

**Battery
Materials**

Rechargeable Battery Reagents



Class of Reagents

- Lithium-Ion Battery
 - Toshima Manufacturing, Ltd.,
Materials of Lithium-Ion Batteries
 - SHINSHU VOLTA CO., LTD.,
Materials of Lithium-Ion Batteries
- Magnesium-Ion Battery
- Sodium-Ion Battery
- Ionic Liquids etc.

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Magnesium-Ion Battery

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Sodium-Ion Battery

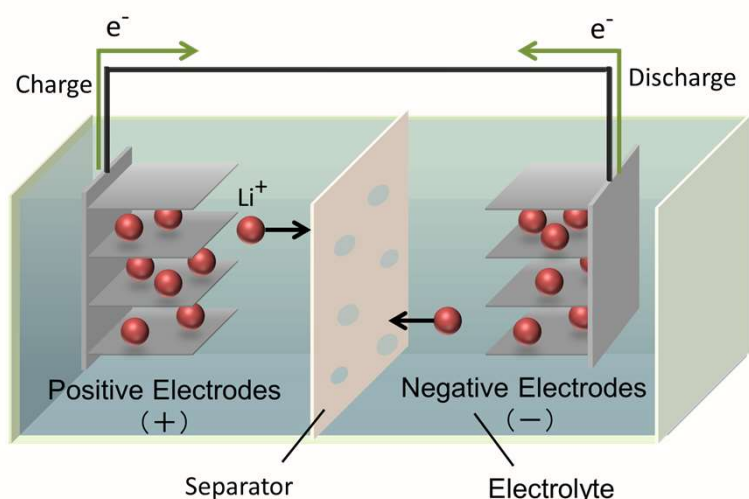
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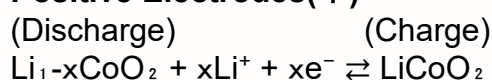
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Lithium-Ion Battery

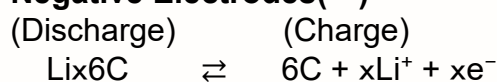
Lithium-ion batteries are used in a wide range of products due to their high energy density and voltage. Because of the development of electric vehicles and mobile devices, the demand for high-capacity, high-voltage, and safe secondary batteries is growing. FUJIFILM Wako deals with various materials that constitute lithium-ion batteries.



Positive Electrodes(+)



Negative Electrodes(-)



Mechanism of the LIB system

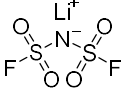
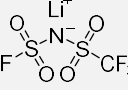
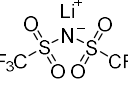
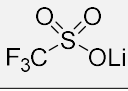
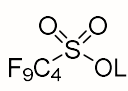
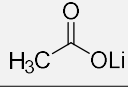
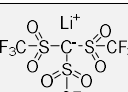
Positive Electrodes

Manufacturer	Code No.	Product Name	Formula	Storage Condition CAS RN®	Pack Size
FUJIFILM Wako Pure Chemical	125-03501	Lithium Molybdate	Li_2MoO_4	Keep at RT	100g
	127-03505			13568-40-6	500g

Negative Electrodes

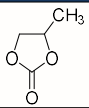
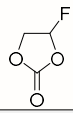
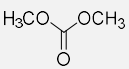
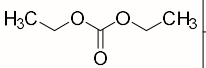
Manufacturer	Code No.	Product Name	Formula	Storage Condition CAS RN®	Pack Size
FUJIFILM Wako Pure Chemical	127-06001	Lithium, Shot	Li	Keep at RT 7439-93-2	10g
FUJIFILM Wako Pure Chemical	208-01602	Tin(IV) Oxide (98.0+%)	SnO_2	Keep at RT	25g
	202-01605			18282-10-5	500g
FUJIFILM Wako Pure Chemical	191-05582	Silicon, Powder, 99.9%	Si	Keep at RT 7440-21-3	25g
FUJIFILM Wako Pure Chemical	198-05612	Silicon Monoxide, 99.9%	SiO	Keep at RT 10097-28-6	25g
FUJIFILM Wako Pure Chemical	190-09072	Silicon Dioxide, 99.9%	SiO_2	Keep at RT	25g
	192-09071			7631-86-9	100g

Electrolytes

Manufacturer	Code No.	Product Name	Formula	Melting point (ref.)	Storage Condition	Pack Size
					CAS RN®	
FUJIFILM Wako Pure Chemical	122-06632	Lithium Bis(fluorosulfonyl)imide 【Synonyms : LiFSI】		140°C	Keep at RT	25g
	124-06631				171611-11-3	100g
FUJIFILM Wako Pure Chemical	120-06851	Lithium (Fluorosulfonyl) (trifluoromethanesulfonyl)imide 【Synonyms : LiTFSI】		100°C	Keep at RT	5g
					192998-62-2	
FUJIFILM Wako Pure Chemical	129-06642	Lithium Bis(trifluoromethanesulfonyl)imide 【Synonyms : LiTFSI】		234-238°C	Keep at RT	25g
	121-06641				90076-65-6	100g
FUJIFILM Wako Pure Chemical	128-03792	Lithium Trifluoromethanesulfonate		423°C	Keep at RT	25g
					33454-82-9	
FUJIFILM Wako Pure Chemical	327-61481	Lithium 1,1,2,2,3,3,4,4,4-Nonafluoro-1-butanesulfonate		370-380°C	Keep at RT	5g
	325-61482				131651-65-5	25g
FUJIFILM Wako Pure Chemical	123-01542	Lithium Acetate		280-285°C	Keep at RT	25g
	127-01545				546-89-4	500g
FUJIFILM Wako Pure Chemical	121-05921	Lithium Hexafluorophosphate*1	LiPF ₆	165-175°C	Keep at RT	10g
	127-05923				21324-40-3	50g
FUJIFILM Wako Pure Chemical	123-06042	Lithium Perchlorate*1	LiClO ₄	236°C	Keep at RT	25g
	125-06041				7791-03-9	100g
FUJIFILM Wako Pure Chemical	128-06031	Lithium Tetrafluoroborate*1	LiBF ₄	293°C	Keep at 2-10 °C	5g
	126-06032				14283-07-9	25g
FUJIFILM Wako Pure Chemical	121-06761	Lithium Tris(trifluoromethanesulfonyl)methide 【Synonyms : LiTFSM】		-	Keep at RT	1g
					132404-42-3	

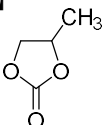
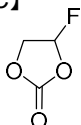
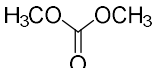
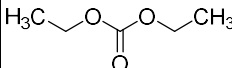
※1 Battery Grade

