China Battery Industry – Rechargeable Cells Technology Innovation Trends 2024

November 2024

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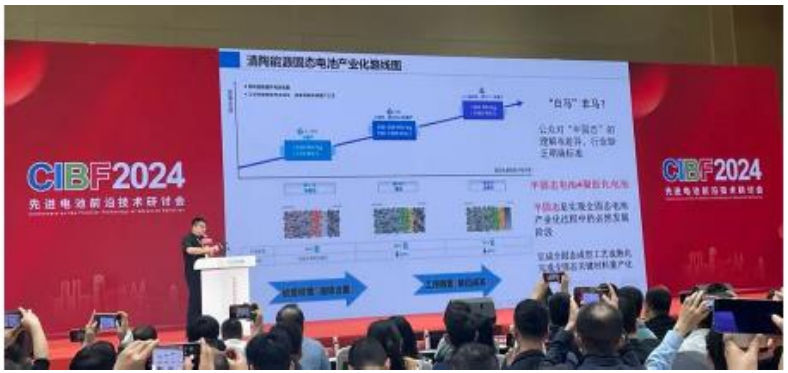
Background

- China manufacture more than 70% of the global cells production.
- Many think China is only production and underestimate the battery technology innovation development.
- New developments come to the market in a very short time like one year.
- China battery industry face over production that push cells cost down but not stopping the R&D efforts.
- CIBF is the most important battery industry event where China introduce new products and technologies https://en.cibf.org.cn/.



Cylindrical Hard Case Cells Advantages

1. High energy density (up to 295Wh/kg, 860Wh/l on 18650, 21700 – up to 333Wh/kg on 46800).
2. Wide operating voltage range 4.35 – 3.0/2.5/2V.
3. Wide power density range (High energy, Medium Power, High Power).
4. Good cycle life ~500-1000 Cycles.
5. Low self-discharge ~ 1% per month.
6. Quick charge is possible (<=2C).
7. Can Include internal safety devices like vents, shut down separators, PTC, CID etc.
8. Cylindrical cells standard sizes: 18650, 21700, 26650, 46800 – No special orders – Commodity.

Cylindrical Hard Case Cells Advantages

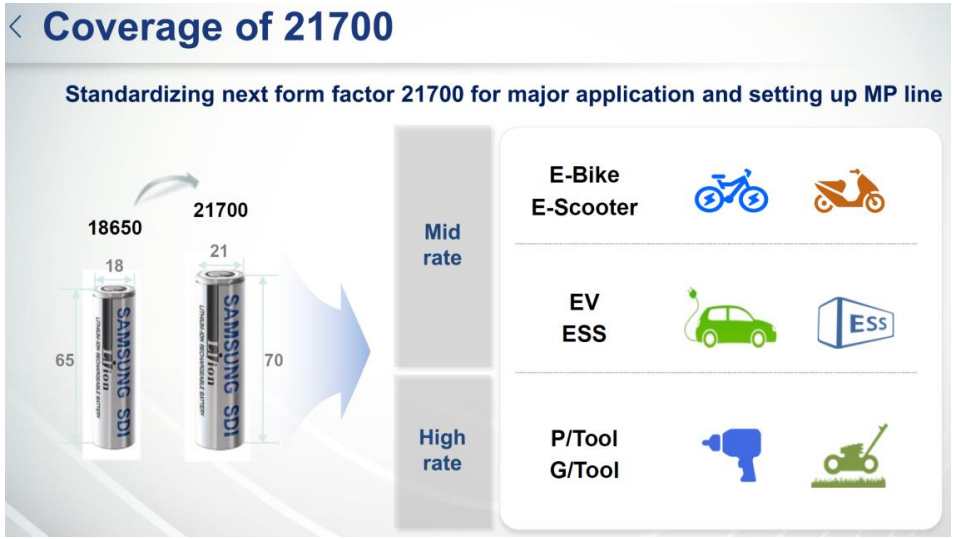
9. **Robust – Good resistant to external shock and vibration.**
10. **Automatic mass production lines ensure cost & quality.**

Cylindrical Hard Case Cells Limitations

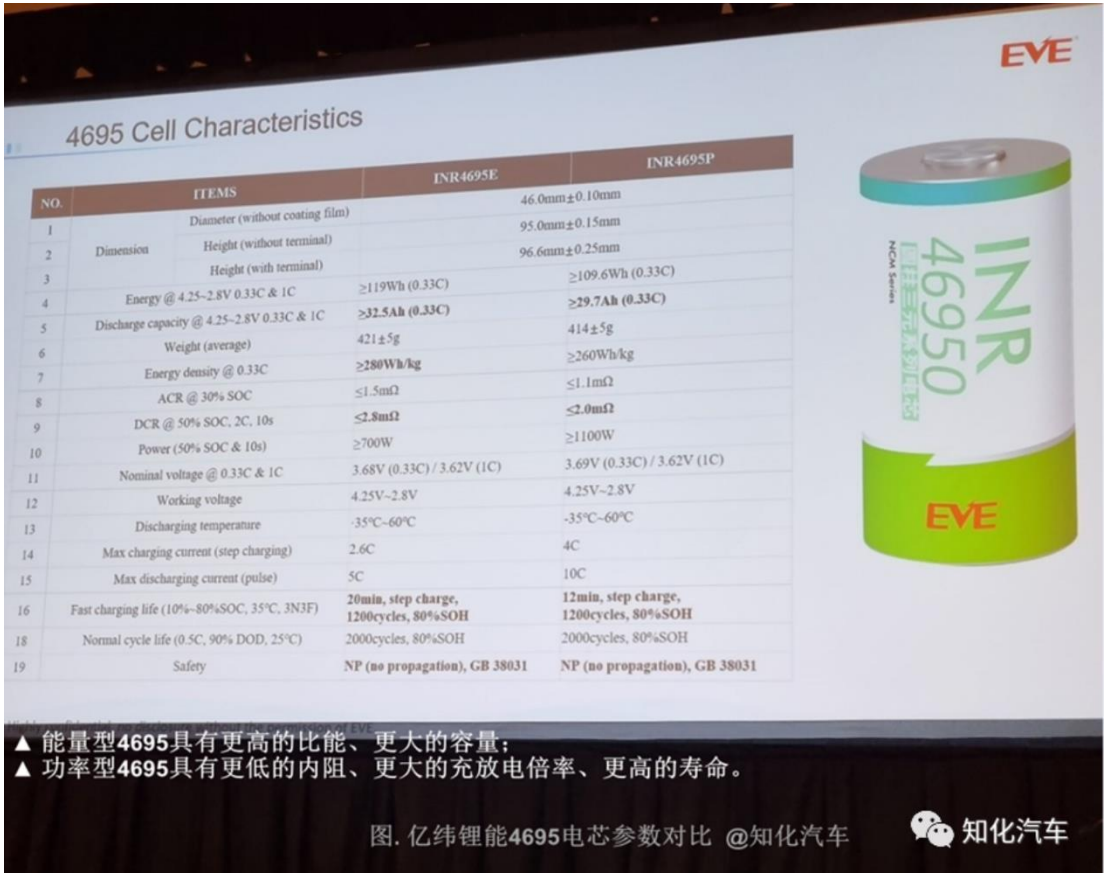
1. Small cell capacities – Space inefficiency.
2. Low volumetric energy density pack level (Cylindrical).
3. Thicker than pouch cells.
4. Difficult to custom made special sizes.
5. Few large cylindrical cells sizes in the market.
6. Difficult to cool cylindrical cells due to lower external surface area (Pouch are much better).

21700,46mm Cells

1. High demand for more energy and cost reduction lead to larger cells.
2. Assembling battery packs with 18650 cells become less efficient, require complicate BMS and costly.
3. 21700 cells increase pack energy density, reduce number of cells in battery packs and increase pack efficiency (Max of 5Ah capacity of today),
4. 46mm under design and production.



