BATTERY MATERIALS

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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_2S	3N	White
Germanium Sulfide	GeS/GeS_2	5N	White
Silicon Sulfide	SiS_2	5N	White
Lithium Fluoride	LiF	3N	White
Lithium Hydroxide	$LiOH/LiOH*H_2O$	3N	White
Lithium Carbonate	Li_2CO_3	3N	Pale grey
Lithium Cobalt Oxide	$LiCoO_2$	3N	Black
Lithium Cobalt Oxide	$Li_{(1+x)}CoO_2$	3N	Black
Lithium Manganate	$LiMn_2O_4$	3N	Black
Lithium Manganate	$Li_{(1+x)}Mn_2O_4$	3N	Black
Aluminum doped Lithium Manganate	$LiMn_2O_4+Al_{(x)}$	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	$LiNi_{(x)}Co_{(y)}Mn_{(y)}O_{(z)}$	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_3O_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_3PO_4	3N5	White

Lithium Borate	LiB_3O_5	3N	White
Lithium Titanate	$Li_4Ti_5O_{12}$	3N	White
Carbon coated Lithium Titanate	C-$Li_4Ti_5O_{12}$	3N	Black
Lithium Titanium Phosphate	$LiTi_2(PO_4)_3$	3N	White
Lithium Titanium Aluminum Phosphate	$LiTiAl(PO_4)_3$	3N	
Carbon coated Lithium Titanium Phosphate	C-$LiTi_2(PO_4)_3$	3N	Gray
Lithium Aluminum Titanium Phosphate	$LiAl_{(x)}Ti_{(2-x)}(PO_4)_3$	3N	White
Lithium Aluminum Germanium Phosphate	$Li_{1.5}Al_{0.5}Ge_{1.5}(PO_4)_3$	3N	White
Lithium Scandium Phosphate	$Li_3Sc_2(PO_4)_3$	3N	White
Lithium Aluminum Scandium Phosphate	$Li_{3.5}Al_{0.4}Sc_{1.6}(PO_4)_3$	3N	White
Lithium Lanthanum Titanate	$Li_{0.3}5La_{0.57}TiO_3$	3N	Faint yellow
Lithium Lanthanum Titanate	$Li_{0.33}La_{0.56}TiO_3$	3N	Faint yellow
Lithium Lanthanum Tantalate	$Li_{0.35}La_{0.57}Ta_{0.8}O_3$	3N	White
Lithium Lanthanum Niobate	$Li_{0.35}La_{0.57}Nb_{0.8}O_3$	3N	White
Lithium Silicate	Li_2SiO_3/Li_4SiO_4	3N	White
Lithium Silicon Phosphate	$Li_{3.5}Si_{0.5}P_{0.5}O_4$($Li_3PO_4$:$Li_2SiO_3$)	3N	White
Lithium Aluminum Silicate	$LiAlSiO_4$	3N	White
Boron oxide doped Lithium Phosphate	Li_3PO_4:B_2O_3	3N	Pale brown
Lithium Lanthanum Zriconium Oxide (LLZO)	$Li_{6.75}La_3Zr_{1.75}O_{12}$/$Li_7La_3Zr_2O_{12}$	3N	Brownish
Aluminum doped Lithium Lanthanum Zriconium Oxide	$Al_{0.25}$-$Li_{6.75}La_3Zr_{1.75}O_{12}$	3N	Brownish
Tantalum doped Lithium Lanthanum Zriconium Oxide	$Ta_{0.25}$-$Li_{6.75}La_3Zr_{1.75}O_{12}$/ $Ta_{0.6}$-$Li_{6.4}La_3Zr_{1.4}O_{12}$	3N	White
Aluminum Tantalum doped Lithium Lanthanum Zriconium Oxide	$Al_{0.2}$-$Ta_{0.25}$-$Li_{6.75}La_3Zr_{1.75}O_{12}$	3N	
Niobium doped Lithium Lanthanum Zriconium Oxide	$Nb_{0.25}$-$Li_{6.75}La_3Zr_{1.75}O_{12}$/ $Li_{6.5}La_3Zr_{1.5}Nb_{0.5}O_{12}$	3N	White
Gallium doped Lithium Lanthanum Zriconium Oxide	$Li_{6.4}Ga_{0.2}La_3Zr_2O_{12}$	3N	White
Tungsten doped Lithium Lanthanum Zriconium Oxide	$Li_{6.3}La_3Zr_{1.65}W_{0.35}O_{12}$	3N	White
Lithium Phosphorus Sulfide	Li_3PS_4	4N	Off-White
Lithium Phosphorus Sulfur Chloride	Li_6PS_5Cl	3N	Off-White
Lithium Phosphorus Sulfur Bromide	Li_6PS_5Br	3N5	Off-White
Lithium Phosphorus Sulfur Iodide	Li_6PS_5I	3N	Off-White
Lithium Germanium Phosphorus Chloride	$Li_{10}GeP_2S_{12}Cl$	3N	Off-White
Lanthanum Manganate	$LaMnO_3$	3N	Black
Lanthanum Barium Manganate	$La_{(1-x)}Ba_{(x)}MnO_3$	3N	Black
Lanthanum Barium Tin Oxide	$La_{(1-x)}Ba_{(x)}SnO_3$	3N	
Lanthanum Titanate	$La_2Ti_2O_7$	3N	Black
Lanthanum Zirconate	$La_2Zr_2O_7$	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	$CoFe_2O_4$	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_2O_3:Al_2O_3(89:10:1wt%)	3N	White
Zirconium Scandium Aluminum Oxides	ZrO_2:Sc_2O_3:Al_2O_3(93:6:1wt%)	3N	White
Zirconium Scandium Cerium Oxides	ZrO_2:Sc_2O_3:CeO_2(89:10:1wt%)	3N	White
Zirconium Scandium Oxides	ZrO_2:Sc_2O_3(90:10wt%)	3N	White
Lanthanum manganese chromate	$LaMn_3Cr_4O_{12}$	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_2WO_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	$B_{i(x)}Y_{(3-X)}Fe_5O_{12}$	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	

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