Solvents of the Electrolyte Solution

Manufacturer	Code No.	Product Name	Formula	Storage Condition	Pack Size
				CAS RN®	
FUJIFILM Wako Pure Chemical	169-25201	Propylene Carbonate 【Synonyms : PC】*1		Keep at RT	100mL
	161-25205			108-32-7	500mL
FUJIFILM Wako Pure Chemical	057-08491	Ethylene Carbonate 【Synonyms : EC】*1		Keep below 25 °C	100g
	059-08495			96-49-1	500g
FUJIFILM Wako Pure Chemical	063-06711	Fluoro Ethylene Carbonate 【Synonyms : FEC】*1		Keep at 2-10 °C	5g
	061-06712			114435-02-8	25g
FUJIFILM Wako Pure Chemical	044-31931	Dimethyl Carbonate 【Synonyms : DMC】*1		Keep at RT	100mL
	046-31935			616-38-6	500mL
FUJIFILM Wako Pure Chemical	047-31921	Diethyl Carbonate 【Synonyms : DEC】*1		Keep at RT	100mL
	049-31925			105-58-8	500mL

※1 = Battery Grade

●Specification

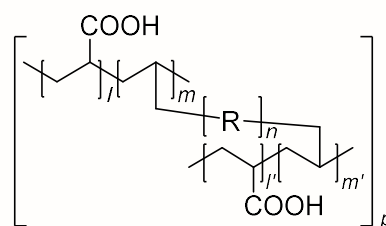
	Specification				
	【PC】 	【EC】 	【FEC】 	【DMC】 	【DEC】 
Purity (cGC)	≥98.0%	≥98.0%	≥99.5%	≥98.0%	≥98.0%
Water Content	≤20ppm	≤50ppm	≤200ppm	≤20ppm	≤20ppm
Acid (as H ₂ CO ₃)	-	-	-	≤0.1%	≤0.2%
Chloride	≤5ppm	≤5ppm	-	≤5ppm	≤5ppm
Ca	≤1.0ppm	≤1.0ppm	-	≤1.0ppm	≤1.0ppm
Fe	≤1.0ppm	≤1.0ppm	-	≤1.0ppm	≤1.0ppm
K	≤1.0ppm	≤1.0ppm	-	≤1.0ppm	≤1.0ppm
Na	≤1.0ppm	≤1.0ppm	-	≤1.0ppm	≤1.0ppm

Binder

Cross-linked Polyacrylic Acids, “CLPA Series”

The CLPA series is a water-based binder developed for the high capacity Si negative electrode for next generation lithium-ion secondary batteries.

The expansion and shrinkage of Si during charge and discharge causes isolation of Li-Si, inhibiting capacity degradation.

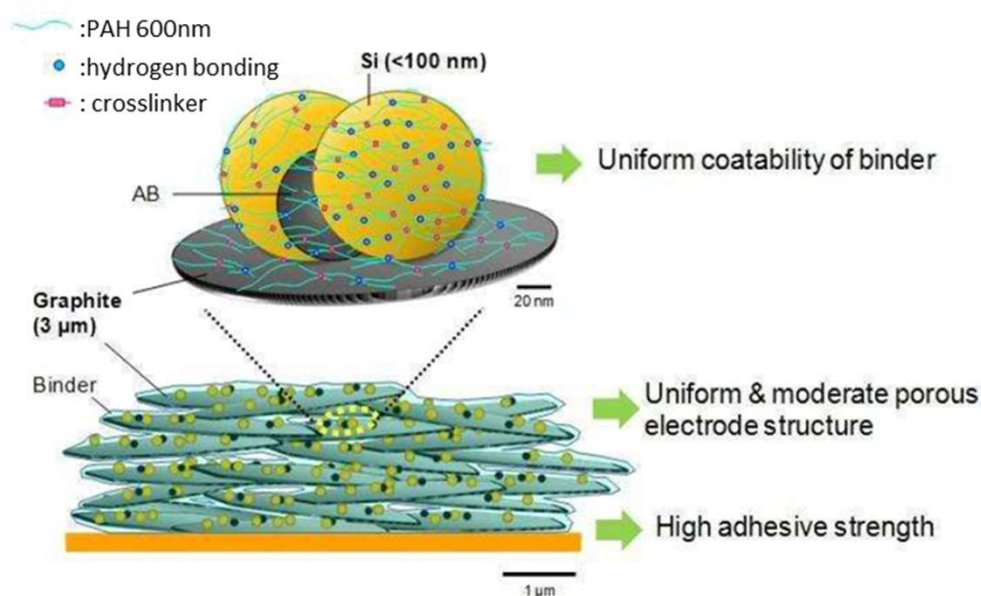


CLPA structure

Features

- The chemically cross-linked polyacrylic acid shows increased viscosity and thixotropy* when it is neutralized.
- Active materials are contained and the electrode destruction is prevented by the physical and chemical crosslinking, so that the cycle characteristic can be improved.

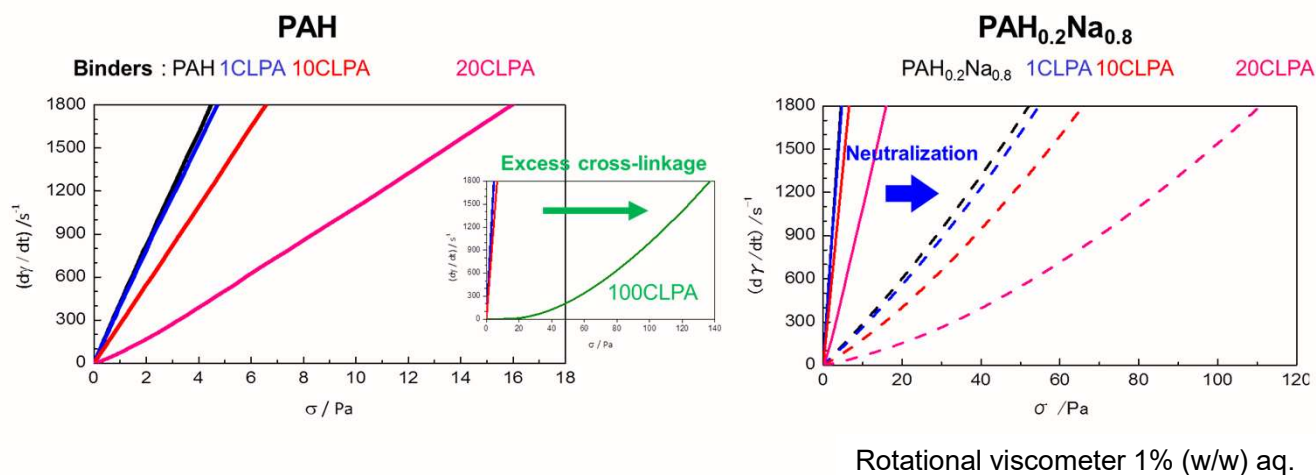
* Thixotropy is the property that the viscosity of a material decreases with time when the material is under constant shear stress and viscosity increases with time when the stress is removed.



