



Chemicals

# Powering the future together

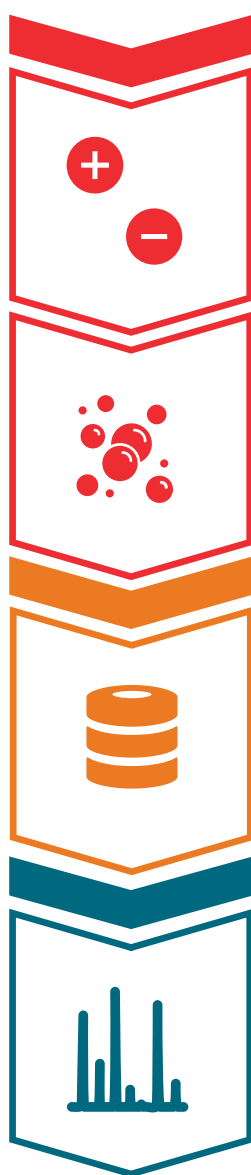
Chemicals and materials for research,  
production, and analysis



Contact us for more information  
on our battery products

# Chemicals for batteries: A total workflow solution

Whether you are engaging in research for the next cation alternative with inorganics and ligands or finding new organic molecules to tap on their resonance abilities for ion transfer, or post-reaction analysis on samples, we have a complete line of solutions for your battery research workflow. Read about how our capabilities and our products can help bring success to your battery research.



## Our lab-to-line workflow

### Formulation chemicals & materials for anode, cathode and electrolytes

- ✓ Extensive range of **pure metals** such as lithium and copper foil, magnesium turnings, and more.
- ✓ **Organic chemicals** used to enhance electrochemical performance.
- ✓ High-quality **inorganic** salts, such as lithium hexafluorophosphate and lithium perchlorate.
- ✓ Acroseal™ packaging, to help ensure that reagents are **protected against air and moisture** for a longer shelf-life.

### Production and bulk capabilities

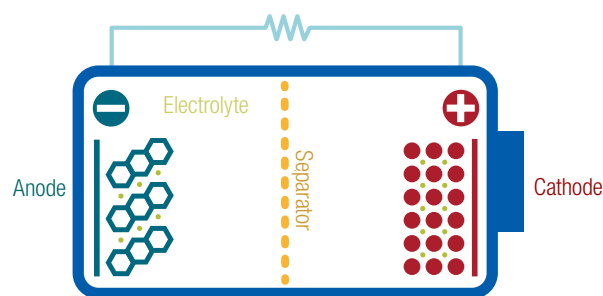
- ✓ Global sourcing network enables supply reliability
- ✓ Customized delivery schedule to meet your project timelines
- ✓ Mixed blends

### Elemental analysis and methods

- ✓ A comprehensive line of spectrochemical analytical standard solutions. Specpure™ products are available from **stock, ready for immediate shipment**.

# Energy cell formulation materials

A battery's core components consist of an anode, cathode, electrolyte, and separator. For areas in research pertaining to each of these core components, Thermo Fisher Scientific provides **high-quality** metals, metal-oxides, ligands, and other raw materials to aid you in successful research.



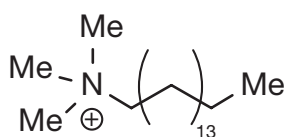
## Cathode formulation materials

The cathode is a source of ions which determines the capacity, as well as the average voltage of a battery. Thermo Scientific offers a **wide portfolio** of lithium-based sources for the traditional research, as well as a variety of salts for battery research.

