

BATTERY MATERIALS

- Lithium Compounds & Battery Materials..... VII 02
- Key Performance indicators..... VII 03
- Battery Materials List..... VII 04



Lithium Compounds & Battery Materials

Lithium-ion battery materials mainly include cathode material, anode material, electrolyte and diaphragm. The cathode material is the decisive factor for the electrochemical performance of lithium batteries, which directly determines the energy density and safety of the battery, and then affects the overall performance of the battery.

The cathode materials of lithium ion battery mainly include the following types:

- Metallic oxide: Mainly include layered structure metal oxides and spinel type metal oxides.
- Polyanionic salts: Phosphate, Silicate, Sulfate, Borate, Titanate, etc.
- Other compounds: Fluoride, Sulfide, Selenide, etc.



Generally, the key performance indicators of anode battery materials include: chemical composition, crystal structure, particle size, Tap density, BET, PH, initial charge/discharge capacity, etc.

- ◆ Chemical composition: The cathode materials in lithium-ion batteries are all lithium-containing oxides, and generally the higher the lithium content, the higher the capacity.
- ◆ Crystal Structure: There are 3 types of lithium-ion battery cathode material: α -NaFeO₂ layered, olivine, spinel
- ◆ Particle size: Particle size distribution is a key factor affecting charge-discharge performance.
- ◆ Tap density: The mass per unit volume measured after the powder in the container is vibrated under specified conditions.
- ◆ BET: When the specific surface area of the anode is large, the cell has better multiplication characteristics, but is usually more likely to react with the electrolyte, making cycling and storage worse.
- ◆ PH: A slightly excessive amount of Li/Me is usually used to prepare cathode materials to ensure that the material is thoroughly lithium from the inside out.
- ◆ Initial charge/discharge capacity: It is closely related to the content of main elements, crystal structure, particle size, charging and discharging voltage, charging and discharging current.



Battery Materials List

CHEMICAL NAME	FORMULA	PURITY	COLOR
Lithium Sulfide	Li ₂ S	3N	White
Germanium Sulfide	GeS/GeS ₂	5N	White
Silicon Sulfide	SiS ₂	5N	White
Lithium Fluoride	LiF	3N	White
Lithium Hydroxide	LiOH/LiOH*H ₂ O	3N	White
Lithium Carbonate	Li ₂ CO ₃	3N	Pale grey
Lithium Cobalt Oxide	LiCoO ₂	3N	Black
Lithium Cobalt Oxide	Li _(1+x) CoO ₂	3N	Black
Lithium Manganate	LiMn ₂ O ₄	3N	Black
Lithium Manganate	Li _(1+x) Mn ₂ O ₄	3N	Black
Aluminum doped Lithium Manganate	LiMn ₂ O ₄ +Al _(x)	3N	Black
Lithium Nickel Manganate	LiNi _{0.5} Mn _{1.5} O ₄	3N	Black
Lithium Nickelate	LiNiO ₂	3N	Black
Lithium Nickel Cobalt Aluminum Oxide (NCA811)	LiNi _{0.8} Co _{0.1} Al _{0.1} O ₂	3N	Black, Spinel structure
Lithium Nickel Manganate	LiNi _{0.5} Mn _{1.5} O ₄	3N	Black, Spinel structure
Lithium Nickel Cobalt Manganate	LiNi _(x) Co _(y) Mn _(z) O _(z)	3N	Black
Lithium Nickel Cobalt Manganate (NCM111)	Li[Ni _{0.33} Co _{0.33} Mn _{0.33}]O ₂	3N	Black
Lithium Nickel Cobalt Manganate (NCM811)	Li _{1.05} [Ni _{0.8} Co _{0.1} Mn _{0.1}]O ₂	3N	Black
Lithium Nickel Cobalt Manganate (NCM523)	Li(Ni _{0.5} Co _{0.2} Mn _{0.3})O ₂	3N	Black
Lithium Nickel Cobalt Manganate (NCM622)	LiNi _{0.6} Co _{0.2} Mn _{0.2} O ₂	3N	Black
Lithium Iron Phosphate	LiFePO ₄	3N	Black
Lithium Cobalt Phosphate	LiCoPO ₄	3N	Fuchsia
Lithium Nickel Phosphate	LiNiPO ₄	3N	Faint yellow
Lithium Manganese Phosphate	LiMnPO ₄	3N	Dark purple
Lithium Nickel Vanadate	LiNiVO ₄	3N	Dark green
Lithium Vanadate	LiV ₃ O ₆	3N	Brownness
Lanthanum Vanadate	LaVO ₄	3N	Greenyellow
Lanthanum metavanadate	LaVO ₃	3N	Black
Lithium Nitrate	LiNO ₃	3N	White
Lithium Aluminate	LiAlO ₂	3N	White
Lithium Phosphate	Li ₃ PO ₄	3N5	White