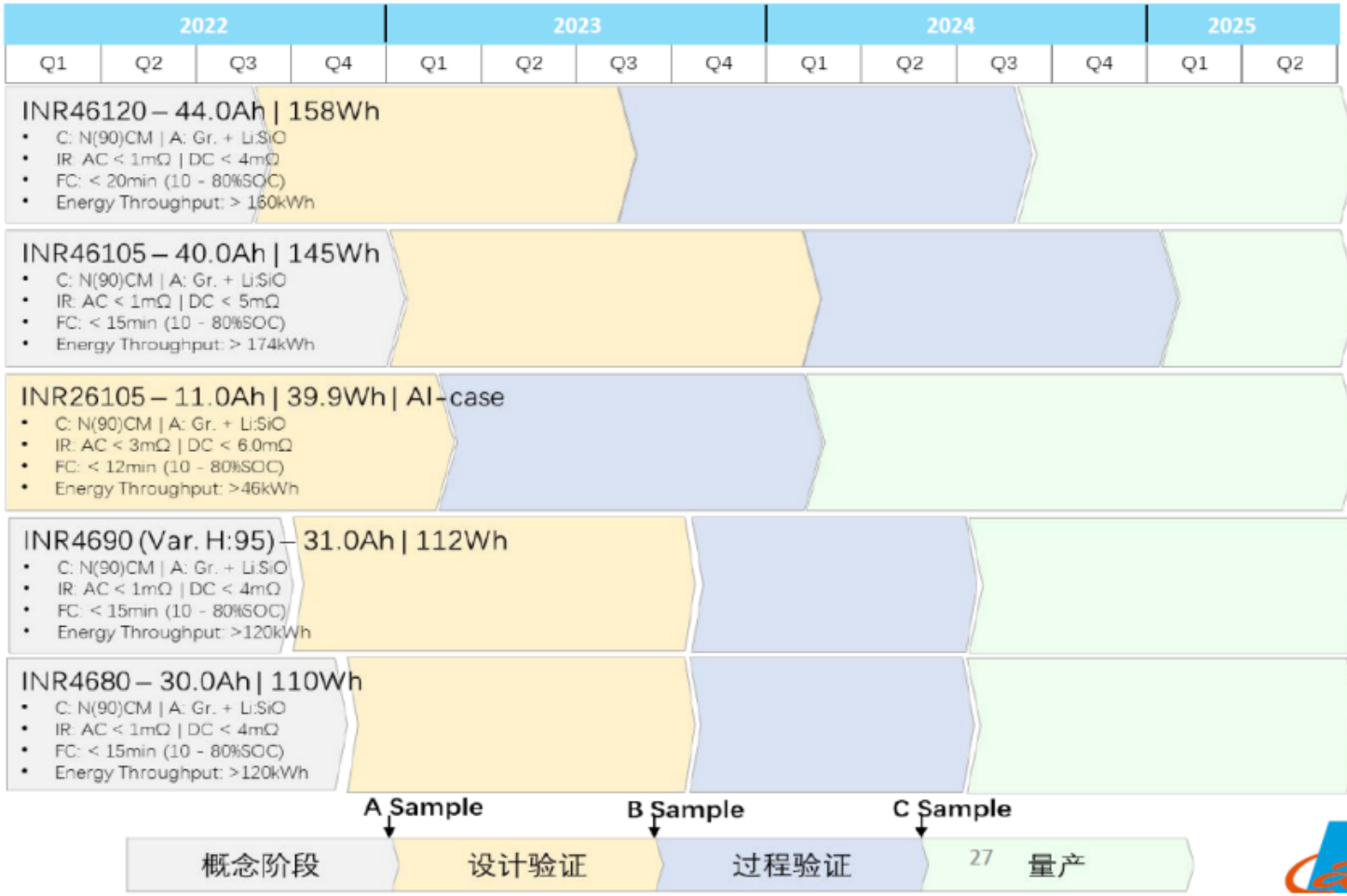
EVE 46XX New Cells



NO.	ITEMS		INR4695E	INR4695P
1	Dimension	Diameter (without coating film)	46.0mm±0.10mm	
2		Height (without terminal)	95.0mm±0.15mm	
3		Height (with terminal)	96.6mm±0.25mm	
4	Energy @ 4.25~2.8V 0.33C & 1C		≥119Wh (0.33C)	≥109.6Wh (0.33C)
5	Discharge capacity @ 4.25~2.8V 0.33C & 1C		**≥32.5Ah (0.33C)**	**≥29.7Ah (0.33C)**
6	Weight (average)		421±5g	414±5g
7	Energy density @ 0.33C		**≥280Wh/kg**	≥260Wh/kg
8	ACR @ 30% SOC		≤1.5mΩ	≤1.1mΩ
9	DCR @ 50% SOC, 2C, 10s		**≤2.8mΩ**	**≤2.0mΩ**
10	Power (50% SOC & 10s)		≥700W	≥1100W
11	Nominal voltage @ 0.33C & 1C		3.68V (0.33C) / 3.62V (1C)	3.69V (0.33C) / 3.62V (1C)
12	Working voltage		4.25V~2.8V	4.25V~2.8V
13	Discharging temperature		-35℃~60℃	-35℃~60℃
14	Max charging current (step charging)		2.6C	4C
15	Max discharging current (pulse)		5C	10C
16	Fast charging life (10%~80%SOC, 35℃, 3N3F)		**20min, step charge, 1200cycles, 80%SOH**	**12min, step charge, 1200cycles, 80%SOH**
18	Normal cycle life (0.5C, 90% DOD, 25℃)		2000cycles, 80%SOH	2000cycles, 80%SOH
19	Safety		**NP (no propagation), GB 38031**	**NP (no propagation), GB 38031**

BAK Power

BAK: Multiple Series of 46XX Cy LIB



BYD

Item	LC1865 -25P	LC1865 -32E	FC 4665	FC 4680	FC 4695	FC 46120	LC 4665	LC 4680	LC 4695	LC 46120	MFC 4665	MFC 4680	MF C4695	MFC 46120
Chemistry	NCM+Gr	NCM+SI	LFP+Gr	LFP+Gr	LFP+Gr	LFP+Gr	LMO+Gr	LMO+Gr	LMO+Gr	LMO+Gr	LFMP+Gr	LFMP+Gr	LFMP+Gr	LFMP+Gr
Capacity	Min. 2450mAh Typ. 2500mAh	Min. 3100mAh Typ. 3200mAh	Min. 12000mAh Typ. 12240mAh	Min. 15000mAh Typ. 15300mAh	Min. 18000mAh Typ. 18400mAh	Min. 24000mAh Typ. 24500mAh	Min. 11000mAh Typ. 11240mAh	Min. 14000mAh Typ. 14300mAh	Min. 16500mAh Typ. 16800mAh	Min. 22000mAh Typ. 22400mAh	Min. 12000mAh Typ. 12240mAh	Min. 15000mAh Typ. 15300mAh	Min. 17750mAh Typ. 18000mAh	Min. 24000mAh Typ. 24500mAh
Initial Impedance	≤20MΩ	≤25MΩ	≤10MΩ	≤8MΩ	≤8MΩ	≤8MΩ	≤12MΩ	≤10MΩ	≤10MΩ	≤10MΩ	≤12MΩ	≤10MΩ	≤10MΩ	≤10MΩ
Discharge end voltage	2.5V	2.5V	2.0V	2.0V	2.0V	2.0V	3.0V	3.0V	3.0V	3.0V	3.0V	3.0V	3.0V	3.0V
Standard Charge Rate	0.2C	0.2C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C
Continuous Discharge Current	20A	10A≥88%	20A	25A	25A	25A	20A	25A	25A	25A	20A	25A	25A	25A
Cycle Life @RT	4A-20A	0.5C-1C	Type A：0.5C-0.5C 4000,Retention rate≥70% Type B：0.5C-0.5C 800,Retention rate≥70%				0.5C-0.5C 500,Retention rate≥70%				0.5C-0.5C 600,Retention rate≥70%			

BYD – Already in production with LFP cells.

CALB

CALB introduced new advanced battery cells with NMC and LMFP chemistry. The company called its innovation "U" structure. And according to CALB, the "U" structure allowed for an increase in the energy intensity of the element. The new structural innovation has reduced the resistance of structural elements by 50%, and improved element space utilization by 3%.

CALB – there is no limit to the improvement of batteries

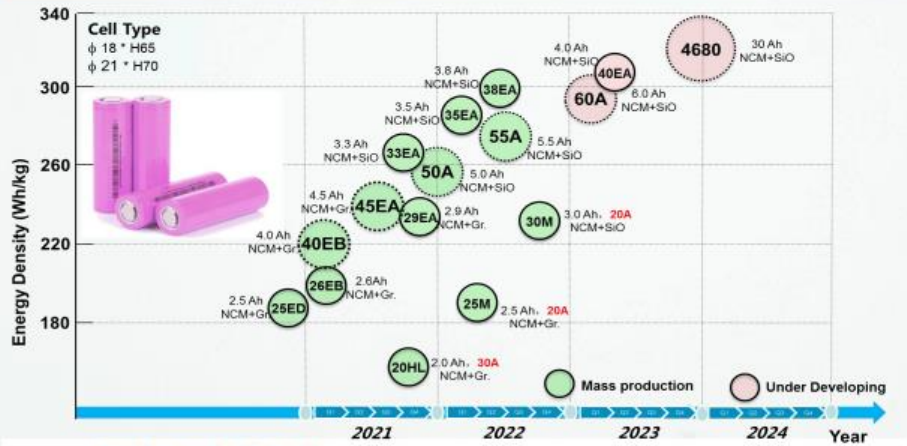
http://www.calbusainc.com

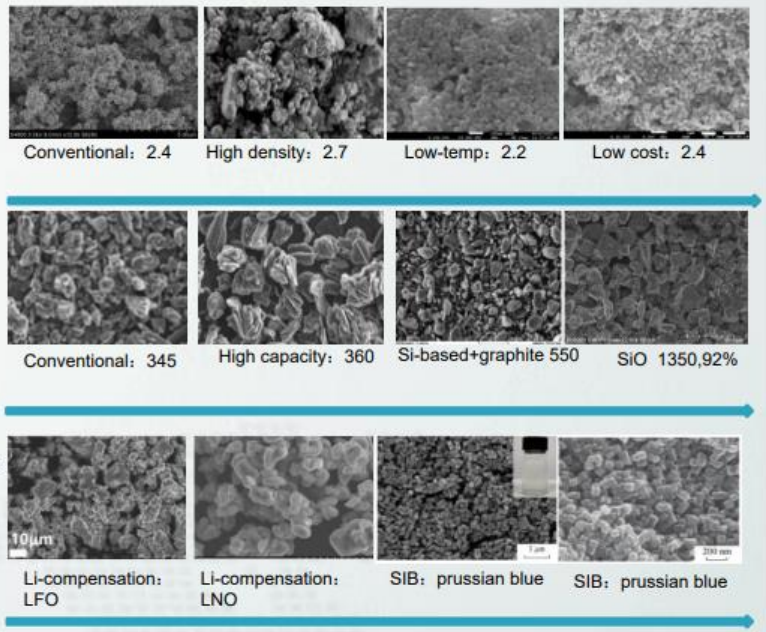
http://www.calb-tech.com/

CALB

Shangahi Far East

R&D COMPETENCE





- Product: LFP50Ah/100Ah/305Ah cells for ESS market;
- Material: LFP **cathode** material features stable structure, long cycle life, excellent high-temperature low temperature performance; **anode** adopts high-capacity low-cost graphite and long-cycle Li-compensation materials

http://www.febbattery.com/

3 Nominal Specification 标准规格

Item 项目	Specification 特性	
Nominal capacity 标称容量	4000mAh	Charge: 0.5C (2000mA), CCCV, 4.2V, 0.02C (80mA) cut-off. Discharge: 0.2C (800mA), 2.5V discharge cut-off
Minimum capacity 最小容量	3850mAh	
Energy density 能量密度	300Wh/Kg	
Nominal voltage 标称电压	3.60V	
Internal resistance 内阻	≤ 25mΩ(AC Impedance, 1000 Hz)	
Charge cut-off voltage 充电截止电压	4.20V	
Discharge cut-off voltage 放电截止电压	2.5V	
Charging cut-off current 充电截止电流	≥0.02C (80mA)	
Standard charging current 标准充电电流	0.5C (2000mA)	
Standard discharge current 标准放电电流	1C (4000mA)	
Max. charge current 最大充电电流	1.0C (4000mA)	45°C>T≥15°C
	0.5C (2000mA)	15°C>T≥5°C
	0.1C (400mA)	5°C>T≥0°C
Max. discharge current 最大放电电流	1C (4000mA)	60°C >T≥45°C
	2C (8000mA)	45°C >T≥0°C
	1C (4000mA)	0°C>T≥-20°C
Working temperature 工作温度	Charge: 0~45°C 充电时：0~45°C	Discharge: -20~60°C 放电时：-20~60°C
Cell dimension 电芯尺寸	Height: 65.05±0.15mm 高度：65.05±0.15mm	Diameter: 18.35±0.15mm 直径：18.35±0.15mm
Weight 重量	≤50g	

