

Energy Storage, e-Mobility

3M™ Battery Materials

Cost saving technologies for more powerful, smaller, safer and longer-lasting batteries

3M has collaborated extensively with universities, government research organizations and customers as a supplier of lithium ion battery materials for more than 15 years.

Add to that experience a portfolio of more than 40 core technologies – including nanotechnology, adhesive, precision coating, fluoromaterials and more.

3M battery materials have proven their utility and reliability in both small and large format applications. All can be tailored to meet specific performance and process requirements, and are available globally in

commercial-scale quantities. And 3M can help you integrate materials to optimize product performance and meet special application requirements.

3M's broad battery materials portfolio includes:

- **Battery Chemicals:**
Anode powders, Cathode powders, Electrolyte (salt and additives)
- **Battery and Cell Assembly solutions:**
Battery tapes, Thermal interface materials, EMI shielding tapes, Adhesives, Insulation Papers and more
- Thermal management fluids

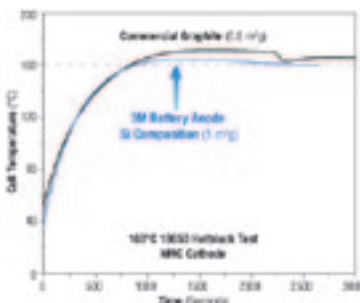
3M™ Anode Powders

3M has pioneered the development of revolutionary silicon anode compositions. With twice the volumetric and gravimetric energy density of graphite anodes, lithium ion battery silicon anode materials can increase cell energy up to 40%, depending on cathode energy density and cell design.

3M silicon anode materials have shown excellent cycling and high rate characteristics suitable for a wide variety of consumer electronic applications. Thermal stability of anode Si compositions are comparable to conventional graphite systems. In addition, 3M water based coating formulations have been designed to fit into conventional graphite coating processes for simplified manufacturing.

Features and Benefits

- Twice the energy density vs. graphite anodes
- Excellent cycling, 70% retention at 500 cycles achieved
- Low swelling of approximately 50% based on electrode formulation
- Ease of manufacturing with water based processing using conventional electrode coating processing
- Thermal stability comparable to graphite



3M™ Cathode Powders

Our lithium battery cathode technology utilizes unique layered mixed metal oxide formulations of nickel, manganese and cobalt (NMC). This 3M proprietary chemistry provides an outstanding balance of power, energy, and safety characteristics optimized for your application. Its lower cobalt content optimizes performance, while providing low and stable pricing.

3M lithium battery cathode technology enables battery designs with low cost (€/Wh) and high performance. NMC cathode materials can be tailored through changes in composition and morphology to meet the most demanding customer requirements. Applications for lithium ion battery materials include high energy handheld consumer electronics to large format high power automotive and grid stabilization applications.



Features and Benefits

- TNMC cathode products can be customized to create an optimum balance of properties
- With modification of composition and morphology cathode materials can be designed for high energy, or high power
- With lower cobalt content, 3M NMC technology can significantly lower the cost of cathode materials
- Thermal stability of NMC cathode materials is excellent and can impact battery safety profile

Electrolyte Additives

3M's ability to synthesize new molecules and evaluate their impact in lithium ion batteries has led to electrolyte additives that are proven to enhance performance and reduce cost.

3M™ Fluorad™ Battery Electrolyte HQ-115

3M Fluorad Battery Electrolyte HQ-115, Lithium bis(trifluoromethane- sulfonyl)imide, is used as both

an additive in lithium ion batteries and as the primary salt in lithium polymer batteries. Used in many high capacity lithium ion cells, electrolyte HQ-115 in additive concentrations of less than 5% has improved capacity retention and cycle life at high temperatures. Electrolyte HQ-115 has also been shown to reduce swelling and gas generation, which can simplify safe battery cell design.



Assembly Solutions

3M is a global leader in tapes, thermal materials, abrasives, adhesives and EMI management products. 3M's broad portfolio includes:



- Heat and corrosion resistant tapes used for edge sealing, tab protection, and current collector bonding
- Thermally conductive tapes, pads and adhesives that provide efficient heat transfer between components
- Electrically conductive tapes for secure grounding and bonding of electronic circuitry
- Flame-Retardant Insulating Papers for high temperature electrical insulation applications and isolation of battery components
- EMI shielding and absorbing material to control electromagnetic interference
- Structural adhesives for pack rigidization
- Thermal conductive film to replace aluminum heat sinks

