



Development and Application of Polyanionic Cathode Materials and Sodium Compensators



共塑净零工业新未来

Toward Net-Zero, Beyond Industry

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01 Company Profile

- 1.1 Tonexus Environmental Technology Overview
- 1.2 Tonexus Haosheng (Yibin) New Energy Technology Co., Ltd. Overview

1.1 Tonexus Environmental Technology Overview

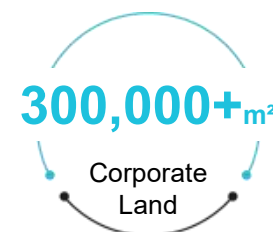
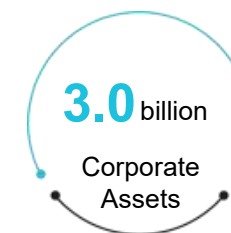
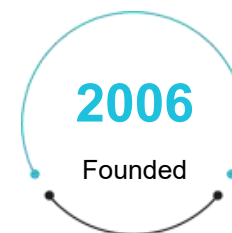
Tonexus listed on the Shenzhen Stock Exchange Main Board (003027), upholds the corporate philosophy of “Toward Net-Zero, Beyond Industry”. The company is committed to becoming a globally recognized strategic partner in pollution, carbon reduction and industrial net-zero, contributing Tonexus’s expertise to the world’s green transition.

Core Business Areas

Flue Gas Treatment (EPC & Catalysts), CCUS, R&D and Production of New Energy Materials and Equipment, etc.

Key Service Sectors

Steel, Power Generation, Coking, Construction Materials, Chemical Industry, Non-Ferrous Metals, Waste Incineration, Pulp & Paper, Renewable Energy, etc.



1.2 Haosheng New Energy Overview

Tonexus Haosheng (Yibin) New Energy Technology Co., Ltd. is a controlled subsidiary of Tonexus Environmental Technology.

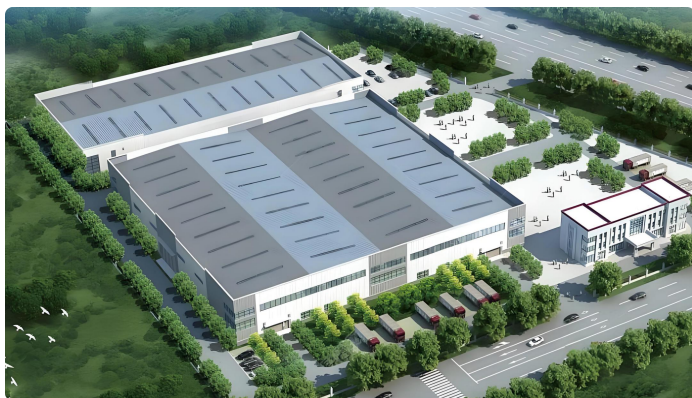
Business Scope:

New energy technology R&D. Energy storage technology services. Advanced material manufacturing. Battery component production and sales. Engineering and technical research

Capacity Planning:

Site Area: **120,000** m²

Annual Capacity: **20,000** tons



02 “A Core, Two Wings” Strategy

"Integrated Two-Wing" business architecture



"A Core, Two Wings" Strategy: Delivering on Our Green Industry Promise.



Division

Environmental
Technology Sector

Low-carbon
Technology Sector

Energy Technology
Sector

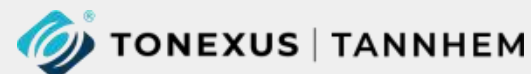
Category

Atmospheric
Governance

Carbon Capture, Storage
and Utilization

Sodium-Ion Battery

Brand



Product

Flue Gas Treatment Engineering & Equipment;
Tonexus Low-Temperature SCR Catalysts