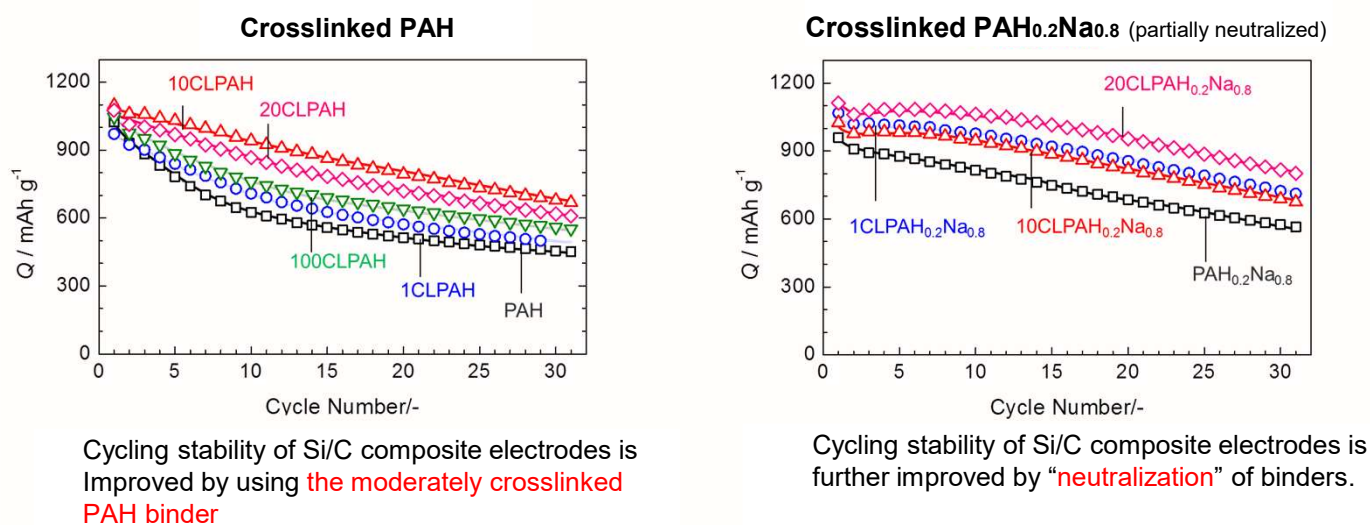
Manufacturer	Code No.	Product Name	Storage Condition	CAS RN®	Pack Size
FUJIFILM Wako Chemical	355-41122	PAH (non-crosslinked type)	Keep at RT	9003-01-4	25g
FUJIFILM Wako Chemical	352-41132	1 CLPAH	Keep at RT	9003-01-4	25g
FUJIFILM Wako Chemical	359-41142	10 CLPAH	Keep at RT	9003-01-4	25g
FUJIFILM Wako Chemical	356-41152	20 CLPAH	Keep at RT	9003-01-4	25g
FUJIFILM Wako Chemical	353-41162	100 CLPAH	Keep at RT	9003-01-4	25g

Physical and Electrochemical Properties of CLPA

● Viscosity of Binder Solution



● Capacity retention; Effect of Covalent Crosslinkage & Partial Neutralization [a]



[a] Komaba, S. et al. : *J. Electrochem. Soc.*, **162.**, A2245 (2015).

Toshima Manufacturing Co., Ltd., Materials of Lithium-Ion Batteries

Creating
Impressive
Technology



TOSHIMA
Manufacturing

FUJIFILM Wako provides lithium-ion battery materials manufactured by Toshima Manufacturing Co., Ltd. A company engaged in the development and marketing of positive electrode materials used in lithium-ion batteries and solid electrolytes, which have been attracting public attention, can provide such materials with high purity. Materials and shapes not listed in the lineups can be provided. Please contact if the product you want is not included in the list.

Positive Electrodes

Code No.	Manufacturer Code No.	Product Name	Purity	Appearance	Size	Storage Condition	Pack Size
						CAS RN®	
381-04661	LiLBPW01	LiCoO ₂	3N*2	Powder	0.5~1μm	Keep at RT	100g
						12190-79-3	
389-04601	LiLBPW03	LiNiO ₂	3N	Powder	5~15μm	Keep at RT	100g
						12031-65-1	
382-04831	LiLBPW05	LiFeO ₂	3N	Powder	5~15μm	Keep at RT	100g
						12022-46-7	
385-04681	LiLBPW07	Li ₂ MnO ₃	3N	Powder	5~15μm	Keep at RT	100g
						-	
386-04611	LiLBPW09	LiMn ₂ O ₄	3N	Powder	5~15μm	Keep at RT	100g
						12057-17-9	
385-04701	LiLBPW13	LiNi _{0.5} Mn _{1.5} O ₄	3N	Powder	30~50μm	Keep at RT	100g
						-	
-	LiLBPW16	LiCo _{1/3} Ni _{1/3} Mn _{1/3} O ₂	3N	Powder	5~15μm	Keep at RT	100g
						346417-97-8	
383-04621	LiLBPW18	LiFePO ₄	3N	Powder	5~15μm	Keep at RT	100g
						15365-14-7	
380-04631	LiLBPW20	LiCoPO ₄	3N	Powder	1~10μm	Keep at RT	100g
						13824-63-0	
388-04671	LiLBPW22	LiNiPO ₄	3N	Powder	1~10μm	Keep at RT	100g
						13977-83-8	
382-04691	LiLBPW24	LiMnPO ₄	3N	Powder	1~10μm	Keep at RT	100g
						13826-59-0	
382-19221	-	Li ₃ V ₂ (PO ₄) ₃	3N	Powder	5~15μm	Keep at RT	100g
						-	
389-04841	-	LiCo _{0.2} Ni _{0.4} Mn _{0.4} O ₂	3N	Powder	1~10μm*3	Keep at RT	100g
						-	

※2 3N=99.9%

※3 Estimation

Code No.	Manufacturer Code No.	Product Name	Purity	Appearance	Size	Storage Condition	Pack Size
						CAS RN®	
-	-	NCM523 ($\text{LiNi}_{0.5}\text{Co}_{0.2}\text{Mn}_{0.3}\text{O}_2$)	3N*2	Powder	5~15 μm	Keep at RT	100g
						-	
-	-	NCM622($\text{LiNi}_{0.6}\text{Co}_{0.2}\text{Mn}_{0.2}\text{O}_2$)	2N5*4	Powder	5~15 μm	Keep at RT	100g
						-	
-	-	NCM811($\text{LiNi}_{0.8}\text{Co}_{0.1}\text{Mn}_{0.1}\text{O}_2$)	2N5	Powder	5~15 μm	Keep at RT	100g
						-	
-	-	1.15C+LiFePO ₄	3N	Powder	1~10 μm	Keep at RT	100g
						-	
-	-	2C+LiMn _{0.6} Fe _{0.4} PO ₄	3N	Powder	1~10 μm	Keep at RT	100g
						-	

