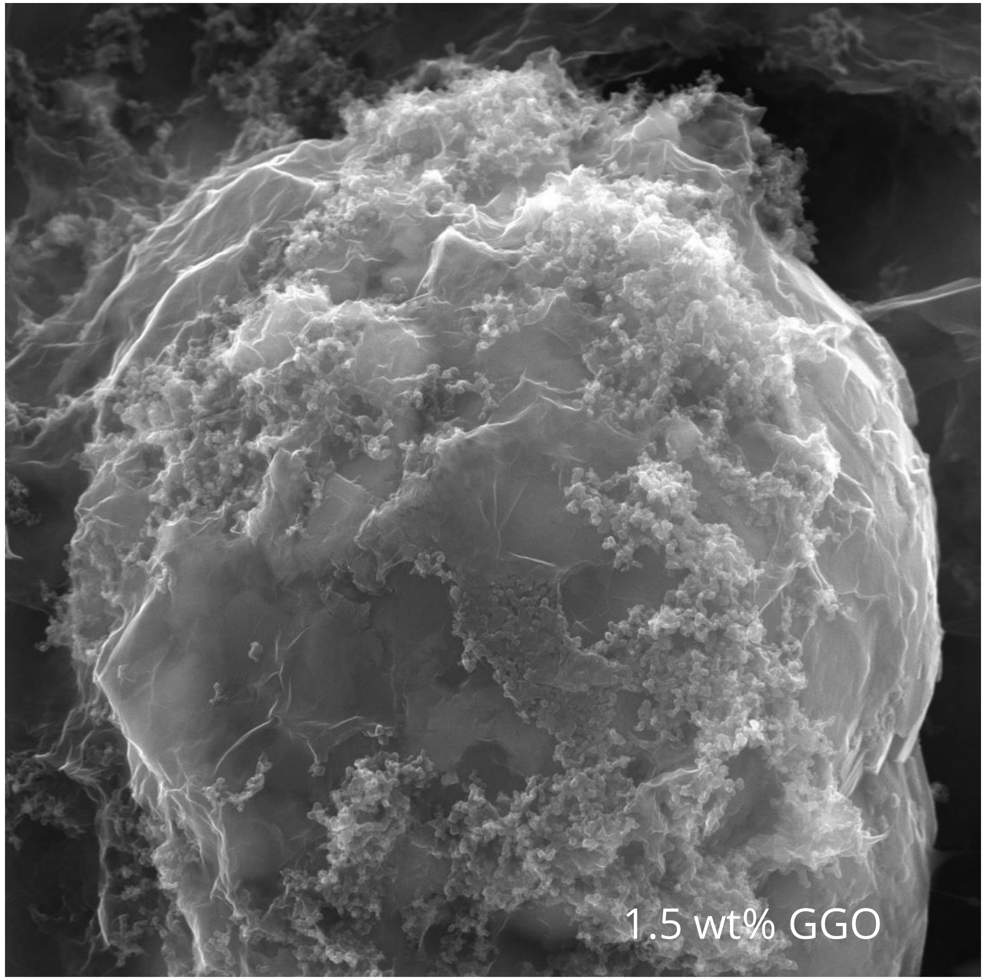
SEM Image



The SEM image of an LNMO electrode containing 0.25 wt% graphene shows the polycrystalline particles partially covered by carbon black (CB), binder, and graphene flakes. The graphene flakes are primarily located between LNMO crystals bridging the non-conductive active materials. CB particles are distributed on the graphene sheets forming a three-component conductive domain. Graphene flakes create electrical contact on a large area on the surface of the LNMO particles, whereas CB forms point contacts. The graphene can through the long-range covalent bond network induce a flexible and strong carbon-binder domain (CBD) that is stable during cycling where the particulate CBD often suffers from degradation after long-term cycling