Tonexus TXio Carbon Capture Process;
Tonexus TX-1 CO₂ Absorption Solvents

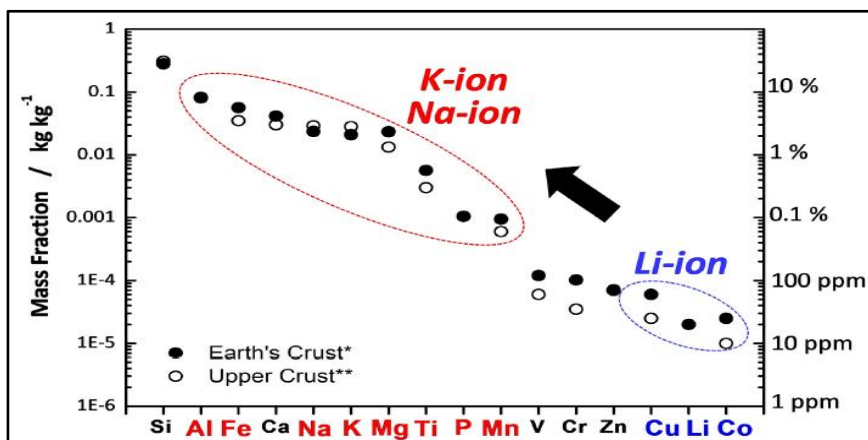
Tonexus NFPP Sodium Battery Cathode Material;
Tonexus NFPP-1 Short Blade Battery Cell

03 Background of sodium-ion batteries

3.1 Sodium-ion Batteries: Cost Advantages & Applications

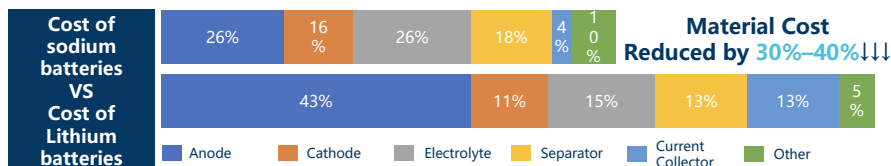
3.2 Current Market scale of Various Applications

3.1 Sodium-ion Batteries: Cost Advantages & Applications

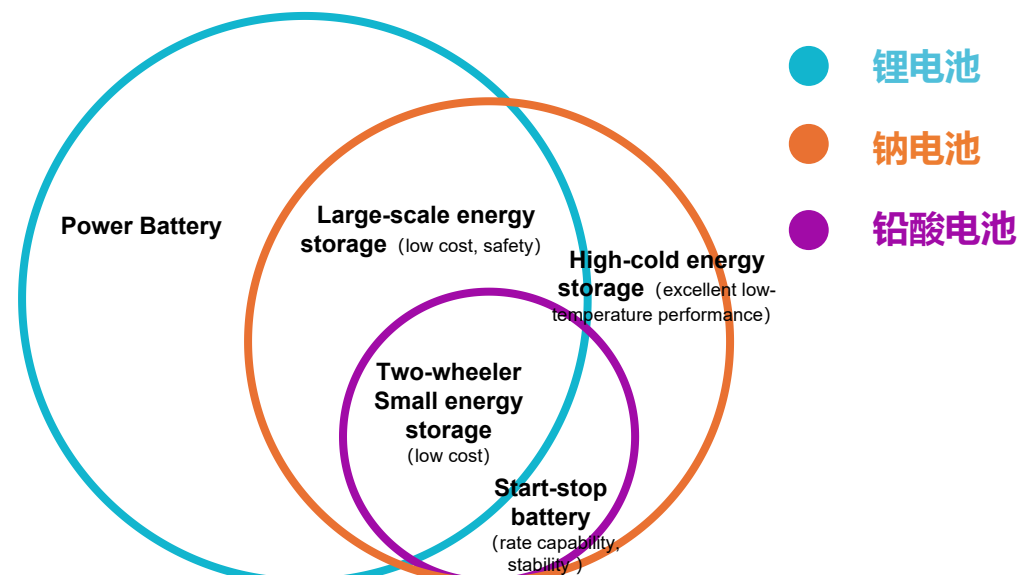


Sodium VS Lithium Resources	Element	Crustal Abundance	Distribution	Price (USD/Kg)
	Sodium	2.75%	Global	~0.3
	Lithium	0.0065%	75% in Americas	~21

Current Collector Choice	Sodium-ion: Aluminum foil (both electrodes, low cost)
	Lithium-ion: Copper foil (anode, expensive)



Li, Na, Pb Batteries: application scenarios and proportions



- Abundant resources & low cost; Al foil usable for anode current collector further reduces cost;
- Compatible with Li-ion battery production equipment;
- Set to largely cover the lead-acid battery market and compete with Li-ion in energy storage