※4 2N5=99.5%

Negative Electrodes

Code No.	Manufacturer Code No.	Product Name	Purity	Appearance	Size	Storage Condition	Pack Size
						CAS RN®	
385-04561	LiLBPW56	Li ₄ Ti ₅ O ₁₂	3N	Powder	1~10 μm	Keep at RT	100g
						-	
-	-	C (Spherical graphite : C-Dm10)	4N*5	Powder	9~11 μm	Keep at RT	100g
						-	
-	-	C (Spherical graphite : C-Dm15)		Powder	14~16 μm	Keep at RT	100g
						-	
-	-	C (Spherical graphite : C-Dm22)		Powder	21~23 μm	Keep at RT	100g
						-	

※5 4N=99.99%

■ All solid Electrolytes for all solid-state Batteries

All solid-state lithium-ion batteries that use no organic solvent are the subject of active research to develop an incombustible and safer next-generation battery. Toshima Manufacturing Co., Ltd. offers various materials, such as NASICON or perovskite type materials, representative solid electrolyte materials and garnet type materials with excellent oxidation/reduction stability and large potential window.

Code No.	Manufacturer Code No.	Product Name	Purity	Appearance	Size	Storage Condition	Pack Size
						CAS RN®	
381-13152	LiLBPW26	$\text{Li}_{6.25}\text{La}_3\text{Zr}_2\text{Al}_{0.25}\text{O}_{12}$ (cubic)	3N	Powder	5~10 μm	Keep at RT	25g
						-	
388-13162	LiLBPW28	$\text{Li}_{6.6}\text{La}_3\text{Zr}_{1.6}\text{Ta}_{0.4}\text{O}_{12}$ (cubic)	3N	Powder	5~10 μm	Keep at RT	25g
						-	
389-04802	LiLBPW32	$\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ (tetra)	3N	Powder	5~15 μm	Keep at RT	25g
						-	
387-04722	LiLBPW36	$\text{Li}_{0.33}\text{La}_{0.55}\text{TiO}_3$ (tetra)	3N	Powder	5~10 μm	Keep at RT	25g
						-	
388-04752	LiLBPW42	$\text{Li}_{1.5}\text{Al}_{0.5}\text{Ge}_{1.5}\text{P}_3\text{O}_{12}$ (amorphous)	3N	Powder	5~15 μm	Keep at RT	25g
						-	
381-04742	LiLBPW44	$\text{Li}_{1.5}\text{Al}_{0.5}\text{Ge}_{1.5}\text{P}_3\text{O}_{12}$ (rhomb)	3N	Powder	5~15 μm	Keep at RT	25g
						-	
385-13172	LiLBPW46	$\text{Li}_{1.3}\text{Al}_{0.3}\text{Ti}_{1.7}\text{P}_3\text{O}_{12}$	3N	Powder	5~15 μm	Keep at RT	25g
						-	
387-04641	LiLBPW48	Li_3PO_4	3N	Powder	1~5 μm	Keep at RT	100g
						10377-52-3	
385-04821	LiLBPW54	Li_3BO_3	3N	Powder	10~30 μm	Keep at RT	100g
						13774-56-6	

■ Others

Code No.	Manufacturer Code No.	Product Name	Purity	Appearance	Size	Storage Condition	Pack Size
						CAS RN®	
386-04655	NaNBPW01	Na_3PO_4	3N	Powder	5~15 μm	Keep at RT	500g
						7601-54-9	
386-04851	NaNBPW03	$\text{Na}_3\text{Zr}_2\text{Si}_2\text{PO}_{12}$	2N*6	Powder	5~15 μm	Keep at RT	100g
						-	

※6 2N5 =99%

Introduction of the Barrel Sputtering Technique

The barrel sputtering is a coating technique for powders and the sputter deposition is used to deposit films primarily on substrates (flat surfaces). Feeding the base material powder into a polyhedral barrel and rotating it to form a film enables a surface to be coated homogeneously and efficiently with the powder. This powder coating used for various purposes such as catalysts, raw materials of cosmetics, decoration, and raw materials of ceramics has drawn attention in recent years as a manufacturing technique for lithium-ion batteries.

Through a joint research collaboration with Professor Abe of the University of Toyama, Toshima Manufacturing Co., Ltd. is engaged in the contract manufacturing of powder coating films (sputter/surface modification).

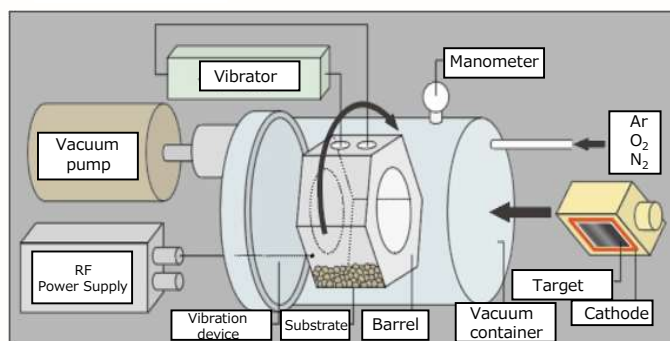
Intended Purposes

- Positive Electrodes of Li Batteries
- Catalyst-related Applications
- Decoration

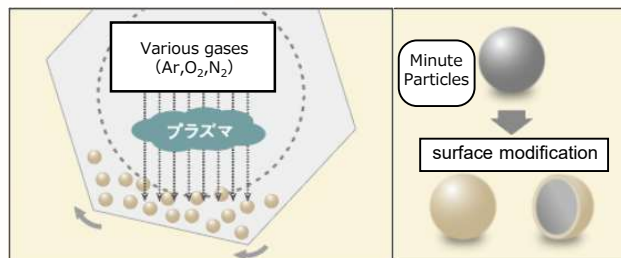
Equipment appearance



Composition Image



Deposition Image



<Example of a Past Successful Result>

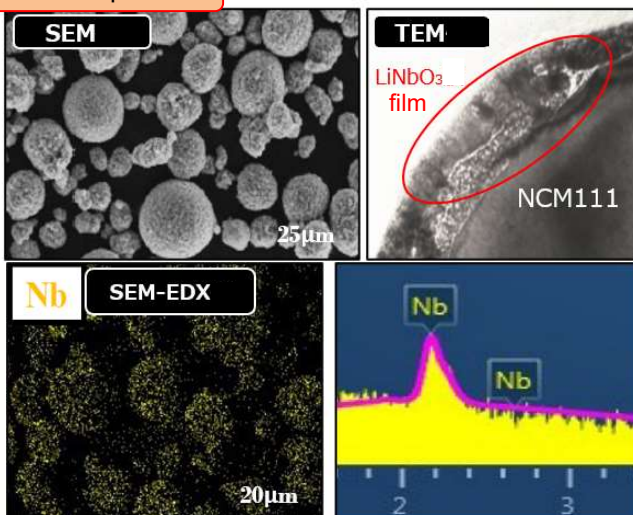
NCM111 ($\text{LiNi}_{0.33}\text{Co}_{0.33}\text{Mn}_{0.33}\text{O}_2$)
LiNbO₃ Deposition on Substrates