3 Nominal Specification 标准规格

Item 项目	Specification 特性	
Nominal capacity 标称容量	6000mAh	Charge: 0.5C (3000mA), CCCV, 4.2V, 0.02C (120mA) cut-off; Discharge: 0.2C (1200mA),2.5V discharge cut-off
Minimum capacity 最小容量	5850mAh	
Energy density 能量密度	296Wh/kg	
Nominal voltage 标称电压	3.60V	
Internal resistance 内阻	≤ 25mΩ (AC Impedance, 1000 Hz)	
Charge cut-off voltage 充电截止电压	4.20V	
Discharge cut-off voltage 放电截止电压	2.50V	
Charging cut-off current 充电截止电流	≥0.02C (120mA)	
Standard charging current 标准充电电流	0.5C (3000mA)	
Standard discharge current 标准放电电流	1C (6000mA)	
Max. charge current 最大充电电流	0.7C (4200mA)	45°C>T≥15°C
	0.5C (3000mA)	15°C>T≥5°C
	0.1C (600mA)	5°C>T≥0°C
Max. discharge current 最大放电电流	0.5C (3000mA)	60°C >T≥45°C
	1C (6000mA)	45°C >T≥35°C
	2C (12000mA)	35°C >T≥0°C
	1C (6000mA)	0°C>T≥-20°C
Working temperature 工作环境温度	Charge: 0~45°C 充电时：0~45°C	Discharge: -20~60°C 放电时：-20~60°C
Cell dimensions 电芯尺寸	Height: 70.95±0.2mm 高度：70.95±0.2mm	Diameter: 21.65±0.2mm 直径：21.65±0.2mm
Weight 重量	≤75g	

Guxin

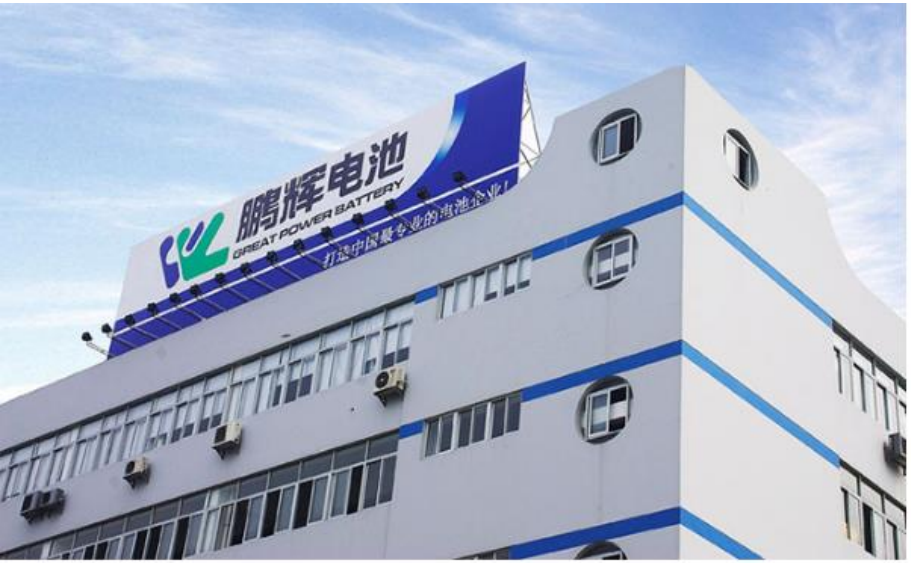
18650 Series
18650 系列

高能量密度 & 高倍率，零下 40°C超强电量保持。

GUXIN 固芯

型号		18650HP-35	18650HE-40
标称容量		3500mAh @ 0.2C	4000mAh @ 0.2C
标称电压		3.34V @ 0.2C	3.34V @ 0.2C
充电终止电压		4.25V	4.25V
放电终止电压		2.3V	2.3V
充电方法	标准	25°C，0.2C 恒流充电至 4.25V，再恒压充电至充电电流小于 0.02C	
	快速	25°C，0.5C 恒流充电至 4.25V，再恒压充电至充电电流小于 0.05C	
放电方法	标准	25°C，0.2C 恒流放电至 2.3V	
	快速	25°C，6C 恒流放电至 2.3V	25°C，3C 恒流放电至 2.3V
循环寿命	常温循环	≥ 500 次	≥ 500 次
工作温度		-40°C -55°C	
储存温度		短期存储 (1 个月): -20°C -35°C ； 长期存储 (6 个月):10°C -30°C ； 推荐存储温度 :25±3°C	
存储湿度		≤ 85%RH	
能量密度		重量比能量≥ 260Wh/kg(0.2C/0.2C)	重量比能量≥ 280Wh/kg(0.2C/0.2C)
交流内阻		≤ 20mΩ	≤ 20mΩ
重量		46±1g	47±2g

Great Power



Great Power (Stock Code: 300438) was founded in 2001, and is a high-tech enterprise focusing on manufacturing, researching and developing lithium batteries for more than 20 years as the top OEM & ODM lithium battery manufacturers China. Now Great Power is fully focusing on ESS, manufacturing batteries with high standards and strict requirements, committed to creating values for customers and becoming the preferred brand of ESS batteries!

https://www.greatpower-battery.net/

鹏辉 GREAT POWER

MODEL/型号: IFR46250

（50Ah　3.2V）

3　Cell Specifications/电芯产品规格

No.	Items/项目	Specifications/规格		Notes/备注
1	Nominal Capacity 标称容量	50Ah		0.5C Standard discharge 0.5C 标准放电
2	Minimum Capacity 最小容量	≥50Ah		
3	Nominal Voltage 标称电压	3.2V		
4	Voltage range 电压区间	2.5~3.65V		
5	Shipment Voltage 出货电压	3.0~3.1V		
6	Standard charging current 标准充电电流	0.5C		0.5C CCCV to 3.65V，0.05C cut off
7	Standard discharging current 标准放电电流	0.5C		
8	Max. charging current 最大充电电流	1.0C		
9	Max. discharging current 最大放电电流	2.0C		
10	Internal Impedance of single cell 单电芯内阻	≤1.0mΩ		1kHz
11	Operation Temperature and Relative humidity Range 工作温度和湿度范围	Charge/充电	0~55℃ ＜85%R.H.	Charging at low temperature blow 0℃ will reduce capacity and cycle life of the battery 低温充电效率会下降，会影响电池使用寿命
		Discharge/放电	-20~60℃ ＜85%R.H.	
12	Storage temperature and Relative Humidity Range 长时间储存温度及湿度	-20~50℃ ＜85%R.H.	3.0~3.1V	Max. 3 months. Must charge every 3 months if store for longer. 不可超过 3 个月，达到 3 个月须充电一次
			30%SOC	Max. 1 year. Must charge every 1 year if store for longer. 不可超过 1 年，达到 1 年须充电一次

SVOLT

https://svolt-eu.com/

SVOLT

DFD New Energy – LFP 60MM Diameter Cell

圆柱电池 Cylindrical Cell

适用于新能源汽车、储能领域

Suitable for new energy vehicles and energy storage fields

公司开发的60系列大圆柱电池，已形成一系列国际上统一的标准规格和型号，生产工艺成熟，PACK成本较低，电池产品良率较高、散热性好，能够满足大批量连续化生产。

The 60 series large cylindrical batteries developed by the company have formed a series of internationally unified standard specifications and models. The production process is mature, the PACK cost is low, the battery product yield is high, and the heat dissipation is good, which can meet the needs of large-scale continuous production.

磷酸铁锂 LFP 钠 离 子 电 池
Sodium-ion Battery

LFP 60130 46.5Ah
NMF 60130 33Ah
LFP 60145 50Ah

http://www.dfdxny.com/

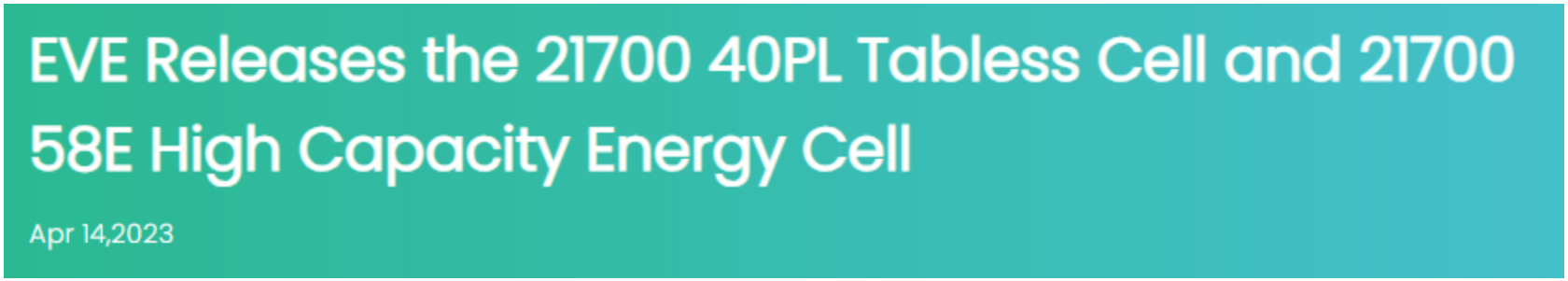
圆柱产品谱系

多氟多新能源
DFD NEW ENERGY

产品种类	ITEM	圆柱铝壳电池		
产品规格	Type	DFDLFR60130 LFP	DFDLFR60145 LFP	DFDSNR60130 NMF
标称电压	Standard Voltage	3.15V/3.20V RT@1C/0.33C Discharge	3.20V RT@0.33C Discharge	3.0V RT@0.33C Discharge
额定容量	Nominal Capacity	46.5Ah/46.5Ah RT@1C/0.33C Discharge	50Ah/50Ah RT@1C/0.33C Discharge	32Ah/33Ah RT@1C/0.33C Discharge
电压范围	Voltage Range	2.0V~3.65V	2.0V~3.65V	1.5-3.95V
标准充电	Standard Charge	1/3C CC to 3.65V,3.65V CV to 0.05C		1/3C CC to 3.95V,3.95V CV to 0.05C
最大充电电流	Max Charge Current	32.6A	50A	16A
标准放电	Standard Discharge	1/3C CC to 2.0V		1/3C CC to 1.5V
最大放电电流	Max Discharge Current	46.5A	50A	60A
使用温度	TEM	充电 Charge：-20℃ ~ 55℃	放电 Discharge：-30℃ ~ 60℃	
重量(g)	Weight	820±20	920±20	770±20
电池尺寸(mm) Dimension	高度1 H1	132±1	145±1	132±1
	高度2 H2	129±1	142.5±1	129±1
	长度 L	60.0±0.5	60.0±0.5	60.0±0.5
能量密度	Densitu	≥178Wh/kg,≥395Wh/L RT@1C Discharge	≥175Wh/kg,≥400Wh/L RT@0.33C Discharge	≥132Wh/kg,≥265Wh/L RT@0.33C Discharge
循环寿命	Life Cycle	2000次	6000次	1500次