Lithium Borate	LiB_3O_5	3N	White
Lithium Titanate	$\text{Li}_4\text{Ti}_5\text{O}_{12}$	3N	White
Carbon coated Lithium Titanate	$\text{C-Li}_4\text{Ti}_5\text{O}_{12}$	3N	Black
Lithium Titanium Phosphate	$\text{LiTi}_2(\text{PO}_4)_3$	3N	White
Lithium Titanium Aluminum Phosphate	$\text{LiTiAl}(\text{PO}_4)_3$	3N	
Carbon coated Lithium Titanium Phosphate	$\text{C-LiTi}_2(\text{PO}_4)_3$	3N	Gray
Lithium Aluminum Titanium Phosphate	$\text{LiAl}_{(x)}\text{Ti}_{(2-x)}(\text{PO}_4)_3$	3N	White
Lithium Aluminum Germanium Phosphate	$\text{Li}_{1.5}\text{Al}_{0.5}\text{Ge}_{1.5}(\text{PO}_4)_3$	3N	White
Lithium Scandium Phosphate	$\text{Li}_3\text{Sc}_2(\text{PO}_4)_3$	3N	White
Lithium Aluminum Scandium Phosphate	$\text{Li}_{3.5}\text{Al}_{0.4}\text{Sc}_{1.6}(\text{PO}_4)_3$	3N	White
Lithium Lanthanum Titanate	$\text{Li}_{0.35}\text{La}_{0.57}\text{TiO}_3$	3N	Faint yellow
Lithium Lanthanum Titanate	$\text{Li}_{0.33}\text{La}_{0.56}\text{TiO}_3$	3N	Faint yellow
Lithium Lanthanum Tantalate	$\text{Li}_{0.35}\text{La}_{0.57}\text{Ta}_{0.8}\text{O}_3$	3N	White
Lithium Lanthanum Niobate	$\text{Li}_{0.35}\text{La}_{0.57}\text{Nb}_{0.8}\text{O}_3$	3N	White
Lithium Silicate	$\text{Li}_2\text{SiO}_3/\text{Li}_4\text{SiO}_4$	3N	White
Lithium Silicon Phosphate	$\text{Li}_{3.5}\text{Si}_{0.5}\text{P}_{0.5}\text{O}_4(\text{Li}_3\text{PO}_4:\text{Li}_2\text{SiO}_3)$	3N	White
Lithium Aluminum Silicate	LiAlSiO_4	3N	White
Boron oxide doped Lithium Phosphate	$\text{Li}_3\text{PO}_4:\text{B}_2\text{O}_3$	3N	Pale brown
Lithium Lanthanum Zirconium Oxide (LLZO)	$\text{Li}_{6.75}\text{La}_3\text{Zr}_{1.75}\text{O}_{12}/\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$	3N	Brownish
Aluminum doped Lithium Lanthanum Zirconium Oxide	$\text{Al}_{0.25}\text{-Li}_{6.75}\text{La}_3\text{Zr}_{1.75}\text{O}_{12}$	3N	Brownish
Tantalum doped Lithium Lanthanum Zirconium Oxide	$\text{Ta}_{0.25}\text{-Li}_{6.75}\text{La}_3\text{Zr}_{1.75}\text{O}_{12}/\text{Ta}_{0.6}\text{-Li}_{6.4}\text{La}_3\text{Zr}_{1.4}\text{O}_{12}$	3N	White
Aluminum Tantalum doped Lithium Lanthanum Zirconium Oxide	$\text{Al}_{0.2}\text{-Ta}_{0.25}\text{-Li}_{6.75}\text{La}_3\text{Zr}_{1.75}\text{O}_{12}$	3N	
Niobium doped Lithium Lanthanum Zirconium Oxide	$\text{Nb}_{0.25}\text{-Li}_{6.75}\text{La}_3\text{Zr}_{1.75}\text{O}_{12}/\text{Li}_{6.5}\text{La}_3\text{Zr}_{1.5}\text{Nb}_{0.5}\text{O}_{12}$	3N	White
Gallium doped Lithium Lanthanum Zirconium Oxide	$\text{Li}_{6.4}\text{Ga}_{0.2}\text{La}_3\text{Zr}_2\text{O}_{12}$	3N	White
Tungsten doped Lithium Lanthanum Zirconium Oxide	$\text{Li}_{6.3}\text{La}_3\text{Zr}_{1.65}\text{W}_{0.35}\text{O}_{12}$	3N	White
Lithium Phosphorus Sulfide	Li_3PS_4	4N	Off-White
Lithium Phosphorus Sulfur Chloride	$\text{Li}_6\text{PS}_5\text{Cl}$	3N	Off-White
Lithium Phosphorus Sulfur Bromide	$\text{Li}_6\text{PS}_5\text{Br}$	3N5	Off-White
Lithium Phosphorus Sulfur Iodide	$\text{Li}_6\text{PS}_5\text{I}$	3N	Off-White
Lithium Germanium Phosphorus Chloride	$\text{Li}_{10}\text{GeP}_2\text{S}_{12}\text{Cl}$	3N	Off-White
Lanthanum Manganate	LaMnO_3	3N	Black
Lanthanum Barium Manganate	$\text{La}_{(1-x)}\text{Ba}_{(x)}\text{MnO}_3$	3N	Black
Lanthanum Barium Tin Oxide	$\text{La}_{(1-x)}\text{Ba}_{(x)}\text{SnO}_3$	3N	
Lanthanum Titanate	$\text{La}_2\text{Ti}_2\text{O}_7$	3N	Black
Lanthanum Zirconate	$\text{La}_2\text{Zr}_2\text{O}_7$	3N	Faint yellow