Before Deposition



LiNbO₃ on
Substrates

After Deposition



Substrates : $\text{LiNi}_{0.33}\text{Co}_{0.33}\text{Mn}_{0.33}\text{O}_2$ Powder

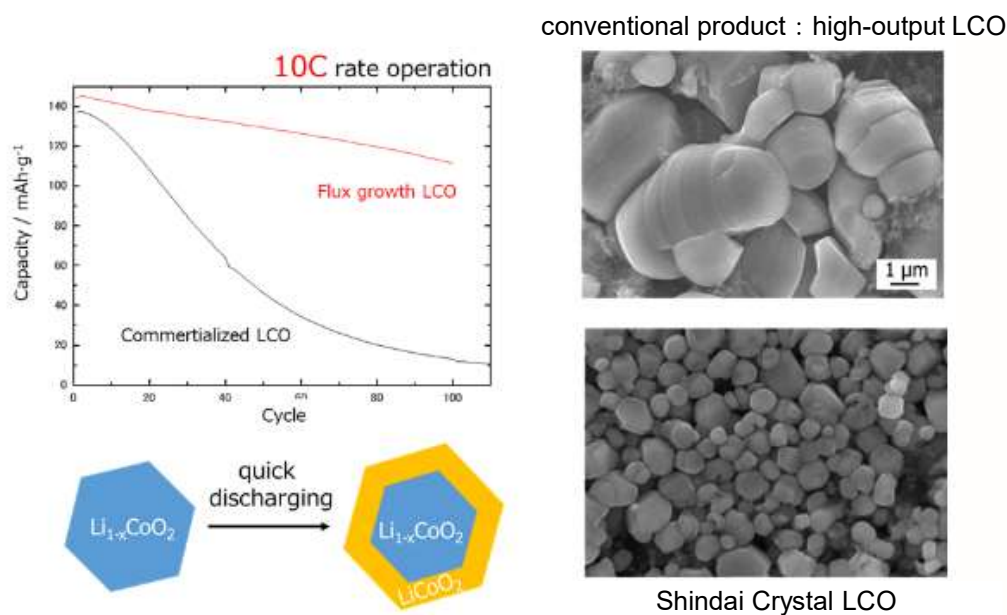


SHINSHU VOLTA CO.,LTD. established in May 2021 (Representative: Takeshi Hashimoto, MEIJO NANO CARBON Co., Ltd.) is a venture company originating from Shinshu University. The company develops lithium-ion batteries based on the research results that were obtained in the development of lithium-ion battery materials, which has been promoted by the leading researcher, Professor Nobuyuki Zettsu in Faculty of Engineering/Director of ELab² Center, Next-generation Research Center Cluster, Interdisciplinary Cluster for Cutting Edge Research (ICCER) of Shinshu University, and were licensed in part to MEIJO NANO CARBON Co., Ltd.

Monocrystal"LiCoO₂(LCO)"

"The world's first commercialization of a battery material grown by the flux method"

Using the flux method (a crystal growth method of recrystallizing inorganic material crystals using a fused salt as a solvent) to grow monocrystalline LCO particles, which are widely used for the positive electrodes of lithium ion batteries to be installed to small consumer electronics and drones, has made it possible to achieve a smaller average size (conventional product) and more excellent 10C rate property (can be fully discharged in 6 minutes) than those of existing products, and significantly improve the capacity decrease in charge and discharge cycles at 10C rate compared with the conventional products. By using the flux method, which is the advantage of Shinshu University, monocrystalline particles with a structure widely covered with a {104} face advantageous to lithium-ion diffusion can be obtained, whereas the LCO particles of the conventional products are amorphous and polycrystalline.



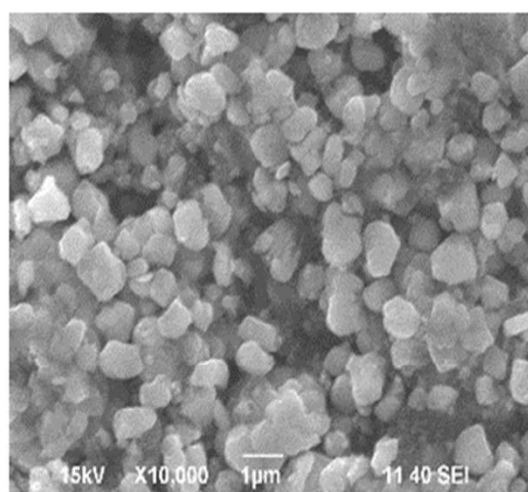
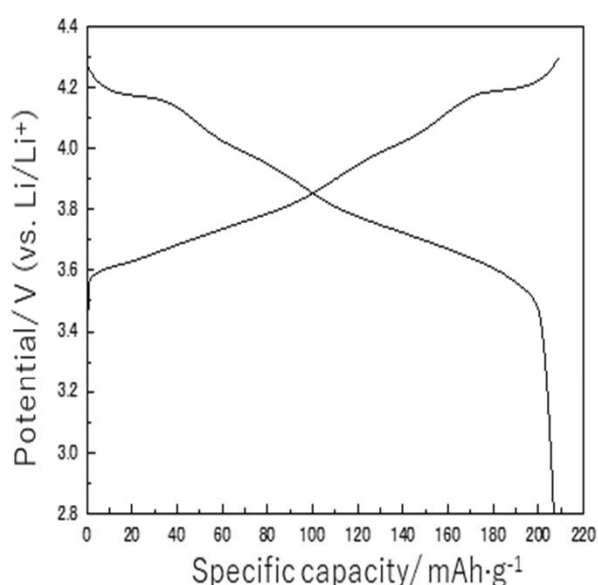
Data resulting from the discharge test of the cell with the monocrystalline LCO grown by the flux method and FE-SEM images of the electrode surfaces after the cycle test. Shindai Crystal hardly deteriorates even after the high-rate discharge test at 10C rate.

Code No.	Product Name	Formula	Storage Condition	Pack Size
			CAS RN®	
636-53211	Lithium Cobalt Oxide	LiCoO ₂	Keep at RT	10g
			12190-79-3	

■ $\text{LiNi}_{0.9}\text{Co}_{0.05}\text{Mn}_{0.05}\text{O}_2$ (NCM91)

Electrode with Bimodal Average Particle Size Distribution

As a next-generation positive electrode for high-capacity lithium-ion batteries used in the electric vehicles, a high nickel layered tertiary positive electrode material whose basic composition is $\text{LiNi}_x\text{Co}_y\text{Mn}_{1-x-y}\text{O}_2$ has been gathering attention. An increased nickel content results in an increase in specific capacity of the positive electrode material but it makes the manufacturing process far more difficult. Through the combination of the precursor manufacturing technique of Tsukishima Kikai Co., Ltd. and the synthesis technique of Shinshu University, a NCM91 positive electrode with bimodal average particle size distribution has been developed. This increases the packing density of the NCM91 particles in the electrode and makes the resulting potential distribution uniform, leading to an extended battery life. A specific capacity of at least 200 mAh/g, which is higher than those of the positive electrode materials used in the conventional electric vehicles, can also be obtained.