3.2 Current Market scale of Various Applications

	Application Scenarios	Current Market Scale	Future Market Scale	Current Battery Systems	Sodium Battery Scale Forecast
	Start-stop battery	~100 GWh	~100 GWh	Lead-acid battery	~10 GWh
	A00-class electric vehicles	~20 GWh	30~50 GWh	Lithium-ion battery	~5 GWh
	Two-wheeled electric vehicles	~60 GWh	60~70 GWh	85% lead-acid battery, 15% lithium-ion battery	~20 GWh
	Small-scale energy storage	~50 GWh	~50 GWh	50% lead-acid battery, 50% lithium-ion battery	~10 GWh
	Large-scale energy storage	~200 GWh	> 1000 GWh	Lithium-ion battery	> 200 GWh

- In the next 1-2 years: SIB will enter start-stop power & two-wheeler markets;
- In the next 3-4 years: SIB will enter large-scale energy storage market.

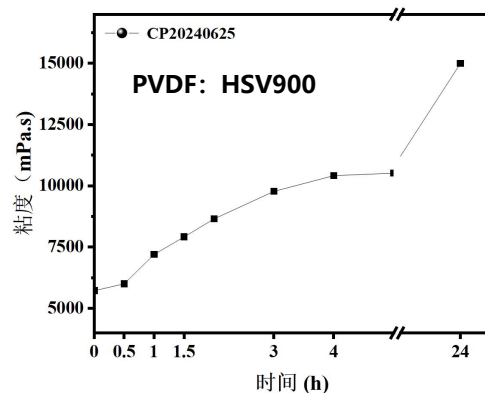
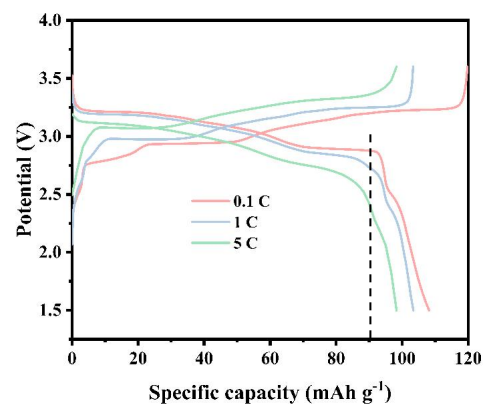
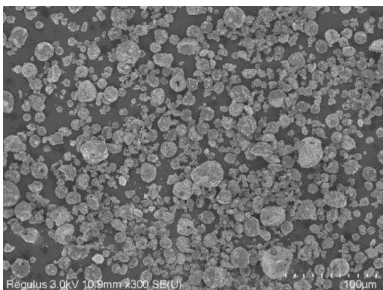
04 Current sodium-battery products

- 4.1 General-purpose NFPP
- 4.2 High Compaction density NFPP
- 4.3 NaCrO₂ Sodium Compensator
- 4.4 High Initial Charge S-NFPP

4.1 General-purpose NFPP

—Higher specific capacity; Lower cost; Better processability

- **Higher specific capacity**
Up to **110** mAh/g
- **Better Processability**
Stable PVDF-based slurry
- **High-Rate Performance**
90% capacity retention at 5C
- **Lower Cost**
Raw material cost < ¥**12000**/ton
- **Good Compaction Density**
2.1g/cm³, non-brittle

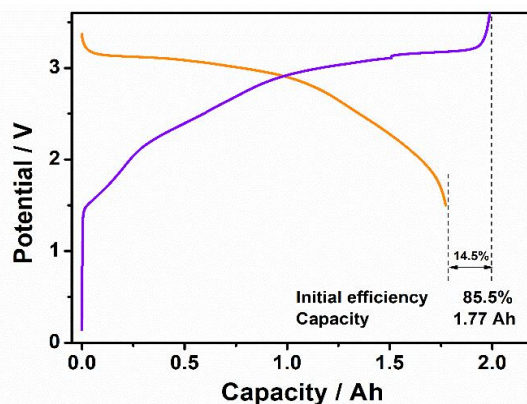


Type		TXHS-3
Testing Voltage		1.5-3.6 V
Capacity	0.1C Initial charge	116 mAh/g
	0.1C Initial discharge	108 mAh/g
Particle Size/μm	D10; D50; D90	1.3; 5.2; 10.2
Cycle performance		80% capacity retention (3000 cycles)
Tap density		1.25 g/cc
Specific Surface Area		9.8 m ² /g
pH		9.9
Compaction Density		2.0~2.2
Carbon Content		1.82%