Cylindrical 21700 Tabless Cells

1. **Demand for higher power 21700 cells for the power tool market push for adaptation of the tabless technology to smaller cells than 46mm cells.**
2. **Ampace (ATL-CATL), LG, Samsung, EVE, SunPower, Tenpower, Highstar, Lishen, BAK, Murata, Reliance**



Ampace 21700 Tableless Cells

JP40

1. High power: Support 45A continuous discharge without triggering temperature cutoff; Support 60A continuous discharge with temperature cutoff;
2. Low temperature rise: 25℃, 10C / 40A continuous discharge, temperature rise <50℃;
3. Fast charging: charging to 80% SOC for 20min;
4. Long cycle life: 8A / 30A cycle life: Capacity ≥2,400mAh @ after 600cycles; 8A / 40A cycle life: Capacity ≥2,400mAh @ after 400cycles;
5. High Safety: Meet UL1642, CB62133, IEC62619, PSE, KC, GB 32141 and other certification;

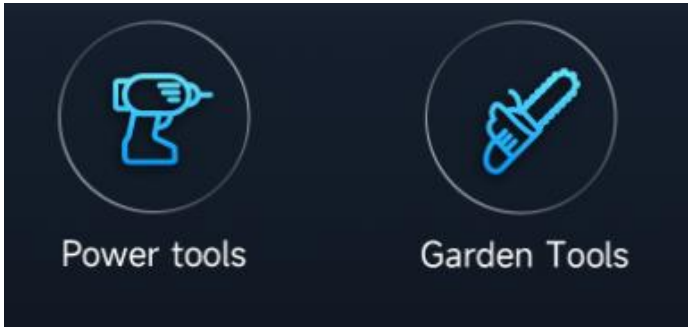
Projects	Specifications
Battery	JP40
Rated Capacity(mAh)	4000
Typical Voltage(V)	3.7
Voltage Range(V)	2.5~4.2
Max Continuous Discharge Current	45A (Not Trigger Temperature Cut-off) 60A (Temperature Cut-off)
Max Continuous Pulse Current	140A 5s
Max Charge Current	8A
8A/30A Cycle Life	Capacity ≥2,400mAh @ after 600cycles -Charge : Rated Charge @ 25±2℃ -Discharge: 30A , 2.5V cut-off @ 25±2℃ -Rest time: ≥30min after charge and ≥60min after discharge
8A/40A Cycle Life	Capacity ≥2,400mAh @ after 400cycles -Charge : Rated Charge @ 25±2℃ -Discharge: 40A , 2.5V cut-off @ 25±2℃ -Rest time: ≥30min after charge and ≥60min after discharge
Weight	Max 70g
Size	Height : Max 70.42mm Diameter : Max 21.31mm

Ampace

CATL & ATL - Joint venture company

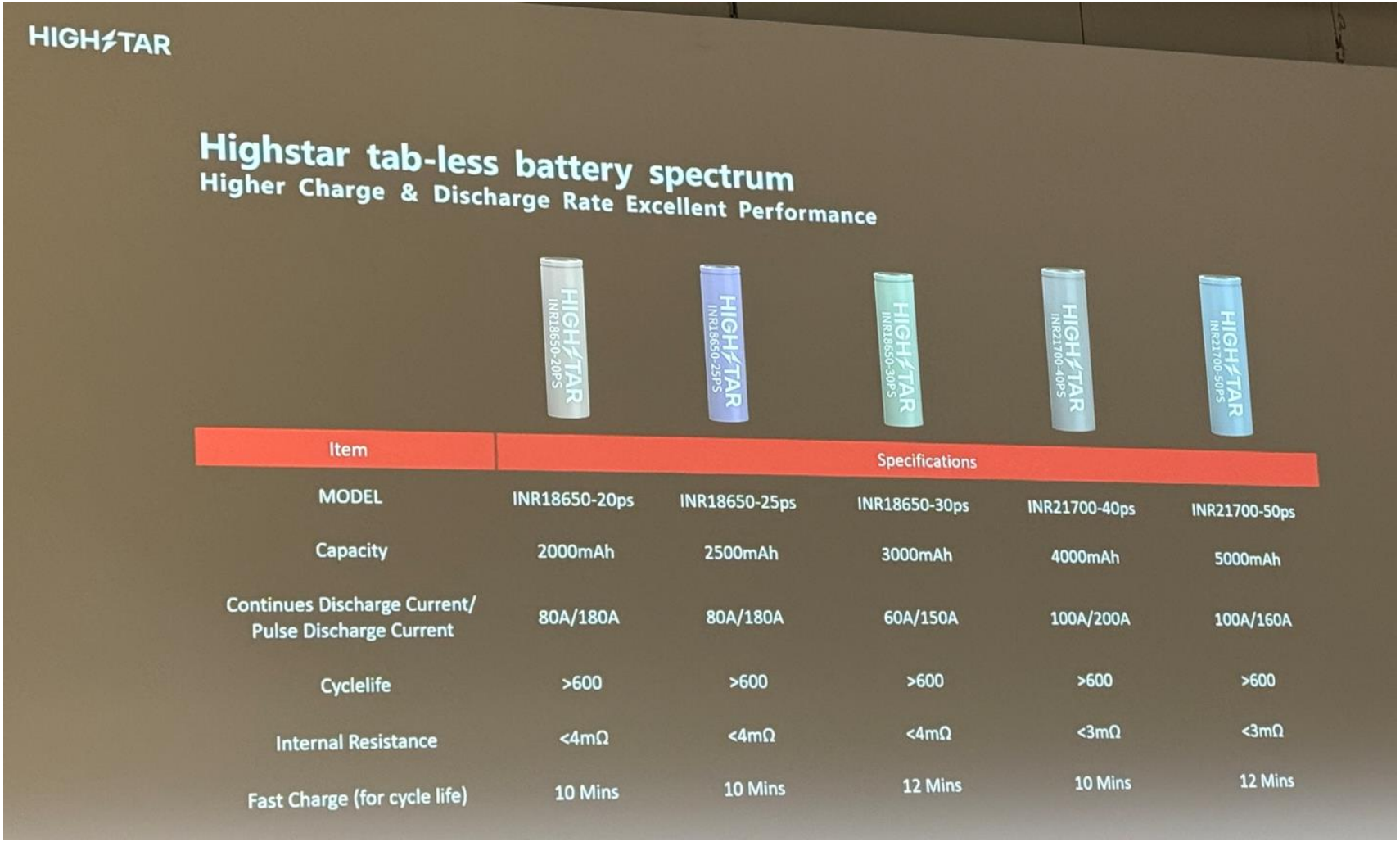
https://www.ampacetech.com/en

EVE Energy 21700 Tabless Cells



https://www.evebattery.com/

High Star Cylindrical 5Ah 21700 Tabless Cells



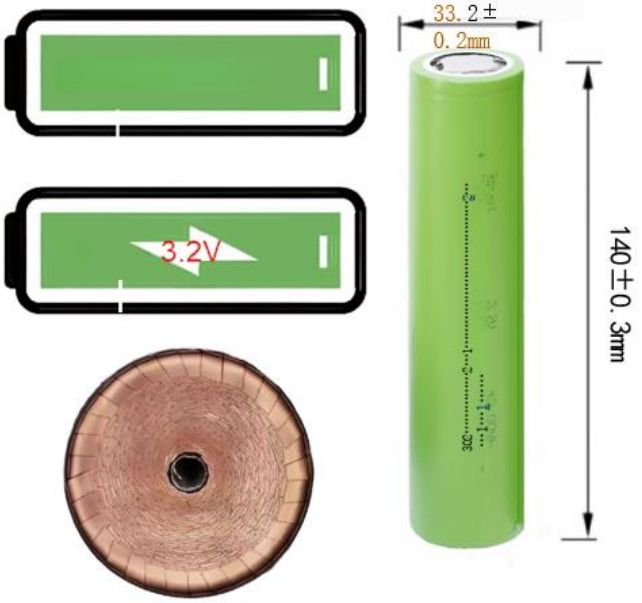
Item	Specifications				
MODEL	INR18650-20ps	INR18650-25ps	INR18650-30ps	INR21700-40ps	INR21700-50ps
Capacity	2000mAh	2500mAh	3000mAh	4000mAh	5000mAh
Continues Discharge Current/ Pulse Discharge Current	80A/180A	80A/180A	60A/150A	100A/200A	100A/160A
Cyclelife	>600	>600	>600	>600	>600
Internal Resistance	<4mΩ	<4mΩ	<4mΩ	<3mΩ	<3mΩ
Fast Charge (for cycle life)	10 Mins	10 Mins	12 Mins	10 Mins	12 Mins

Xiao Lu Cylindrical 32140 LFP Tabless Cells

32140Series

ELECTRIC CELL

32140-
15Ah



Advatanges/Features

1.All-pole low resistance, low temperature rise;

2.Long life, high performance LFP32140-15Ah;

3.The products are widely used, and the product system covers electric passenger cars, low-speed electric vehicles, electric logistics vehicles, energy storage and other markets;

4.Many product models, main products: LFP32140-12.5Ah、LFP32140-15Ah、LFP32140-17.5Ah.

