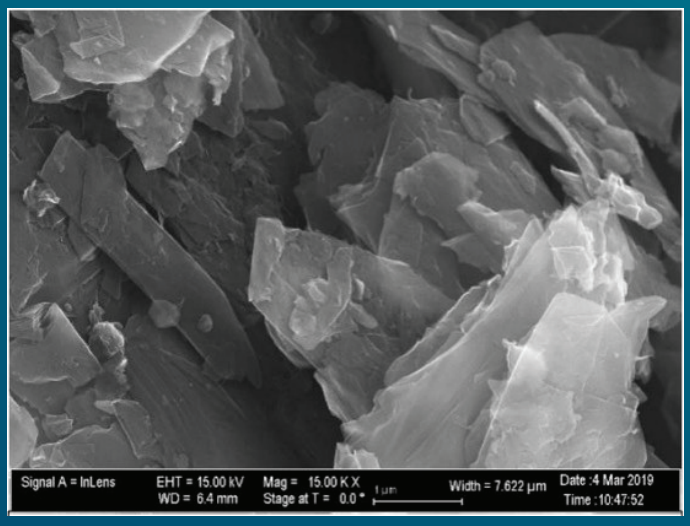
Meet NTeC-G:
An Advanced CNT-Coated Graphite Hybrid

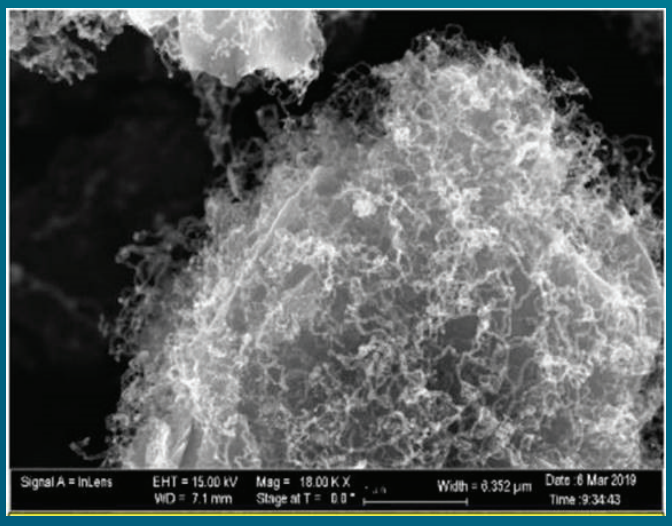
Nanotube-enhanced Carbon Graphite (NTeC-G) is the latest advanced material for Li-ion batteries and a variety of other applications. This material is a carbon nanotube CNT-graphite hybrid that is low cost and easy to handle. In this type of CNT-coated graphite material, a “carpet” layer of CNTs are grown directly on the exterior of graphite particles, providing a highly porous surface coating on a solid graphite core.

In this growth process, a solid catalyst is mixed with natural or synthetic graphite, and the mixed material is placed in a reactor for multi-walled CNT growth. This material can be grown using a simple catalytic process in a specialized reactor. Graphite particles are seeded with a metallic catalyst, which drives CNT growth on the graphite core. CNTs grow directly on the graphite particles and remain attached once growth is complete. The growth process for these hybrid CNT/graphite particles is simple enough for scalable production with high yield and low cost. Multi-walled CNTs grow on the graphite core with controllable diameter (typically 20-25 nm) and length (3-10 microns). The final step in the NTeC-G manufacturing process is purification, used to produce the higher grades. Using a thermal purification method, the carbon mixture is heated to high temperature for graphitization and removal of metal impurities. Both standard purity (approximately 96%) and high purity (approximately 99.9%+) are available. SEM images of uncoated graphite and the NTeC-G-carpet material are shown below.

Graphite Particles



NTeC-G: CNTs Grown on Graphite Particles



For more information:
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This CNT-graphite hybrid material is quite easy to handle and integrate into cylindrical battery cells, coin cells, and pouch cells. As the material is in the solid state, it can be mixed with a surfactant and binder to form a slurry. This slurry can then be spread onto a copper foil and dried, yielding a porous film with low resistance. No specialized growth processes are required to integrate these materials with other standard battery materials.

As can be seen above, the web of CNTs forms a highly porous surface on top of the core graphite particles. The porous nature of this CNT-graphite hybrid material provides a number of benefits. For example, when used as an anode in Li-ion batteries, NTeC delivers:

- **Lower Internal Resistance than Bare Graphite:** The multi-walled CNTs have high electrical conductivity along the axial direction, allowing for ballistic charge transport. As the internal resistance of the CNT layer is lower, less power is lost as heat during charging/discharging. The lower resistance of the CNT layer provides faster charging compared to conventional graphite anodes.

- **Higher Thermal Conductivity:** CNTs have high thermal conductivity along the axial direction, allowing any heat to be easily transported away from the anode. This provides additional protection against temperature rise, heating during overcharging, and thermal failure.

- **Greater Li+ Storage:** The porous nature of the CNT means the exposed surface area to volume ratio is larger than that of a solid graphite anode, which provides greater charge and discharge capacity, respectively.

- **Robust Interparticle Connections:** The CNT layer allows particles to easily agglomerate with each other and form strong mechanical connections. This aids ballistic charge transport through the anode material.

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