Lanthanum Aluminate	LaAlO ₃	3N	
Lanthanum nickelate	LaNiO ₃	3N	Black
Lanthanum Iron nickelate	LaFe _{0.25} Ni _{0.75} O ₃	3N	Black
Lanthanum Iron aluminate	LaFe _{0.25} Al _{0.75} O ₃	3N	
Lanthanum Manganese aluminate	LaMn _(x) Al _(1-x) O ₃	3N	
Lanthanum Nickel aluminate	LaNi _(x) Al _(1-x) O ₃	3N	
Lanthanum Vanadium aluminate	LaV _(x) Al _(1-x) O ₃	3N	
Lanthanum Strontium Manganate	La _(1-x) Sr _(x) MnO ₃	4N	Black
Lanthanum Strontium Manganate	(La _{0.8} Sr _{0.2}) _{0.98} MnO ₃	3N5	Black
Lanthanum Strontium Cobaltate	La _(1-x) Sr _(x) CoO ₃	3N	Black
Calcium Manganate	CaMnO ₃	3N	Black
Lanthanum calcium manganate	La _(1-x) Ca _(x) MnO ₃	3N	Black
Lanthanum Cobaltate	LaCoO ₃	3N	Yellow
Lanthanum Strontium Cobaltate	La _(1-x) Sr _(x) CoO ₃	3N	Black
Cobalt Ferrite	CoFe ₂ O ₄	3N	Black
Lanthanum Strontium Ferrite	(La _{0.8} Sr _{0.2})FeO ₃	3N	Black
Lanthanum Strontium Iron Cobaltate	La _(1-x) Sr _(x) Fe _(y) Co _(1-y) O ₃	3N	Black
Cerium Oxide	CeO ₂	3N	Pale Yellow
Samarium doped Cerium Oxide	Ce _{0.9} Sm _{0.1} O _{1.95}	3N	Pale Yellow
Gadolinium doped Cerium Oxide	Ce _{0.9} Gd _{0.1} O _{1.95} /Ce _{0.8} Gd _{0.2} O _{1.95}	3N	Pale Yellow
Zirconium Scandium Aluminum Oxides	ZrO ₂ :Sc ₂ O ₃ :Al ₂ O ₃ (89:10:1wt%)	3N	White
Zirconium Scandium Aluminum Oxides	ZrO ₂ :Sc ₂ O ₃ :Al ₂ O ₃ (93:6:1wt%)	3N	White
Zirconium Scandium Cerium Oxides	ZrO ₂ :Sc ₂ O ₃ :CeO ₂ (89:10:1wt%)	3N	White
Zirconium Scandium Oxides	ZrO ₂ :Sc ₂ O ₃ (90:10wt%)	3N	White
Lanthanum manganese chromate	LaMn ₃ Cr ₄ O ₁₂	3N	Black
Yttrium manganate	YMnO ₃	3N	Black
Lanthanum Ferrite	LaFeO ₃	3N	
Lanthanum Magnesium Ferrite	La _(1-x) Mg _(x) FeO ₃	3N	
Lithium tungstate	Li ₂ WO ₄	3N	White
Lithium Niobate	LiNbO ₃	3N	White
Lithium Tantalate	LiTaO ₃	3N	White
Magnesium Phosphate	Mg ₃ (PO ₄) ₂	3N	White
Bismuth Yttrium ferrite	B _{i(x)} Y _(3-x) Fe ₅ O ₁₂	3N	Sepia
Yttrium tantalate	YTaO ₄	3N5	White
Neodymium aluminate	NdAlO ₃	3N	
Lanthanum chromate	LaCrO ₃	3N	
Yttrium chromate	YCrO ₃	3N	
Strontium vanadate	SrVO ₄	3N	

Ownership belongs to VI HALBLEITERMATERIAL, reprinting is prohibited.