Power/Stored energy

Shell material: Nickel-plated steel Nominal capacity: 15000mAh

Rated voltage: 3.2V Charge Ending Voltage: 3.65V

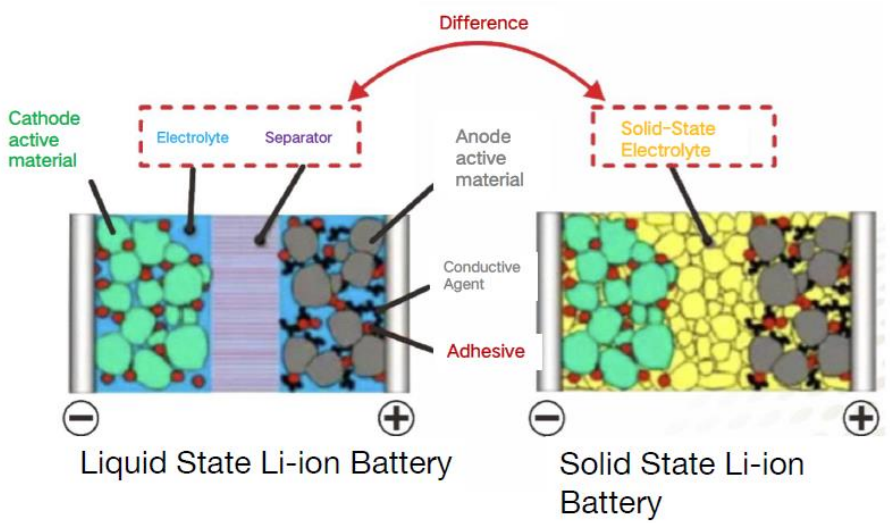
Discharge Ending Voltage: 2.0V Weight: ≤320g

Solid-State Cells Background

All Solid State Battery - 0% liquid electrolyte
ASSB completely eliminate liquid electrolytes, and use solid materials as both electrodes and electrolytes. No liquid is present in these batteries whatsoever.

Quasi Solid Battery - up to 5% liquid electrolyte
While QSSB are closer to solid-state batteries compared to traditional liquid electrolyte batteries, they still incorporate a minimal amount of liquid or gel in the electrolyte composition.

Semi Solid Battery - between 5-10% liquid electrolyte
Compared to quasi-solid and all solid-state, SSB have a larger fraction of liquid or gel in their overall composition, particularly within the electrodes. The electrolyte in these batteries is not fully solidified, but rather exists in a semi-solid state, where a significant portion is in a liquid or gel form.



Solid State Batteries Advantages

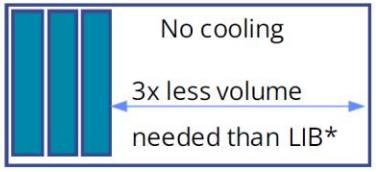
Solid-state battery

Solid Electrolyte
- Nonflammable
- No cooling required
- Allows metal anode
- Blocks dendrites
- Increased durability

Less dead weight components
- No plastic separator
- Ideally, no binder to hold electrodes

Metal anode
- Eliminates the ion host (a dead weight)
- High capacity (long-l

Less volume required for packing

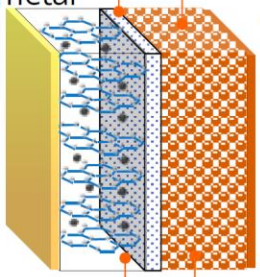


https://plugboats.com/tag/solid-state-battery/

Liquid electrolyte battery

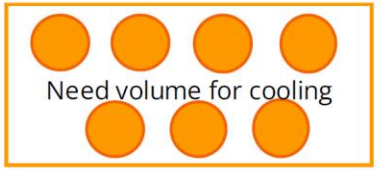
liquid electrolyte
- Flammable
- Not compatible with metal
- Dendrites can form

Several dead weight components
- Plastic separator
- Binder
- Solvent



carbon-based anode
- Limited capacity to accom

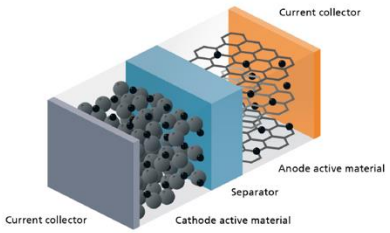
Pack overhead



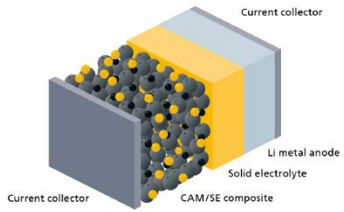
https://batterybro.com/

Solid-State Batteries Limitations

- **Power limited by electrolyte low ionic conductivity and resistance induced at electrode/electrolyte interface**
- **High working operating temperatures - Operation at low temperature may be challenging**
- **High mechanical constraints in the cell**
  - Volume changes during charge and discharge causes loss of contact between particles/films
  - Insulating layers at the grain-boundaries/interfaces
- **Requires different manufacturing processes than liquid batteries**
- **High pressure required to maintain electrode contact**
- **Electrochemical stability issues with some electrolytes**
- **More expensive**

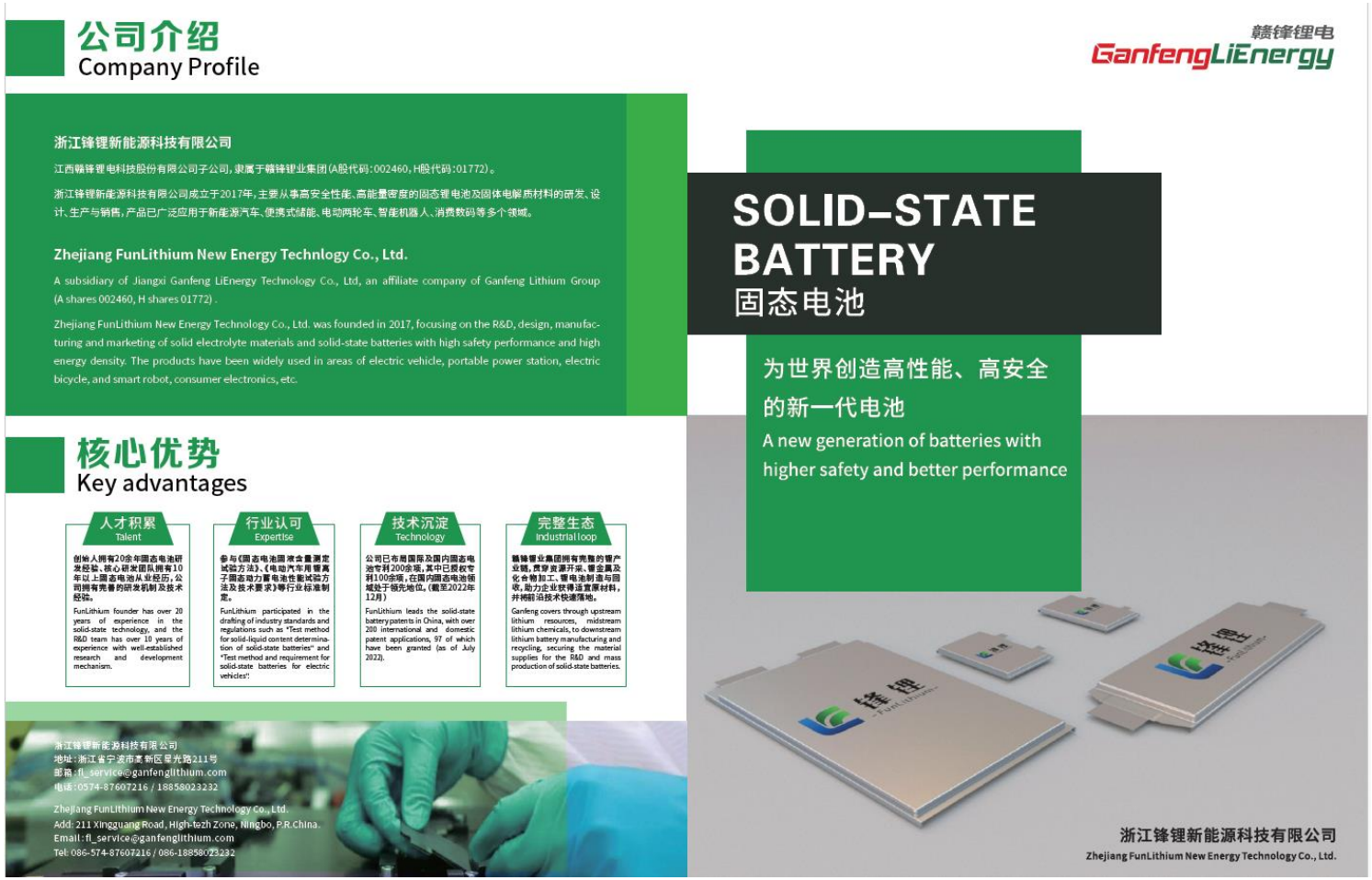


Liquid electrolyte LIB



Solid-state battery

Dongguan Ganfeng Electronics



http://www.ganfenglithium.com/

GanfengLithium

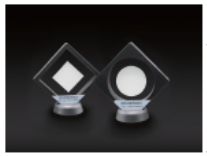
主要产品
Product Portfolio

氧化物 固体电解质材料 Oxide Solid Electrolyte

公司研发的氧化物固体电解质材料包括NASICON结构和Garnet结构两个系列产品。产品形式包括粉体、浆料、电解质片，离子电导率达到规模化产品一流水平，批次稳定性高。目前产能可达百吨级，并将于2023年投产千吨级电解质材料产线。

The oxide solid electrolyte materials developed and produced by Funlithium include NASICON and Garnet structures in forms of powder, slurry, and electrolyte sheet. Being one of the first in the industry to achieve mass production capability with stable batch consistency and first-class ionic conductivity, the company will ramp up its production capacity to kiloton in 2023.

结构 Structure	室温离子电导率 Ionic Conductivity@RT	产品粒度 Particle Size
NASICON	体相电导率 Bulk: ⩾4.5 mS/cm 总电导率 Total: ⩾0.8 mS/cm	粉体 Powder: 300/600/5000/10000nm 浆料 Slurry: 150/300/600nm
Garnet	常规产品 Standard Product: ⩾0.8 mS/cm 高电导率产品 Next-Gen.: ⩾1.5 mS/cm	粉体 Powder: 300/500/5000/10000nm 浆料 Slurry: 160/300/500nm



结构 Structure	室温离子电导率 Ionic Conductivity@RT	产品规格 Dimensions
NASICON	(5.0±0.5) x 10^{-1} mS/cm	圆片 Round: Φ12mm/Φ16mm/Φ20mm 方片 Square: 20×20mm/60×60mm 厚度 Thickness: 260μm/280μm/300μm 其它规格可定制 Customizable

硫化物 固体电解质材料 Sulfide Solid Electrolyte

硫化物固体电解质是目前离子电导率最高的一类无机固体电解质材料，具有热稳定性好、电化学窗口宽、机械性能好等优点，是全固态电池重点采用的电解质材料。公司已研制出LGPS、LPSC、$Li_7P_3S_{11}$与Li_3PS_4等硫化物体系固体电解质材料，离子电导率达到目前行业最高水平，量产能力达到行业领先水平。公司采用自产的优级硫化锂原料，向行业提供性能最优的硫化物电解质产品。

Sulfide solid electrolyte is a kind of inorganic solid electrolyte material with the highest ionic conductivity. Attributing to good thermal stability, wide electrochemical window, and good mechanical performance of the material, it is considered to be a key electrolyte material used in all-solid-state batteries. FunLithium provides LGPS, LPSC, $Li_7P_3S_{11}$ and Li_3PS_4 with the highest ionic conductivity with mass production capability and competitive price.