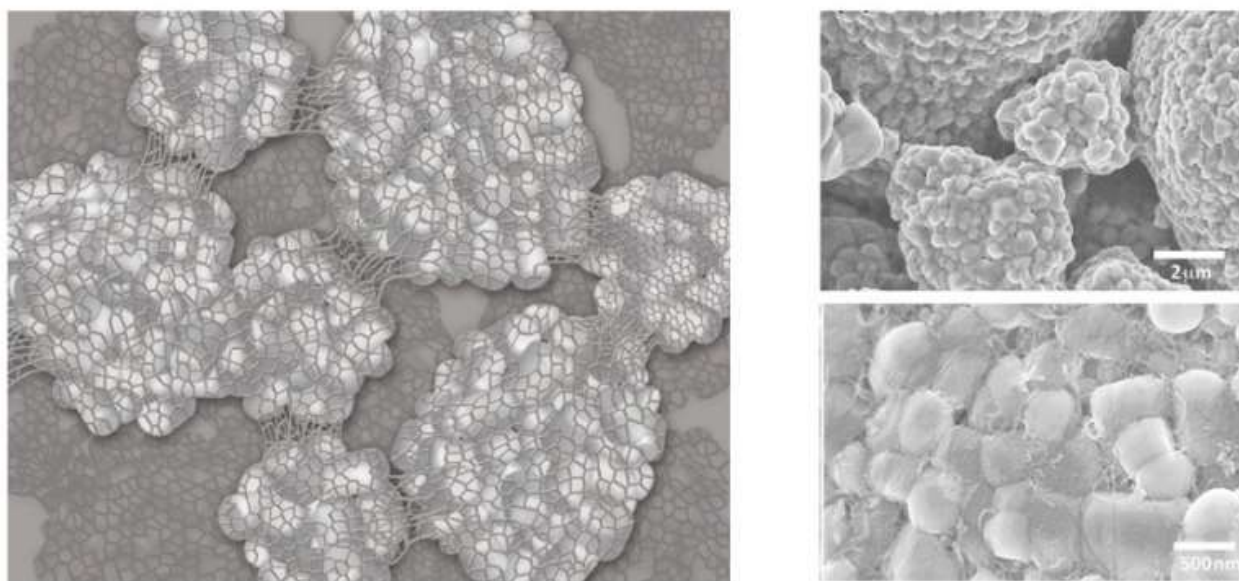


Charge/discharge curves and FE-SEM image of the $\text{LiNi}_{0.9}\text{Co}_{0.05}\text{Mn}_{0.05}\text{O}_2$ (NCM91) positive electrode with bimodal average particle size distribution. A specific capacity of about 210 mAh/g can be obtained in the cut-off voltage range of 2.8-4.3 V (vs. Li/Li⁺).

Code No.	Product Name	Formula	Storage Condition	Pack Size
			CAS RN [®]	
633-53221	Lithium Nickel Manganese Cobalt Oxide 【NCM91】	$\text{LiNi}_{0.9}\text{Co}_{0.05}\text{Mn}_{0.05}\text{O}_2$	Keep at RT	10g
			346417-97-8	

■ Carbon Nanotube Dispersion Liquid [high output]

The world's first conductive binder has been developed by the creation of a hybrid of single-walled and multi-walled carbon nanotubes. This brings a success in significantly reducing the amount of a conductive aid or binder to be used, which does not contribute to the battery capacity, and enables a high-energy density electrode with high concentrations of active materials. The carbon nanotube forms an electronic conduction network that spreads three-dimensionally and uniformly in the electrode, making it possible to significantly reduce conventional electrode resistance. It has been shown clear that the reticulately spreading electronic conduction network serves as a binder to bind the adjacent active material particles existing in the electrode.

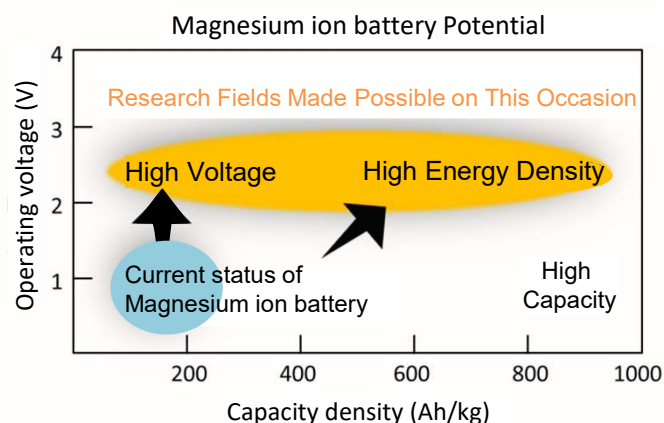


Diagrammatic illustration of low-modulus carbon nanotube binder and FE-SEM images of an NCM electrode with high concentrations of active space: materials (NCM : CNT = 99.5 : 0.5 (wt%)). The company provides electrodes with input-output characteristics, high energy density, and cycle characteristic.

Code No.	Product Name	Formula	Storage Condition	Pack Size
			CAS RN®	
632-53235	Carbon Nanotube Dispersion Liquid [high output]	C	Keep at RT	500mL
			-	

Magnesium-Ion Battery

As a successor to lithium-ion batteries, for which there is concern about resource depletion, magnesium batteries have been gathering attention. Although magnesium is a promising material for secondary batteries because it is more abundant and safer than lithium, magnesium batteries have room for improvement compared to lithium-ion batteries in terms of energy density and cycle characteristics. Therefore, the development of advanced electrodes and electrolytes is expected for magnesium batteries.