4.1 General-purpose NFPP

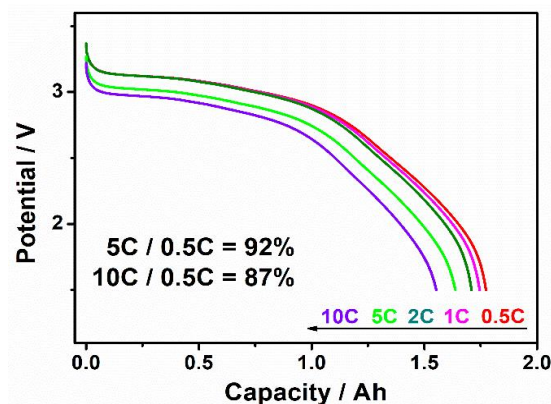
—Results of Independent Third-Party Testing

Initial Charge/Discharge Data



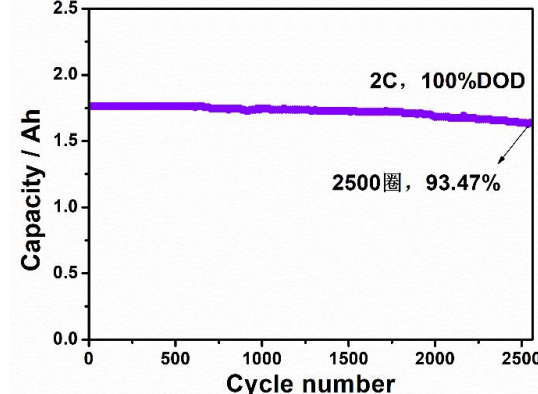
- Initial Coulombic Efficiency: **85.5%**;
- Operating Voltage: **~3.0 V**.

Rate Performance



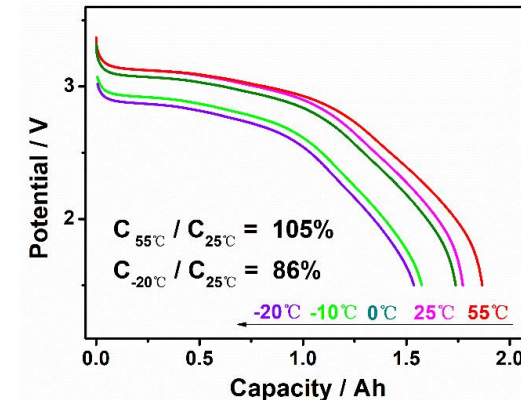
- Excellent Rate Performance, **92%** capacity retention at 5C;
- **87%** at 10C with only **0.2V** voltage drop.

Cycle Performance



- Excellent cycle performance, **>93%** capacity retention after 2500 cycles.

High/Low-Temp Performance



- Excellent low-temp performance; **86%** capacity retention at **-20°C**.

4.1 General-purpose NFPP

—Results of Independent Third-Party Testing

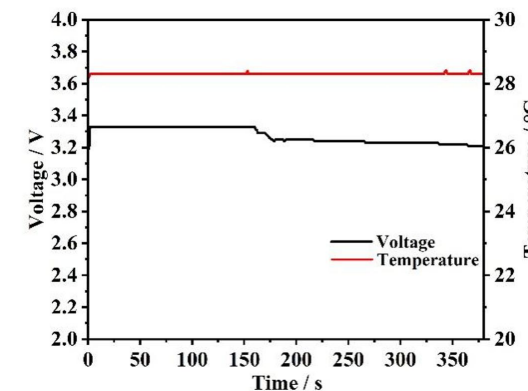
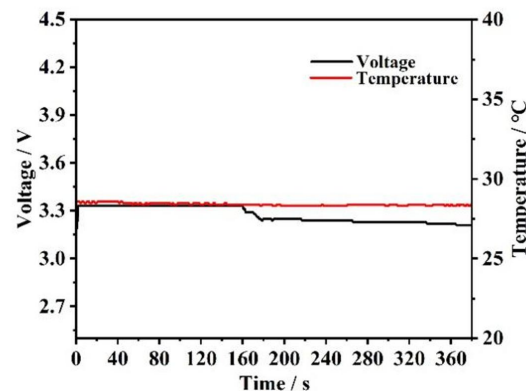
Nail penetration test