产品名称 Product Name	室温离子电导率 Ionic Conductivity@RT	产品粒度 Particle Size
LGPS	⩾7.0 mS/cm	0.5~50 μm
LPSC常规规格	⩾10.5 mS/cm	2.0~50 μm
LPSC超细规格	⩾5.0 mS/cm	0.5~10 μm
LPS7311	⩾2.5 mS/cm	0.5~20 μm
LPS314	⩾3.0 mS/cm	0.5~20 μm

混合固液锂离子电池 Solid-liquid Hybrid Electrolyte Li-ion Battery

赣锋锂电率先实现混合固液锂离子电池的产业化及装车示范运营。同时，公司已将电池产品导入便携式储能、电动两轮车、智能机器人、消费电子等多个应用领域。公司现有固态锂电池产能2GWh，并在重庆拟建设新的生产制造基地，设立先进电池研究院。

Ganfeng LIEnergy takes a lead in the industrialization of hybrid solid-liquid electrolyte li-ion batteries, and pioneered in automotive demonstration project. The batteries have also been introduced into other applications, including portable power stations, electric bicycles, smart robots, consumer electronics, etc. The company now has a 2GWh production line, and is building a new manufacturing base and an advanced battery research instute in Chongqing, China.

260 Wh/kg
电芯能量密度 Cell Energy Density

2000 @RT, 1C/1C
室温循环寿命 Cycle Life @RT (25℃)

1000 @HT, 1C/1C
高温循环寿命 Cycle Life @HT (45℃)

85% @-20℃
低温容量保持率 Low-temperature Capacity

安全测试项目 Safety Test Items	《电动汽车用动力蓄电池安全要求》 Safety Requirement for EV Batteries "GB38031-2020"	赣锋锂电混合固液锂电池安全性能 Safety Performance of GF Hybrid Electrolyte Battery
针刺 Nail Penetration	新国标已取消 Canceled in the new GB requirement	5mm 钢针, 针刺速度 25mm/s φ5mm steel nail, vilosity of 25mm/s
加热 Thermal Stability	加热至130℃ Heat the cell to 130°C	加热至180℃ Heat the cell to 180°C
过充电 Overcharge	以1C充电至终止电压1.1倍 Charge the cell with 1C to 1.1 U_{max}	以1C充电至终止电压1.5倍 Charge the cell with 1C to 1.5 U_{max}
挤压 Crush	变形量达到15%或挤压力达到100 kN Crush until 15% cell deformation or 100 kN	变形量达到30%或挤压力达到200 kN Crush until 30% cell deformation or 200 kN

动力领域 Electric Vehicle

50Ah 318.5*100.1*11.7mm

123Ah 548.0*116.0*12.0mm

便携/户用储能、电动两轮车 Portable/Household Power Station, Electric Bicyles

28Ah 133.0*202.0*7.6mm

42Ah 162.0*226.0*8.4mm

锂金属负极固态电池 Solid-liquid Hybrid Electrolyte Li Metal Battery

锂金属负极固态电池解决了传统液态锂电池面临的高能量密度与高安全性能无法兼顾的问题，可将能量密度提升至400Wh/kg以上，并具备远超国标要求的安全性能，计划2024年底量产。

High energy density and high safety performance can both be achieved with hybrid electrolyte lithium metal batteries, while it is difficult to balance for conventional liquid electrolyte batteries. The company is commercializing and starting to mass produce the batteries by the end of 2024.

400 Wh/kg
电芯能量密度 Cell Energy Density

70 Ah
车规级电芯尺寸 Automotive Grade Battery

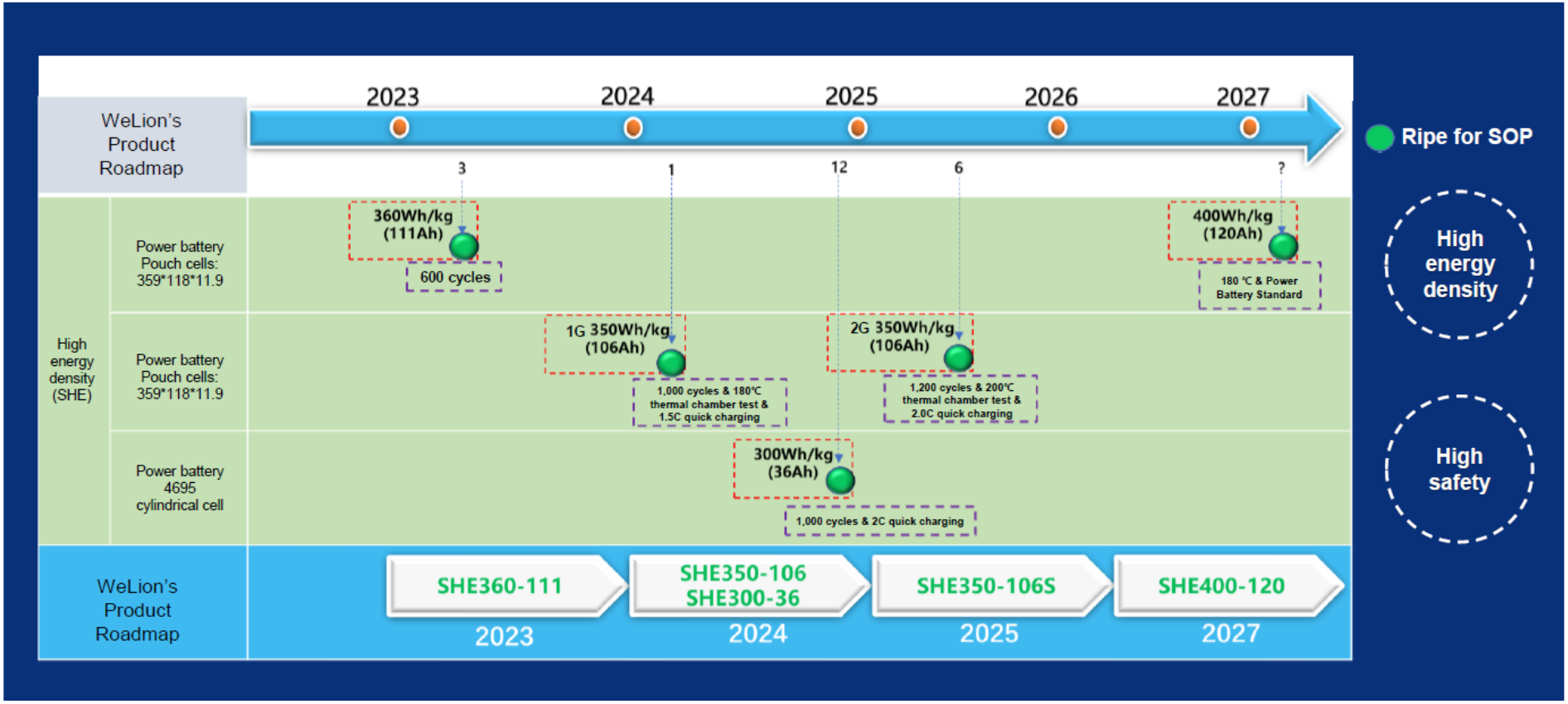
5C @RT
持续放电能力 Continuous Discharge Rate

200 ℃ 加热测试 Thermal Stability
超高安全性能 Super-high Safety Performance

Semi Solid-State with Li-Metal cells, 400 Wh/kg

Beijing WeLion New Energy

02. Product Planning and Development Roadmap



Talent New Energy

Completion of 0.2GWh semi-solid-state lithium battery production line at Phase I of manufacturing base in Chongqing

High-energy-density solid-state EV batteries

In terms of material system design, Talent employs cutting-edge materials for high-energy-density cathodes and anodes and has developed our very own solid-state electrolytes and multi-layer electrode technology. Our electrode design optimization process includes micro-structure characterization and simulation, which not only improves both the cell energy density and intrinsic safety but also makes breakthroughs in augmenting the rate capability of high-energy-density solid-state EV batteries.

Currently, the mass-produced pouch and prismatic aluminum shell products have excellent performance, achieved product delivery of two-wheel vehicles, passed related performance tests of NEVs, as well as passed the GB38031-2020 safety performance test and the Nail Penertration Test. Talent plans to unveil the second generation of ultra-high-energy-density solid-state batteries with an energy density beyond 400 Wh/kg in 2024 to meet the market's upgrade demand.

Project/Parameter	Pouch cell high-energy-density solid-state battery			Prismatic cell with aluminum casting high-energy-density solid-state battary
Battery Type	NCM	NCM	NCM	NCM
Working Voltage (V)	2.7~4.2	2.7~4.2	2.7~4.2	2.7~4.2
Nominal Capacity (Ah)	56	60	105	150
Energy Density (Wh/kg)	290	310	330	300
Maximum Continuous Charge Rate	⩾ 2C	⩾ 2C	⩾ 2.5C	⩾ 2C
Working Temperature Range (°C)	-20-60°C	-20-60°C	-20-60°C	-20-60°C
Cycle Life (@ 25 °C)	1500 cycle	1500 cycle	1000 cycle	1500 cycle

Passed the safety performance test according to GB 38031-2020 and the Nail Penetration Test

https://www.ctlne.com/

太蓝新能源 TALENT NEW ENERGY

Shenzhen BAK Power Battery

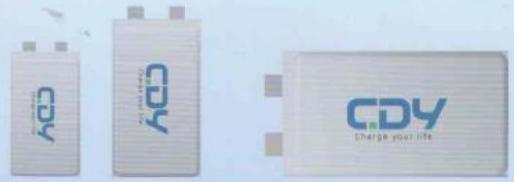
BAK Battery Unveils Cutting-Edge Semi-Solid Battery Products at CIBF 2024, Promoting Breakthroughs in Application Fields

https://www.bakpower.com/

Guangdong Jusheng technology (Polyentech)