### Examples of inorganic materials used in battery research

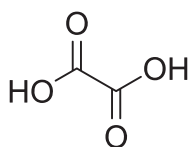
CAS No.	Catalog No.	Product Description	Formula
7429-90-5	040682	Aluminum Ultrathin foil, 0.0075 micron thick, 99.995% (metals basis)	Al
12057-24-8	041832	Lithium oxide, 99.5% (metals basis)	Li <sub>2</sub> O
12190-79-3	042090	Lithium Cobalt (III) Oxide, 99.5% metals basis (LCO)	LiCoO <sub>2</sub>
12057-17-9	040250	Lithium Manganese (III, IV) oxide, 99.5% (metals basis)	LiMn <sub>2</sub> O <sub>4</sub>
1310-66-3	H36379	Lithium hydroxide monohydrate, battery grade	LiOH
554-13-2	010734	Lithium carbonate, Puratronic™, 99.998% (metals basis excluding Ca), Ca LT 20 ppm	Li <sub>2</sub> CO <sub>3</sub>
1313-99-1	010819	Nickel(II) oxide, Puratronic™, 99.998% (metals basis)	NiO
1313-13-9	010805	Manganese(IV) oxide, Puratronic™, 99.996% (metals basis)	MnO <sub>2</sub>
6156-78-1	010802	Manganese(II) acetate tetrahydrate, Puratronic™, 99.999% (metals basis)	Mn(CH <sub>3</sub> COO) <sub>2</sub> ·4H <sub>2</sub> O
10034-96-5	A17615	Manganese(II) sulfate monohydrate, 99%	MnSO <sub>4</sub> ·H <sub>2</sub> O
6147-53-1	044345	Cobalt(II) acetate tetrahydrate, 99.999% (metals basis)	Co(CH <sub>3</sub> COO) <sub>2</sub> ·4H <sub>2</sub> O
1308-06-1	045806	Cobalt(II,III) oxide, 99.7% (metals basis), 2 to 6 μm powder	Co <sub>3</sub> O <sub>4</sub>
12136-58-2	012839	Lithium sulfide, 99.9% (metals basis)	Li <sub>2</sub> S
6018-89-9	010813	Nickel(II) acetate tetrahydrate, Puratronic™, 99.999% (metals basis)	Ni(CH <sub>3</sub> COO) <sub>2</sub> ·4H <sub>2</sub> O
10101-97-0	053130	Nickel(II) sulfate hexahydrate, 99.97% min (metals basis)	Ni <sub>2</sub> SO <sub>4</sub> ·6H <sub>2</sub> O
12030-49-8	043396	Iridium(IV) oxide, Premion™, 99.99% (metals basis), Ir 84.5% min	IrO <sub>2</sub>
50926-11-9	042677	Indium tin oxide, Vacuum Deposition Grade, 99.99% (metals basis)	In <sub>2-x</sub> Sn <sub>x</sub> -O <sub>3</sub>

### Examples of organic materials used in battery cathode research



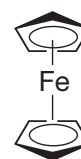
(1-Hexadecyl)trimethylammonium bromide (CTAB), 99+%,

Cat. No: 22716  
CAS No: 57-09-0



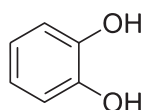
Oxalic acid dihydrate, 98%,

Cat. No: A13866  
CAS No: 6153-56-6



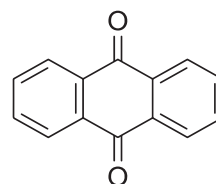
Ferrocene, high purity, 99+%,

Cat. No: 087202  
CAS No: 102-54-5



Catechol, 99+%

Cat. No: 15898  
CAS No: 120-80-9



9,10-Anthraquinone, 98+%

Cat. No: 10493  
CAS No: 84-65-1



# Anode formulation materials

Much of today's research is centered around increasing the anode's capacity and thereby battery performance. The combination or single-use of various metals, inorganic complexes, and organic materials are being explored in various research fields. Ranging from inorganic compounds to organic materials exhibiting various behaviors (e.g. **aromaticity**, **resonance**, **conjugation**, etc.), Thermo Scientific has the products you need to fulfil your anode research workflows.

## Examples of inorganic materials used in battery anode research

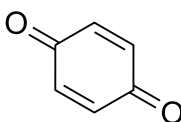
CAS No.	Catalog No.	Product Description	Formula
7440-50-8	010950 042972	Copper foil, 0.025mm (0.001in) thick, Puratronic™, 99.999% (metals basis) Copper foil, 0.05mm (0.002in) thick, Puratronic™, 99.9999% (metals basis)	Cu (0)
7439-93-2	010767	Lithium foil, 1.5mm (0.06in) thick x 100mm (3.9in) wide, 99.9% (metals basis)	Li (0)
7440-21-3	046308 044384	Silicon powder, crystalline, APS ≈ 100 nm, 99%, Plasma synthesized Silicon powder, crystalline, APS   <50 nm, 98%, Laser synthesized from vapor phase	Si (0)
7782-42-5	040798 040797 014734	Graphite powder, synthetic, conducting grade, -325 mesh, 99.9995% (metals basis) Graphite powder, synthetic, conducting grade, -200 mesh, 99.9995% (metals basis) Graphite powder, natural, high purity, -200 mesh, 99.9998% (metals basis)	C
7782-42-5	010832 043078	Graphite foil, 0.254mm (0.01in) thick, 99.8% (metals basis) Graphite foil, 0.13mm (0.005in) thick, 99.8% (metals basis)	C
1333-86-4	H30253 039724 045527	Carbon black, Conductive, 99+% (metals basis) Carbon black, acetylene, 50% compressed, 99.9+% Carbon black, acetylene, 100% compressed, 99.9+%	C
1317-80-2	014631	Titanium(IV) oxide, rutile, 99.99% (metals basis)	TiO <sub>2</sub>
10102-25-7	044352	Lithium sulfate, anhydrous, 99.99% (metals basis)	Li <sub>2</sub> SO <sub>4</sub>
10377-52-3	010743	Lithium phosphate, Puratronic®, 99.99% (metals basis)	Li <sub>3</sub> PO <sub>4</sub>