4mm nail



6mm nail



No fire, even no temperature rise

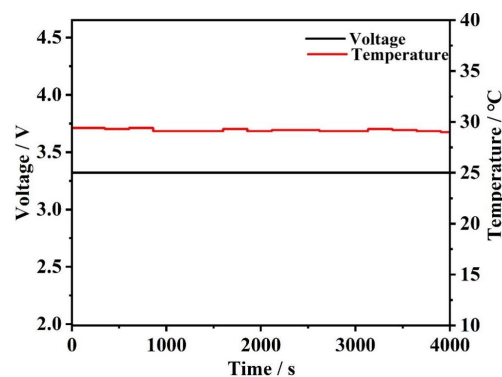
※ According to Chinese national standard GB/T 38031-2020 "Safety Requirements for Power Batteries of Electric Vehicles", standard using 4mm and 6mm steel nails, there was no smoke, fire or explosion during or one hour after the test; the results confirm full compliance with national safety standards.

4.1 General-purpose NFPP

—Results of Independent Third-Party Testing

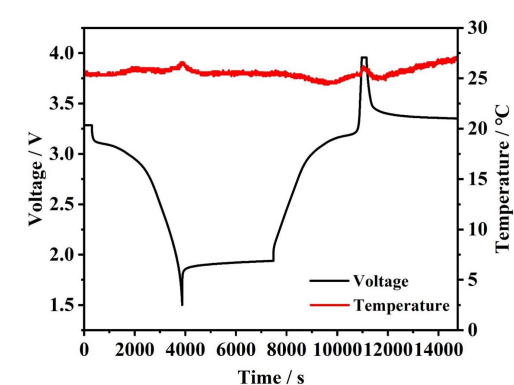
Crush Test

The crush test per GB/T 38031-2020 on a fully charged battery - using a 75 mm semi-cylindrical bar to 15% deformation or 100 KN for 10 minutes - resulted in no smoke, fire, or explosion during or one hour post-test, demonstrating full safety compliance.



Overcharge Test

The overcharge test per GB/T 38031-2020—charging at 0.05C to full, then 1C to 4V—was passed with no smoke, fire, or explosion during or one hour post-test, demonstrating safety compliance.