Solid-state pouch cell

高安全固态软包电池

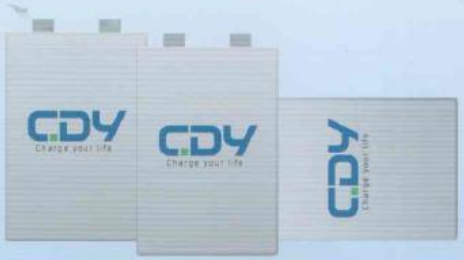


聚圣科技电芯产品规格说明表

参数	固态软包电池	固态软包电池	固态软包电池	固态软包电池	固态软包电池
型号	INP601562405T-30Ah	INP551562405T-30Ah	INP80156240MS-27Ah	INP70156240MT-26Ah	INP78132204MT-20Ah
材料体系	三元/石墨	三元/硅碳	锰酸锂/石墨	三元+锰酸锂/石墨	三元+锰酸锂/石墨
尺寸(mm)	6.0*156*240	5.5*156*240	8.0*156*240	7.0*156*240	7.8*132*204
重量(g)	485	386	625	530	430
标准容量(Ah)	30	30	27	26	20
标称电压(V)	3.7	3.6	3.7	3.7	3.7
充电工作温度(℃)	0-45	0-45	0-45	0-45	0-45
放电工作温度(℃)	-20-55	-20-55	-20-55	-20-55	-20-55
25℃循环寿命(次)(@1C/1C)	≥1500	≥1200	≥800	≥1000	≥1000
45℃循环寿命(次)(@1C/1C)	≥1200	≥1000	≥500	≥600	≥600
能量密度(Wh/kg)	240	280	160	182	172
特点	高安全高能量密度	高能量密度高安全	低成本，改善荷电保持和高温	低成本	低成本

High Energy Density solid-state lithium metal batteries

高比能固态锂金属电池



聚圣科技电芯产品规格说明表

参数	固态金属锂电池
型号	401562405LI-30Ah
材料体系	高镍NCM/金属锂
尺寸(mm)	4.0*156*240
重量(g)	278
标准容量(Ah)	30
标称电压(V)	3.7
充电工作温度(℃)	0-45
放电工作温度(℃)	-20-55
25℃循环寿命(次)(@1C/1C)	≥300
45℃循环寿命(次)(@1C/1C)	≥150
能量密度(Wh/kg)	450
特点	高比能高安全

应用领域：无人机。

http://www.polyentech.com/

POLYENTECH

Solid-state cylindrical

固态圆柱电池

聚圣科技电芯产品规格说明表

参数	固态圆柱电池	固态电子烟电池
型号	INR18650ST-2200mAh	ICR13400ST-600mAh
材料体系	三元/石墨	钴酸锂/石墨
尺寸(mm)	φ18.5*65.5	φ13.2*40
重量(g)	46	12.3
标准容量(Ah)	2.2	0.6
标称电压(V)	3.7	3.7
充电工作温度(℃)	0-45	0-45
放电工作温度(℃)	-20-55	-20-55
25℃循环寿命(次)(@1C/1C)	≥1000	≥300
45℃循环寿命(次)(@1C/1C)	≥700	≥250
能量密度(Wh/kg)	177	180
特点	高安全圆柱	高安全电子烟电池

应用领域：电动工具、消费类电子、电动交通工具、家居智能化设备、电动玩具、电子烟、医疗设备、军工设备、工业设备等。

Shenzhen Chuangming New Energy (CHAM)

Quasi-solid-state battery

Nominal capacity	15000mAh
Q	3.2V
internal resistance	≤3mΩ
Charge cutoff voltage	3.65V
Discharge cutoff voltage	2.0V
weight	295±10g
Standard charging current	0.5C
Fast charging current	1C

Fast charging current	1C
Standard discharge current	0.5C
Maximum continuous discharge current	2C
Normal temperature cycle life	2000 times > 80% 0.5C/1C
High temperature cycle life	Cycle life at 45℃ 1000 times > 80% 0.5C/1C Cycle life at 60℃ 500 times > 80% 0.5C/1C
Operating temperature (charging)	0℃~60℃
Operating temperature (discharge)	-20~60℃

http://www.cham.com.cn

CHAM

Highstar

安全耐久 成本领先 | TO BE HIGHSTAR

Big Cylindrical Battery

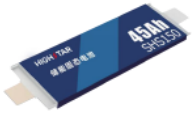
Model	4695 SHP800L
Material Chemical System	NCM solid-liquid mixture
Mass Energy Density	⩾300Wh/kg@0.33C
Volume Energy Density	⩾800Wh/L@0.33C
Nominal Capacity	35Ah
Nominal Voltage	3.58V
Working Temperature	-20℃~60C
Charging Time	⩽20min(10%~80%SOC)
Low Temperature Discharge Performance	-20℃/0.33C capacity retention > 80%
Dimension	φ46*95mm
Cycle Life	⩾1200cycles@90%DOD
Testing & Certification	GB UL IEC UN38.3

HIGHSTAR PRET

http://www.highstar.com/

HIGHSTAR 海四达

Solid Battery — ESS



Model	45Ah SHS150	280Ah SHS165
Material Chemical System	LFP solid-liquid mixture	LFP solid-liquid mixture
Energy Density	⩾150Wh/kg	⩾165Wh/kg
Nominal Capacity	45Ah	280Ah
Nominal Voltage	3.2V	3.2V
Standard charge/discharge rate	0.5P	0.5P
Dimension	359*117*11.7mm	173.6*71.6*207mm
Cycle Life	⩾8000 cycles (100%D0D@0.5P)	⩾6000 cycles (0.5P/0.5P,100%D0D@25°C)
Working Temp.	-20℃~60C	-20℃~60C
Test & Certification	GB 36276-2018 · UL1973 UL1642 UL9540A · IEC 62619 · UN38.3 UN38.3	

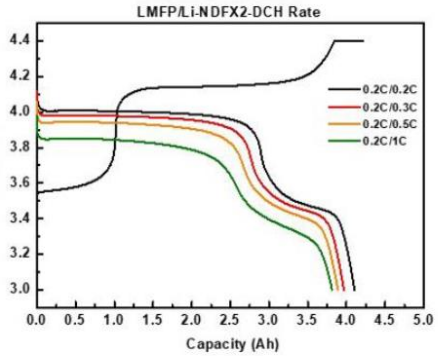
Solid Battery — EV

Model	SHS360C	SHS360S
Material Chemical System	NCM solid-liquid mixture	NCM solid-liquid mixture
Mass Energy Density	⩾350Wh/kg@0.33C	⩾360Wh/kg@0.33C
Volume Energy Density	⩾745Wh/L@0.33C	⩾775Wh/L@0.33C
Nominal Capacity	106Ah	111Ah
Nominal Voltage	3.55V	3.51V
Charging Time	⩽35min(10%-80%SOC)	⩽60min(10%-80%SOC)
Dimension	359*118*11.9mm	359*118*11.9mm
Cycly Life	⩾1000 cycles	⩾600 cycles
Test & Certification	GB · UL · IEC · UN38.3	

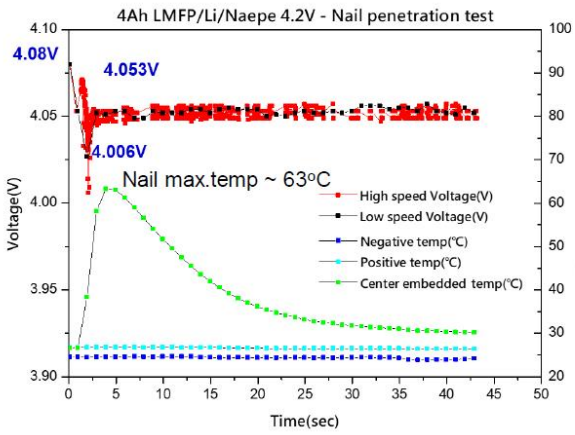
Lithium Metal With Liquid Electrolyte Cells

HCM – Lithium metal-LMFP Cell

LMFP/Li Cell (318Wh/kg)

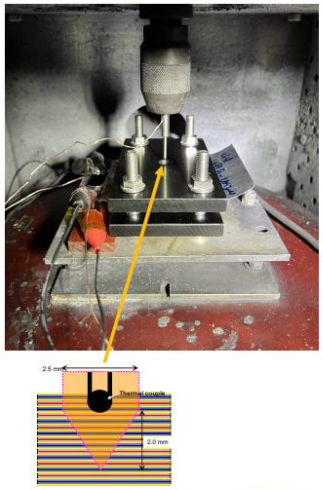


4.15Ah
LMFP/Li cell Charged to 4.2V
(CC/CV, 92.5% SOC, 294Wh/kg)



LMB Cell showed 74mV voltage drop at the beginning of nail penetration, then recovered to 27mV drop by the ISC fusing.

Nail: SUS, diameter: ø2.5mm
Penetration speed: 20mm/s
Test result: Pass



SUS nail, 2.5mm OD, Thermo Couple embedded

http://www.hcmaterial.com.tw

Beijing Golden Feather New Energy

Cell Summary

金羽新能 Golden Feather

	Model	GEV Wh/kg	2023 Q1	2023 Q2	2023 Q3	2023 Q4	2024 Q1	2024 Q2	2024 Q3	2024 Q4	2025 Q1	2025 Q2	2025 Q3	2025 Q4	Material
1	**S300** High Energy Density Semi-Solid	300													NCM811+SiO
2	**S320** High Energy Density Semi-Solid	320													NCM811+Si@C
3	**S340** High Energy Density Semi-Solid	340													NCM811+SiO
4	**S200** Fast Charge Semi-Solid	200													NCM811+C
5	**46xx** Fast Charge Cylindrical Cell	280													NCM811+Si@C
5	**S500** Anode Free LMB	500													NCM811+Cu/Li

Pilot scale

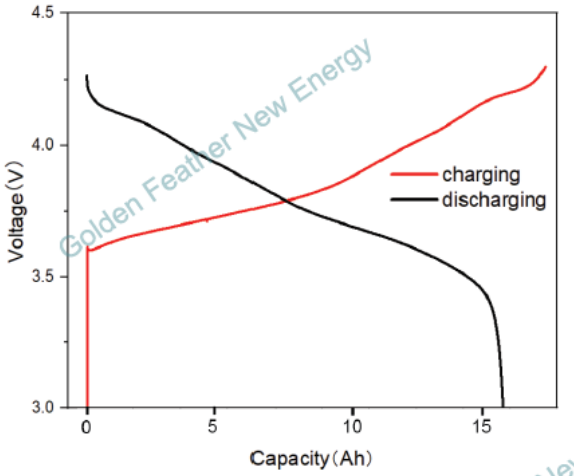
Mass production

https://www.gfenergy.com/

金羽新能 Golden Feather

7650D0 High Energy

Cell Parameters	
Dimension（mm）	7.6mm*50mm*130mm (T*W*L)
Capacity (mAh)	15700（0.1C）
Voltage window（V）	3.0-4.3
Nominal voltage (V)	3.65 (0.33C/1C)
Weight（g）	130±2g
Energy density (Wh/kg)	**450**
Volumetric energy density (Wh/L)	**1250**
Internal resistance (mΩ)	~3
Working temperature (℃)	-20~45
Cycle life	>80
Instant discharge rate (C)	≥3
Safety test	External Short, Forced Discharge, Free Fall, Stress, Vibration