SEM Images of LNMO Polycrystals





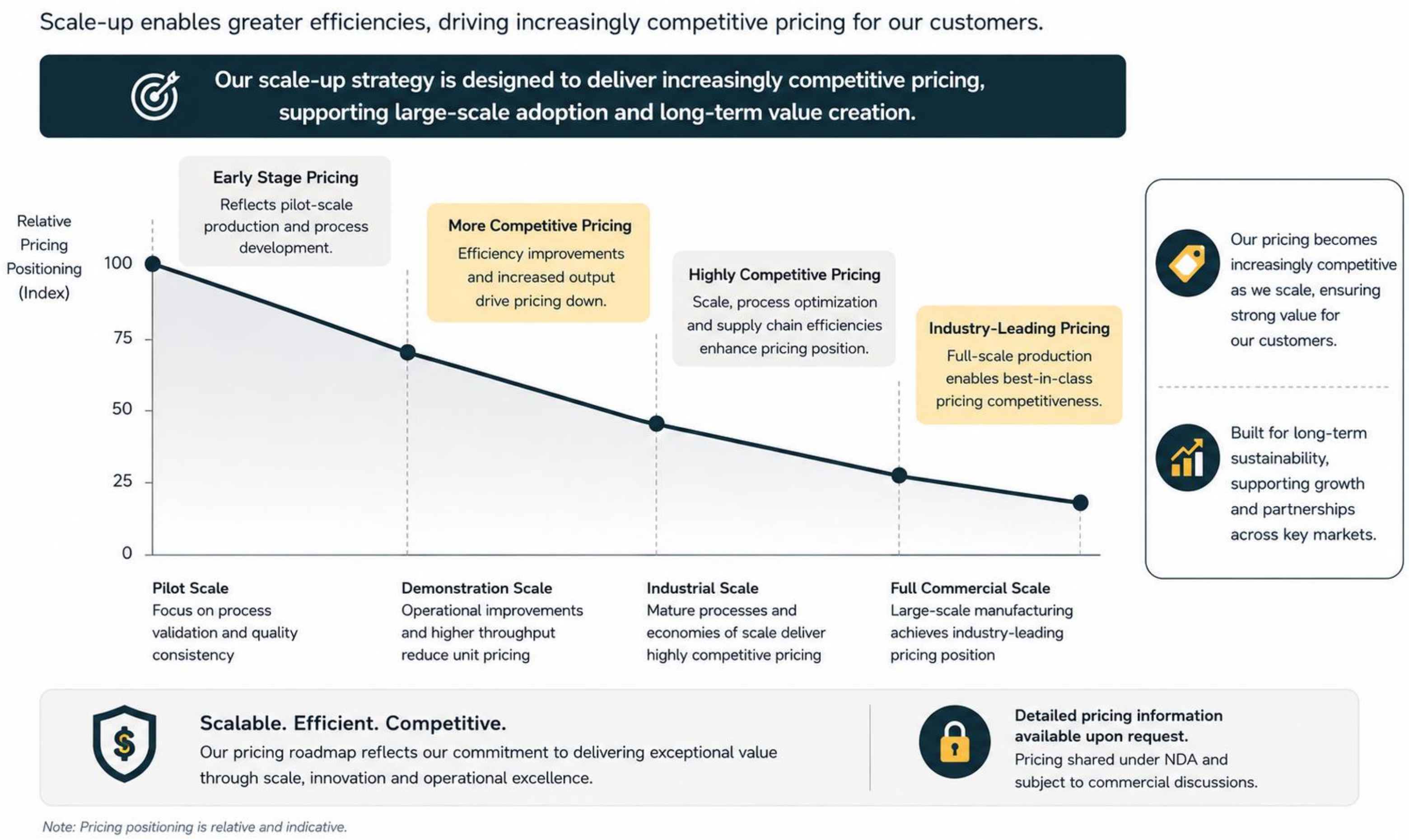
"Following laboratory trials on our coating equipment and using our patented pre-doping process, we have observed that the graphene battery additive from Danish Graphene has the potential to become the core of a conductive material structure in our systems; therefore, we recommend considering it for the development of electrodes with a variety of active materials, including organic active materials."

Dr. Satoh Masaharu, CEO, Orlib Limited

Commercial Focus

- The scale-up strategy enables highly competitive market pricing while maintaining high material quality and supply reliability.

- As production capacity expands, manufacturing efficiencies and process optimization will enable more industries to integrate graphene.



Global Reach

Customers in various industries all over the world.

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France
Leading aircraft manufacturer

ESA
European Union
European Space Agency

NASA
USA
U.S. space agency

ICEYE
Finland
Satellite company

Anteotech
Australia
Battery company

TERMA
Denmark
Aerospace and defense

NAGASE
Germany/Japan
Specialty chemicals company

Atmos Space Cargo
Germany
Space company

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Leonardo
Italy
Space and defense

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Current Distributor Network: NAGASE, ADVAM (Passion & Reliability), VED GROUP (SINCE 1976)

Thank you for your time and consideration

We welcome any questions or collaboration opportunities and look forward to the possibility of working together. Let's drive innovation and growth together.

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