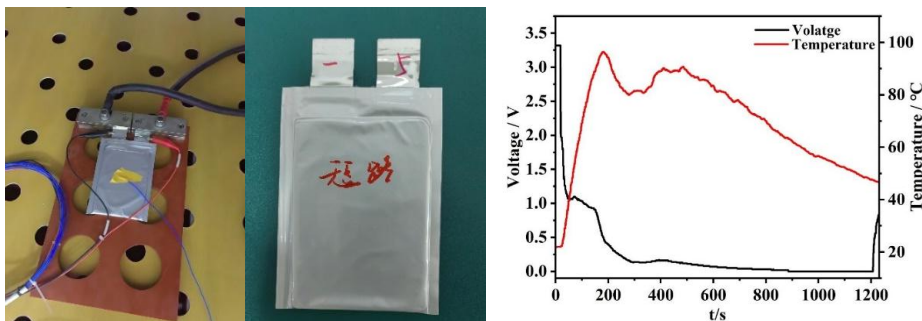


4.1 General-purpose NFPP

—Results of Independent Third-Party Testing

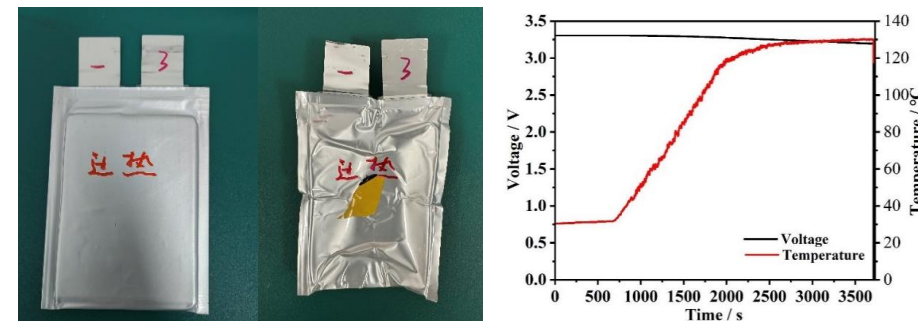
External Short Circuit Test

The external short-circuit test per GB/T 38031-2020 on a fully charged battery (10-minute short-circuit) was passed with no smoke, fire, or explosion during or one hour post-test, confirming safety compliance.



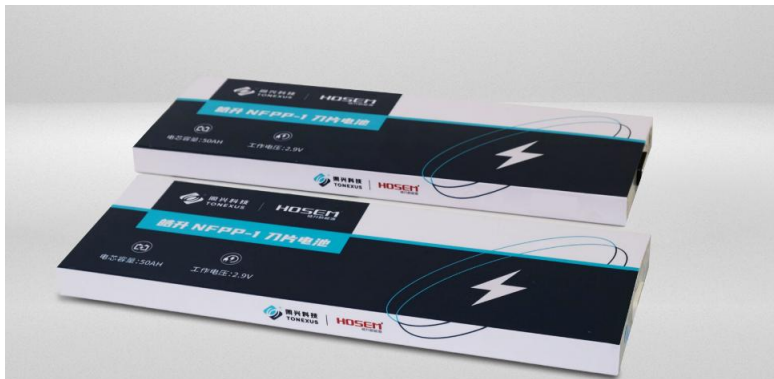
130°C Thermal Chamber Test

The battery passed the thermal stability test per GB/T 38031-2020, which involved heating the fully charged unit to 130°C at 5°C/min with a 30-minute hold, with no smoke, fire, or explosion during or within one hour after the test.



4.1 General-purpose NFPP

——50Ah Blade Battery Test Results

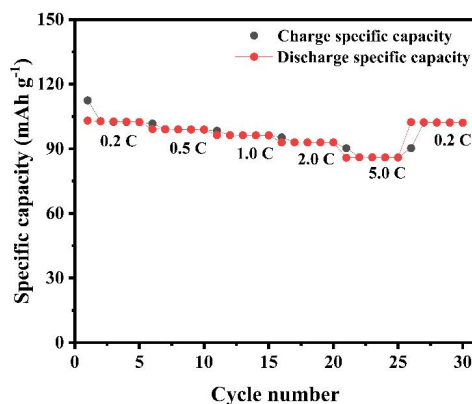
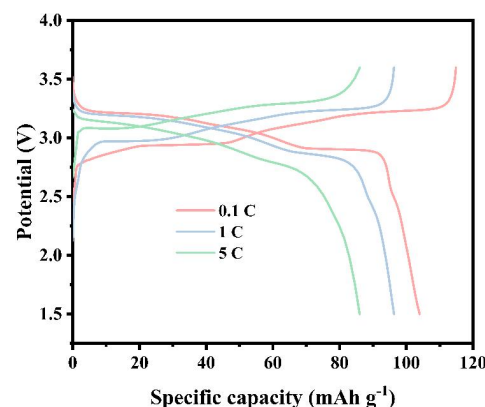
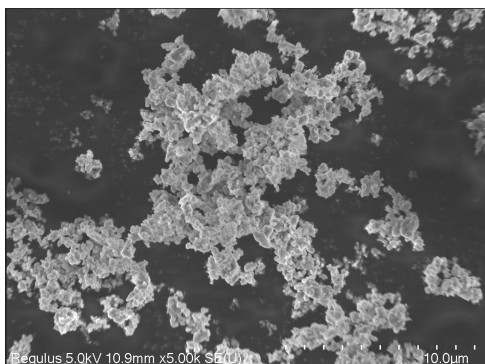