## Examples of organic materials used in battery anode research



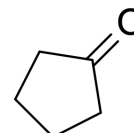
**Fullerene, carbon nanotube, multi-walled, ≤8 nm OD, 2-5 nm ID, 0.5-2 micron long**

Cat. No: 044790  
CAS No: 308068-56-6



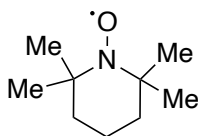
**p-Benzoquinone, 98+%,**

Cat. No: A13162  
CAS No: 106-51-4



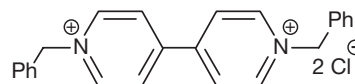
**Cyclopentanone, 99+% pure,**

Cat. No: 011153  
CAS No: 120-92-3



**TEMPO, free radical, 98+%,**

Cat. No: A12733  
CAS No: 2564-83-2



**Benzoyl viologen dichloride, 97%,**

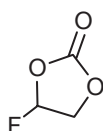
Cat. No: H66836  
CAS No: 1102-19-8

# Electrolyte formulation materials

Transporting positively charged ions between the anode and cathode, the electrolyte is a key component of any battery cell. Our range of organic compounds from Thermo Scientific will be able to help you through your research requirements, particularly in these classes of compounds:

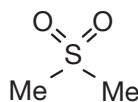
- 1. Conjugated Hydrocarbons:** These include various olefins, alkynes, and conjugated pi structures.
- 2. Heterocyclics:** Cyclic compounds which contain atoms from at least two different elements in the ring, and include nitrogen, oxygen, phosphorous, sulfur, and mixed heterocycles.
- 3. Aromatics:** Examples include benzene or pyridine and its derivatives.
- 4. Carbonyls:** Oxygen-containing compounds include aldehydes, ketones, esters, and carboxylic acids and its derivatives.

## Examples of materials used in electrolyte research



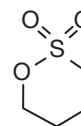
**4-Fluoro-1,3-dioxolan-2-one**  
98.0%

Cat. No: H61502  
CAS No: 114435-02-8



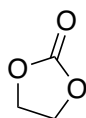
**Dimethyl sulfone, 99%,**

Cat. No: B21747  
CAS No: 67-71-0



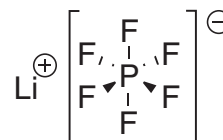
**1,4-Butanesultone, 99%**

Cat. No: L03992  
CAS No: 121-43-7



**Ethylene carbonate, 99%,**

Cat. No: A15735  
CAS No: 96-49-1



**Lithium hexafluorophosphate**  
**(LiPF<sub>6</sub>), 98%**

Cat. No: 011529  
CAS No: 21324-40-3

# Supporting your production needs

## Custom and Bulk (C&B) chemical services at a glance

When you are ready to take your research into the production stage, we can bridge that gap by providing end-to-end customer solutions to serve specialty fine chemical and analytical solvent needs.

Through our extensive global network of over 3,000 chemical suppliers, trust us to manage your entire process – supply chain management and logistics. You will get the quality, ready-to-use, chemicals you need shipped to your schedule.

### Summary of capabilities:

#### 1. Supply Chain Management

This allows our customers to **simplify scale-up costs** effectively and it **drives efficiency** in handling, storage, and product integrity. At the same time, confidently manage and source the chemicals you need throughout your entire workflow with our custom and bulk chemical services.