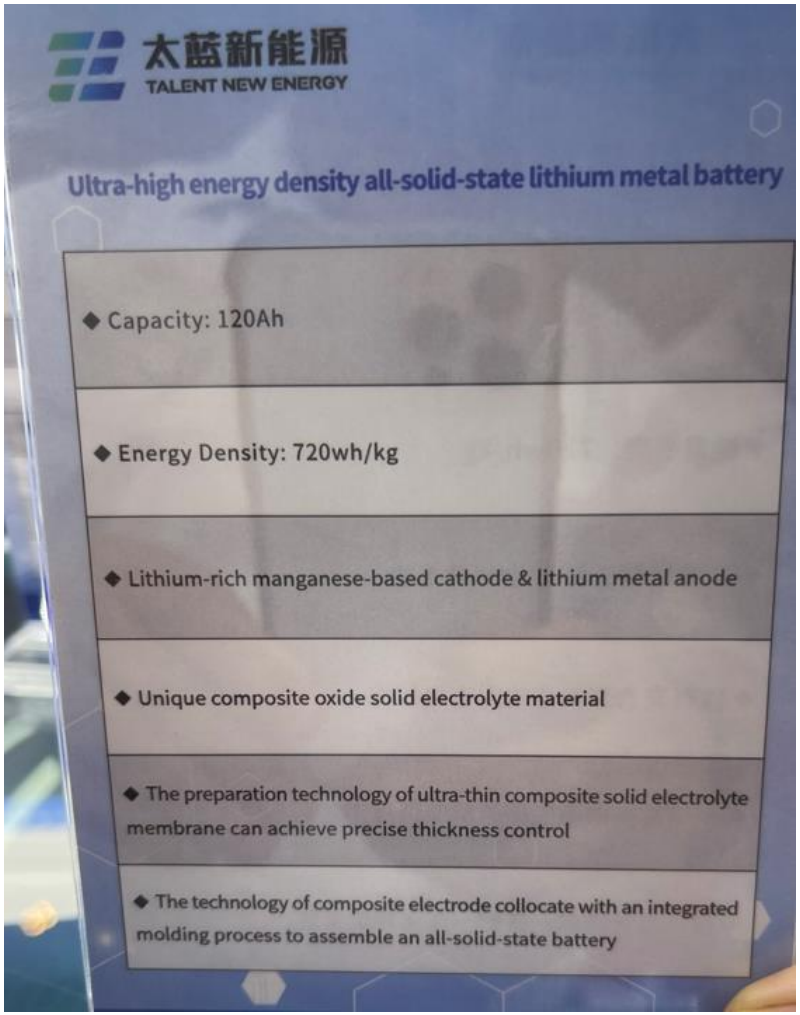
Capacity **15Ah**

GED **450Wh/kg**

VED **1200Wh/L**

Instant Discharge **>4C**

Talent New Energy



https://www.ctlne.com/

太蓝新能源
TALENT NEW ENERGY

Anhui Tongneng New Energy - China

聚合物锂硫电池
Polymer lithium-sulfur battery

100Ah聚合物锂硫电池

序号	项目	特性
1	电池种类	锂硫电池
2	电池型号	PLS13102322(两端极耳)
3	额定容量	100Ah
4	工作电压	2.1V
5	充电限制电压	2.8V
6	充电截止电流	0.02CA
7	放电终止电压	1.0V
8	标准充/放电电流	0.5C/0.5C
9	最大持续充/放电电流	1C/1C
10	能量密度	309Wh/Kg
11	重量	大约680g±5g
12	尺寸（T*W*H）不含极耳	13*102*322mm
13	工作温度和湿度范围	充电温度，5℃～45℃
		充电湿度，低于85%RH
		放电温度，－20～60℃
		放电湿度，低于85%RH

80Ah聚合物锂硫电池

序号	项目	特性
1	电池种类	锂硫电池
2	电池型号	PLS90160230
3	额定容量	80Ah
4	工作电压	2.1V
5	充电限制电压	2.8V
6	充电截止电流	0.02CA
7	放电终止电压	1.0V
8	标准充/放电电流	0.5C/0.5C
9	最大持续充/放电电流	1C/1C
10	能量密度	311Wh/Kg
11	重量	大约540g±5g
12	尺寸（T*W*H）不含极耳	9.0*160*232mm
13	工作温度和湿度范围	充电温度，5℃～45℃
		充电湿度，低于85%RH
		放电温度，－20～60℃
		放电湿度，低于85%RH

通能公司拥有专业、独立的测试团队，经过多年的开发，为各个部门提供了广泛支持，是GNE公司技术不断发展和进步的关键组成部分。测试团队可以进行从新材料到电池，到客户要求的特殊性能等各种测试。

通能公司电池易安装，安装包括通信端口，可提供完整诊断，状态报告，运行状况和使用监控。

通能公司拥有先进的BMS管理方法，不仅确保电池最佳运行，还提供额外的安全级别，包括过充电保护、过放电保护、外部短路保护、超温监测。

公司接受来自全球的锂硫电池和磷酸铁锂电池订单，可对电池尺寸、能量密度、循环性能等进行定制。

客户若需求锂硫电池组，通能公司可以与其合作的电池组管理系统厂商一起，为系列应用产品开发提供解决方案。有关锂硫电池组的信息，可致电通能公司了解。

www.generalnewenergy.com

Cells are in prototype production

通能新能源 GENERAL NEW ENERGY

China's GNE develops lithium-sulfur battery with energy density of 700Wh/kg

The energy density of the newly developed lithium-sulfur prototype far exceeds the one of common lithium -ion batteries.

China's General New Energy (GNE) has recently announced a significant breakthrough in lithium-sulfur (Li-S) battery technology, unveiling a prototype with an energy density of 700Wh/kg.

According to GNE, this new battery not only far exceeds the energy density of existing lithium-ion batteries but also offers substantial improvements in both mileage and safety.

Lithium-sulfur batteries, which use sulfur as the cathode and lithium metal as the anode, represent a promising alternative to traditional lithium-ion batteries. Theoretically, Li-S batteries can achieve energy densities of up to 2,600Wh/kg, which is over five times that of their lithium-ion counterparts. Furthermore, sulfur is abundant, inexpensive, and environmentally friendly, giving Li-S batteries a cost and sustainability edge.

However, Li-S batteries face significant technical challenges. Sulfur's poor electrical conductivity hinders the battery's high-rate performance, while the "shuttle effect" of lithium polysulfides dissolving in the electrolyte leads to increased electrolyte viscosity, reduced ion conductivity, and accelerated capacity decay. Furthermore, the considerable density difference between sulfur and lithium sulfide causes volume shrinkage during charge-discharge cycles, compromising structural stability.

The GNE research team, led by Dr. Jiujun Zhang, a fellow of multiple academies including The Academy of Science of the Royal Society of Canada, the Canadian Academy of Engineering (CAE), the Engineering Institute of Canada and the Chinese Academy of Engineering, has been at the forefront of overcoming these hurdles. With more than a decade of persistent effort, Zhang and his team have made many breakthroughs in Li-S battery technology.

By employing innovative designs and materials, they have successfully addressed many of the key technical challenges. For example, the team improved sulfur's conductivity and ion transport by using nano-material coatings and electrolyte additives, effectively mitigating the shuttle effect. They also developed novel electrolyte materials that improve both the battery's cycle life and safety. These innovations have laid a strong foundation for the commercialization of Li-S batteries.

Founded in 2022, GNE specializes in developing efficient and eco-friendly energy storage solutions. The company's R&D team is led by Dr. Zhang, including scientists from the U.S. and Japan. GNE has secured several patents related to Li-S battery technology, covering materials such as cathodes, anodes, separators, and electrolytes.

The company also operates an advanced production line for Li-S batteries and supporting materials, ensuring full control over the entire production process from R&D to manufacturing. GNE has also established a testing team to ensure the quality and performance of its products.

鋰硫電池 Lithium Sulfur Battery

容量 22.535Ah Capacity: 22.535Ah

型号：0975130 Model: 0975130

能量密度 Energy Density

381.2%

701.8 Wh/Kg

重量 Weight

67.8g

铁鋰電池 Lithium Iron Battery

容量 22.633Ah Capacity 22.633Ah

型号：1460136 Model: 1460136

能量密度 Energy Density

100%

184.1 Wh/Kg

重量 Weight

393.5g

通能新能源 GENERAL NEW ENERGY

CETC Lan Tian Technology

Energy Storage Product Series

CETC Rechargeable battery/Lithium Metal Battery

Product introduction

Lithium metal secondary batteries use $Li[Ni_xCo_yMn_z]O_2$ cathode with lithium metal anode. Power type lithium metal secondary batteries combine high specific energy and high power characteristics; High specific energy lithium metal secondary batteries have industry-leading specific energy indexes.

Features & Benefits

High specific energy: Power type batteries with specific energy up to 450Wh/kg, high specific energy batteries with specific energy up to 515Wh/kg.

High power characteristics: Maximum continuous discharge rate up to 5C.

Technical Specifications

Project	Power type batteries	High specific energy batteries
Sizes(mm)	8*103*330	6.2*117*116
Rated Voltage(V)	3.73	3.73
Capacity(Ah)	≥66	≥20
Specific energy (Wh/kg)	450	515
Cycle life (times)	200	55
Maximum continuous discharge rate	5C	1C
Safety features	Through the short-circuit, over-charging, over-discharging, drop	Through the short-circuit, over-charging, over-discharging, drop

Applications

Power supply for unmanned aerial vehicles and robots.

Aerospace@lantiantech.com.cn

https://www.lantiantech.com.cn/

CETC 中电科蓝天科技股份有限公司

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2. **Shmuel De-Leon Battery/Energy Sources DataBase ® (Includes 15,000 cell PDF data sheets).**