Test Item	Test Conditions	Test Results
Cycle Life	25°C, 1C	80% after 10000 cycles
Rate Charge	2C/5C	98%、96%
Rate Discharge	3C/5C/10C	94%、90%、85.5%
Room Temp Storage	25°C, 28 days	Capacity Retention: 93.0% Capacity Recovery: 98.8%
High Temp Storage	55°C, 7 days	Capacity Retention: 96.0% Capacity Recovery: 99.0%
Low Temp Discharge	0°C/-20°C/-40°C	93%、88%、83%
High Temp Discharge	40°C/55°C	102%、104%

4.2 High Compaction density NFPP

——Combination of large and small particles

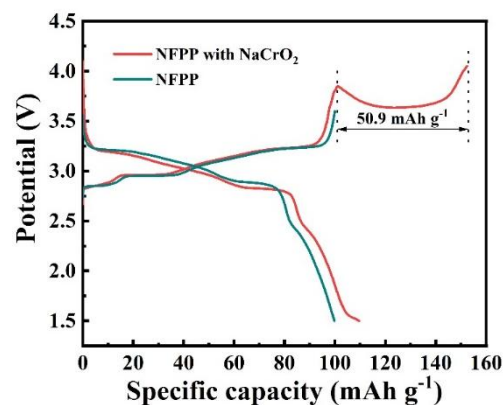
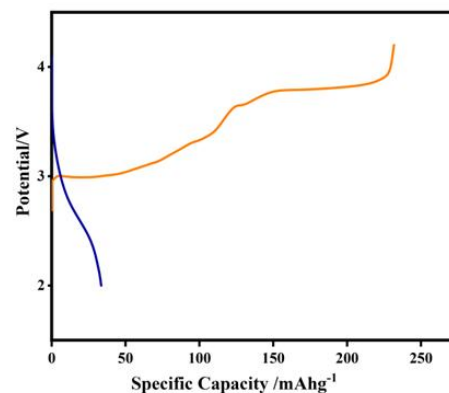
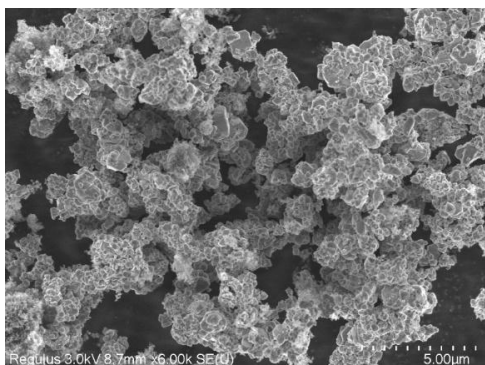
- **Higher specific capacity**
Up to **104** mAh/g
- **Particle Composite Design**
Electrode compaction density up to **2.4**
- **High-Rate Performance**
90% capacity retention at 5C
- **Very Low Cost**
Raw material cost < ¥**14000**/ton



Type		TXHS-4
Testing Voltage		1.5-3.6 V
Capacity	0.1C Initial charge	114 mAh/g
	0.1C Initial discharge	104 mAh/g
Particle Size/μm	D10; D50; D90	0.6; 1.9; 7.1
Cycle performance		80% after 3000 cycles
Tap density		0.8 g/cc
Specific Surface Area		8.6 m²/g
pH		10.2
Compaction Density		2.3~2.4
Carbon Content		1.62%

4.3 NaCrO₂ Sodium Compensator

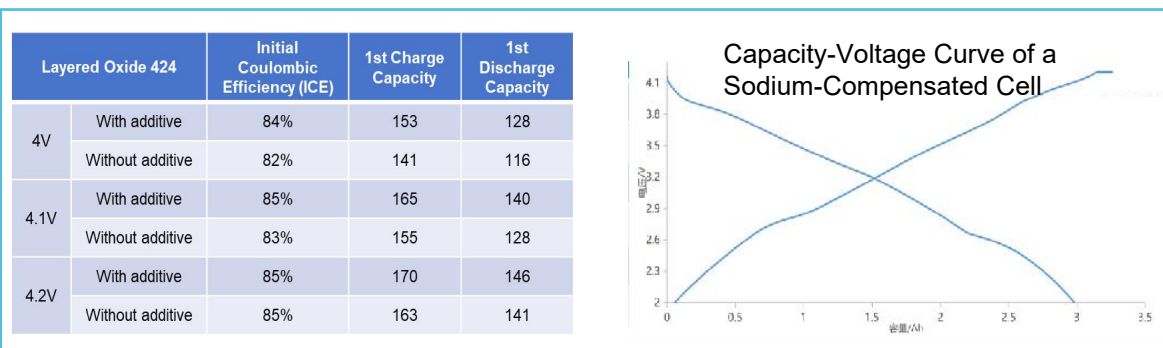
- **Higher specific capacity**
Up to **225 mAh/g**
- **High electrochemical activity**
The **1% addition** amount still retains its activity
- **Significantly increase the capacity**
- **Significantly enhance battery cycle life**