Positive Electrodes

Manufacturer	Code No.	Product Name	Formula	Storage Condition	Pack Size
				CAS RN®	
FUJIFILM Wako Pure Chemical	222-00122	Vanadium(V) Oxide	V_2O_5	Keep at RT	25g
	226-00125			1314-62-1	500g

Negative Electrodes

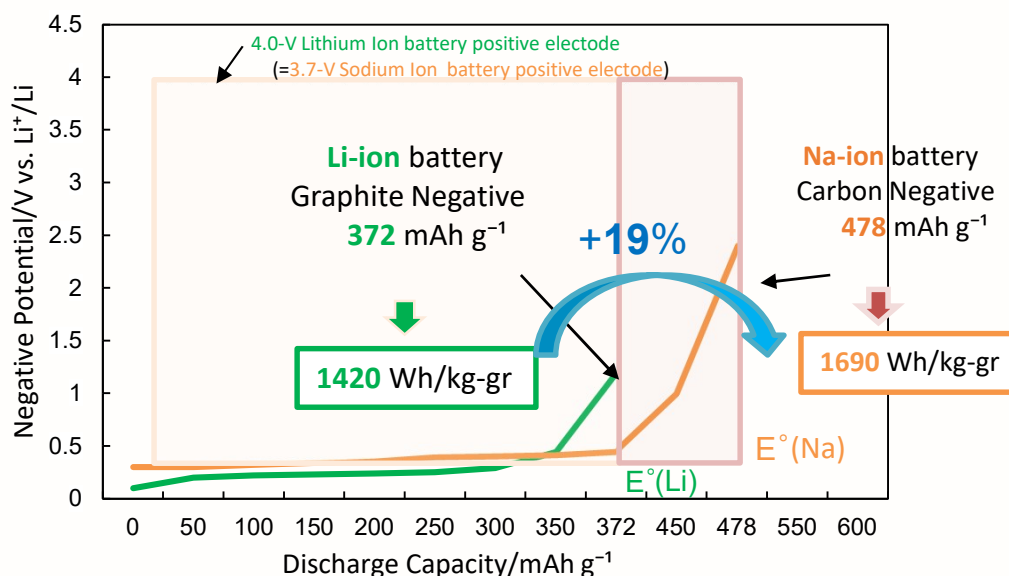
Manufacturer	Code No.	Product Name	Formula	Storage Condition	Pack Size
				CAS RN®	
FUJIFILM Wako Pure Chemical	201-15301	Tin, Powder, -45 μ m, 99.5%	Sn	Keep at RT	100g
				7440-31-5	

Electrolytes

Manufacturer	Code No.	Product Name	Formula	Storage Condition	Pack Size
				CAS RN®	
FUJIFILM Wako Pure Chemical	133-07981	Magnesium Perchlorate 300~850 μ m(20~48mesh)	$Mg(ClO_4)_2$	Protect from light	50g
	139-07983			10034-81-8	400g
FUJIFILM Wako Pure Chemical	195-05703	Sulfolane		Keep at RT	25mL
	199-05706			126-33-0	500mL

Sodium-Ion Battery

Sodium secondary batteries are made from raw materials that are more abundant than those for lithium-ion batteries, so they can be produced at a lower cost than lithium-ion batteries. Although sodium secondary batteries were considered to have lower energy density than lithium-ion batteries in the past, it is expected that with a newly developed negative electrode material, they will achieve energy density equivalent to that of lithium-ion batteries^[b].

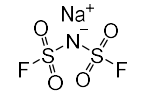
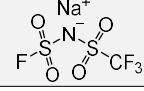


[b] Azusa. Kamiyama. *et al.* : *Angew. Chem. Int. Ed.*, **60**, 5114 (2021).

Negative Electrodes

Manufacturer	Code No.	Product Name	Formula	Storage Condition	Pack Size
				CAS RN®	
FUJIFILM Wako Pure Chemical	201-15301	Tin, Powder, -45μm, 99.5%	Sn	Keep at RT	100g
				7440-31-5	
FUJIFILM Wako Pure Chemical	204-09862	Tin(II) Oxide, 99.9%	SnO	Keep at RT	25g
				21651-19-4	

Electrolytes

Manufacturer	Code No.	Product Name	Formula	Storage Condition	Pack Size
				CAS RN®	
FUJIFILM Wako Pure Chemical	195-01462	Sodium Tetrafluoroborate	NaBF ₄	Keep at RT	25g
	199-01465			13755-29-8	100g
FUJIFILM Wako Pure Chemical	198-09252	Sodium Perchlorate	NaClO ₄	Keep at RT	25g
	192-09255			7601-89-0	500g
FUJIFILM Wako Pure Chemical	190-18801	Sodium Bis(fluorosulfonyl)imide 【Synonyms : NaFSI】		Keep at RT	5g
				100669-96-3	
FUJIFILM Wako Pure Chemical	197-18811	Sodium (Fluorosulfonyl)(trifluoromethanesulfonyl)imide 【Synonyms : NaFTFSI】		Keep at RT	5g
				1233836-95-7	

Ionic Liquids

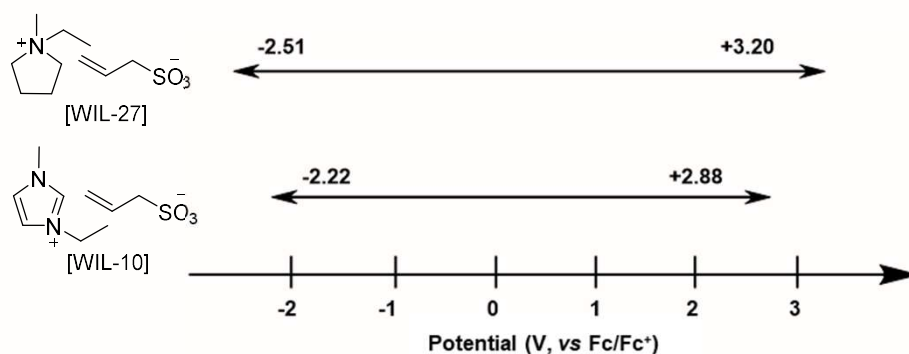
Battery Grade 『WIL Series』

Ionic liquids, which are refractory, flame-retardant, and heat-resistant and safer than organic solvents, have been receiving attention as a flame-retardant material. Research and development of ionic liquids as electrolytes and electrolyte solutions for lithium-ion secondary batteries have been widely proceeded with from the viewpoint of enhanced safety, in particular, such as preventing ignition and explosion of batteries, and they are expected to be put into practical use as a material for secondary batteries.

FUJIFILM Wako has developed the **WIL series**, original ionic liquids suitable for research of batteries. The series has the advantage of having a larger potential window than the existing ionic liquids.

What is a Potential Window?

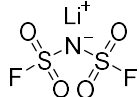
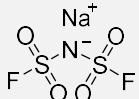
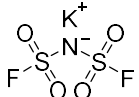
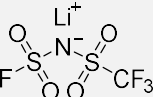
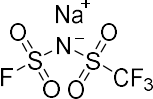
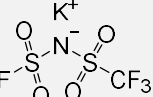
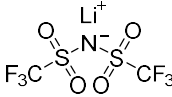
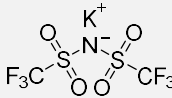
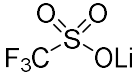
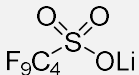
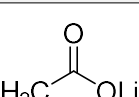
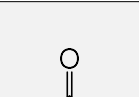
Potential window is defined as an electrolyte range where current does not flow in the electrolyte solution, that is, a range that an oxidation-reduction reaction does not take place on the electrodes and is used as an indicator of electrochemical properties.