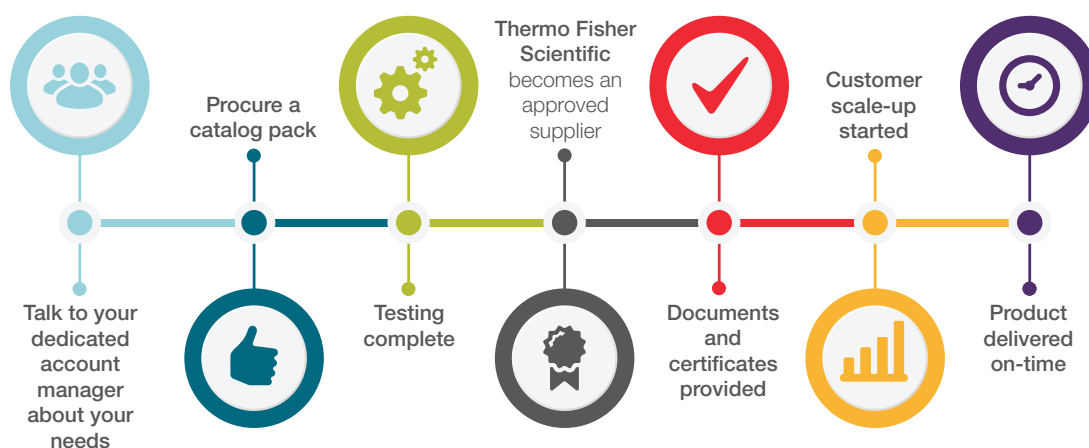
#### 2. Customization

As part of understanding our customers' stringent requirements, we offer tailor-made specifications, blending, packaging, labeling, documentation, and delivery schedule. Custom specifications are also incorporated into the corresponding certificate of analysis (CoA) of these products.

#### 3. Mixed blends

Chemicals that are compatible for mixing can be done so through our manufactured blends. This has the potential to **save time, reduce waste**, and bring about consistent quality every single time.

### Your journey guide



We enable our customers to focus on results with a fully managed service.



# Elemental analysis and methods

## Thermo Scientific™ Specpure™ analytical standards

Our range of Thermo Scientific Specpure™ products is our comprehensive offering of spectrochemical analytical standard solutions.

Specpure standards are unsurpassed in accuracy, purity and quality. Our atomic absorption standards solutions are accurate to  $\pm 1.0\%$  and the plasma solutions to  $\pm 0.3\%$ .

### Specpure™ atomic absorption standards

These solutions are intended for use with either flame or furnace absorption spectroscopy. Our standards are the most frequently used instrumental technique for elemental analysis. The Thermo Scientific range offers 70 single element aqueous solutions at 1,000  $\mu\text{g/mL}$  in both 100 mL and 500 mL sizes.

### Specpure™ plasma standards

These solutions are intended for ICP-OES, ICP-MS, XRF, and other techniques for elemental analysis. These techniques are capable of determining the concentrations of many elements **quickly**, either **simultaneously** or **sequentially**.

### Features of Specpure™ analytical standards

- A NIST-traceable Certificate of Analysis is included with each standard solution
- These standards are ISO9001, ISO Guide 34, and ISO/IEC17025
- Expiration date stickers are included with each standard solution
- Certified accuracy of  $\pm 1.0\%$  for atomic absorption standards and  $\pm 0.3\%$  for plasma solutions from the stated concentration



### Additional resources

Learn more about our products in detail through our Analytical standards brochure

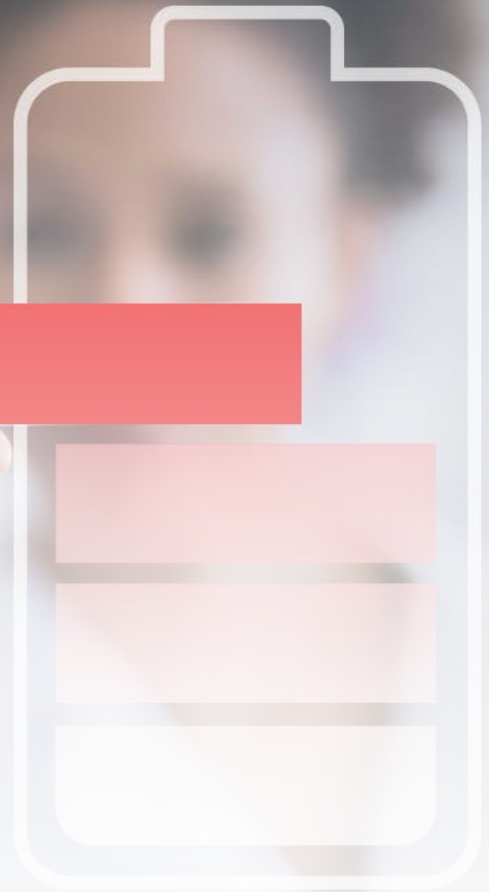
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