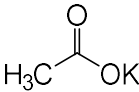


Code No.	Product Name	Pack Size	Storage Condition	Viscosity (mPa · s, 25°C)	Melting Point (°C)	Conductivity (mS/cm, 25°C)	Electric Potential	
			CAS RN [®]				Area (V)	Width (V)
052-08561	WIL-27	1g	Keep at RT	312	-83	1.2	-2.51 ~ +3.20 (Fc)	5.71
058-08563		5g	1268622-88-3					
056-08581	WIL-10	1g	Keep at RT	210	-68	1.0	-2.22 ~ +2.88 (Fc)	5.10
052-08583		5g	1268622-81-6					

Ionic Liquids as Precursors

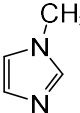
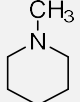
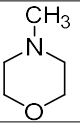
The anion exchange method is one of the synthesis methods of ionic liquids. An ionic liquid can be prepared by the reaction of a desired cationic haloid salt with a desired anionic lithium salt. Potassium salt and sodium salt are also offered. Consider the use of the products for the synthesis of ionic liquids.

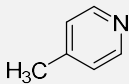
Manufacturer	Code No.	Product Name	Formula	Melting Point (ref.)	Storage Condition	Pack Size
					CAS RN®	
FUJIFILM Wako Pure Chemical	122-06632	Lithium Bis(fluorosulfonyl)imide 【Synonyms : LiFSI】		140°C	Keep at RT	25g
	124-06631				171611-11-3	100g
FUJIFILM Wako Pure Chemical	190-18801	Sodium Bis(fluorosulfonyl)imide 【Synonyms : NaFSI】		112°C	Keep at RT	5g
					100669-96-3	
FUJIFILM Wako Pure Chemical	167-28742	Potassium Bis(fluorosulfonyl)imide 【Synonyms : KFSI】		101°C	Keep at RT	25g
	169-28741				14984-76-0	100g
FUJIFILM Wako Pure Chemical	120-06851	Lithium (Fluorosulfonyl) (trifluoromethanesulfonyl)imide 【Synonyms : LiFTFSI】		100°C	Keep at RT	5g
					192998-62-2	
FUJIFILM Wako Pure Chemical	197-18811	Sodium (Fluorosulfonyl) (trifluoromethanesulfonyl)imide 【Synonyms : NaFTFSI】		-	Keep at RT	5g
					1233836-95-7	
FUJIFILM Wako Pure Chemical	166-28751	Potassium (Fluorosulfonyl) (trifluoromethanesulfonyl)imide 【Synonyms : KFTFSI】		101°C	Keep at RT	5g
					860653-59-4	
FUJIFILM Wako Pure Chemical	129-06642	Lithium Bis(trifluoromethanesulfonyl)imide (Synonyms : LiTFSI)		234-238°C	Keep at RT	25g
	121-06641				90076-65-6	100g
FUJIFILM Wako Pure Chemical	167-28002	Potassium Bis(trifluoromethanesulfonyl)imide (Synonyms : KTFSI)		200°C	Keep at RT	25g
	169-28001				90076-67-8	100g
FUJIFILM Wako Pure Chemical	128-03792	Lithium Trifluoromethanesulfonate		423°C	Keep at RT	25g
FUJIFILM Wako Chemical	327-61481	Lithium 1,1,2,2,3,3,4,4,4-Nonafluoro-1-butanesulfonate		370-380°C	Keep at RT	5g
	325-61482				131651-65-5	25g
FUJIFILM Wako Pure Chemical	123-01542	Lithium Acetate		280-285°C	Keep at RT	25g
	127-01545				546-89-4	500g
FUJIFILM Wako Pure Chemical	198-01072	Sodium Acetate		>300°C	Keep at RT	25g
	190-01071				127-09-3	100g
	192-01075					500g

Manufacturer	Code No.	Product Name	Formula	Melting Point (ref.)	Storage Condition	Pack Size
					CAS RN®	
FUJIFILM Wako Pure Chemical	166-03172	Potassium Acetate		292°C	Keep at RT	25g
	160-03175				127-08-2	500g
FUJIFILM Wako Pure Chemical	121-05921	Lithium Hexafluorophosphate* ¹	LiPF ₆	165-175°C	Keep at RT	10g
	127-05923				21324-40-3	50g
FUJIFILM Wako Pure Chemical	128-06031	Lithium Tetrafluoroborate* ¹	LiBF ₄	293°C	Keep at 2-10 °C	5g
	126-06032				14283-07-9	25g
FUJIFILM Wako Pure Chemical	195-01462	Sodium Tetrafluoroborate	NaBF ₄	384°C	Keep at RT	25g
	199-01465				13755-29-8	500g
FUJIFILM Wako Pure Chemical	161-16792	Potassium Tetrafluoroborate	KBF ₄	530°C	Keep at RT	25g
	165-16795				14075-53-7	500g

※1 Battery Grade

Cation Precursors

Manufacturer	Code No.	Product Name	Formula	Melting Point (ref.)	Storage Condition	Pack Size
					CAS RN®	
FUJIFILM Wako Pure Chemical	134-12801	1-Methylimidazole		-60°C	Protect from light	100mL
	136-12805				616-47-7	500mL
FUJIFILM Wako Pure Chemical	133-08042	1-Methylpiperidine		-18°C	Keep at RT	25mL
	137-08045				626-67-5	500mL
FUJIFILM Wako Pure Chemical	132-06873	4-Methylmorpholine		-66°C	Keep at RT	25mL
	136-06876				109-02-4	500mL

Manufacturer	Code No.	Product Name	Formula	Melting Point (ref.)	Storage Condition	Pack Size
					CAS RN®	
FUJIFILM Wako Pure Chemical	164-05312	Pyridine		-42°C	Keep at RT	25mL
	162-05313					100mL
	166-05316				110-86-1	500mL
FUJIFILM Wako Pure Chemical	161-02603	4-Methylpyridine		2.4°C	Keep at RT	25mL
	165-02606				108-89-4	500mL
FUJIFILM Wako Pure Chemical	200-07723	Tributyl Phosphine	$P(n-C_4H_9)_3$	-	Keep at RT	25mL
	204-07726				998-40-3	500mL
FUJIFILM Wako Pure Chemical	208-03662	Trimethylammonium Chloride	$\begin{matrix} H_3C^+ \\ \\ H_3C-NH \\ \\ H_3C \end{matrix} Cl^-$	277°C	Keep at RT	25g
					593-81-7	
FUJIFILM Wako Pure Chemical	204-02363	Tributylamine	$N(n-C_4H_9)_3$	-70°C	Keep at RT	25mL
	208-02366				102-82-9	500mL
FUJIFILM Wako Pure Chemical	205-09272	Trioctylamine	$N(n-C_8H_{17})_3$	-	Keep at RT	25mL
	209-09275				1116-76-3	500mL