Type		TXHS-NCO-1
Testing Voltage		1-4.2 V
Capacity	0.1C Initial charge	225 mAh/g
	0.1C Initial discharge	35 mAh/g
Particle Size/μm	D10; D50; D90	0.5; 1.2; 5.2
decomposition tension		3.6 V(vs Na ⁺ /Na)
Full battery capacity	Without NaCrO ₂	85 mAh/g
	With NaCrO ₂	110 mAh/g

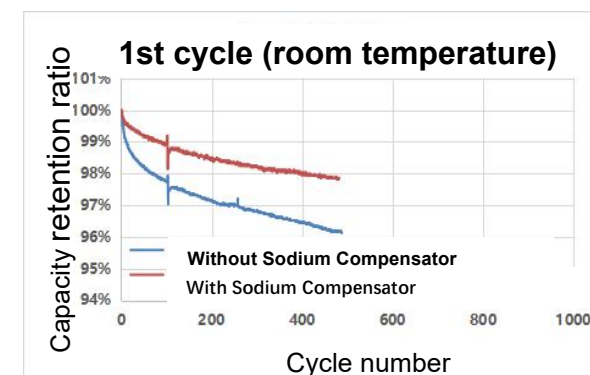
4.3 NaCrO₂ Sodium Compensator

—Feedback from Customers Who Received Samples



Sample	Total charge Capacity(mAh)	Discharge capacity (mAh)	Coulombic Efficiency(%)
NMC-1	25.61	19.32	75.42%
NMC-2	24.08	17.53	72.78%
NMC-Comp-1	26.82	24.90	92.84%
NMC-Comp-2	26.61	17.46	65.63%

Solution	Solution A	Solution B	
	Reference	Reference +Additive	
0.2C Charge Capacity (mAh/g)	115.21	121.05	
0.2C Discharge Capacity (mAh/g)	94.55	99.55	
Initial Efficiency (%)	82.07%	82.25%	Without sodium compensation
0.33C Grading Capacity (mAh/g)	92.5	96.08	99.05
0.5C Grading Capacity (mAh/g)	91.6	95.11	98.05
1C Grading Capacity (mAh/g)	90.12	93.60	96.50



4.4 High Initial Charge S-NFPP

- **Exclusive Coating Process**

Enhance initial charge capacity while maintaining electrochemical or processing performance.

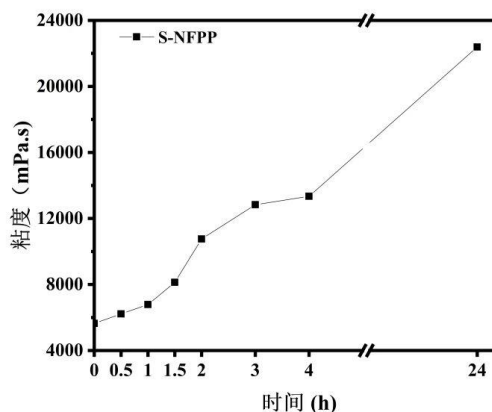
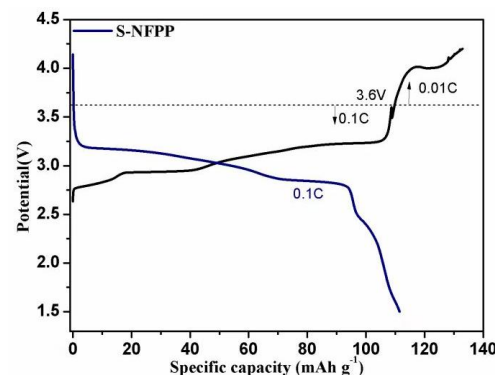
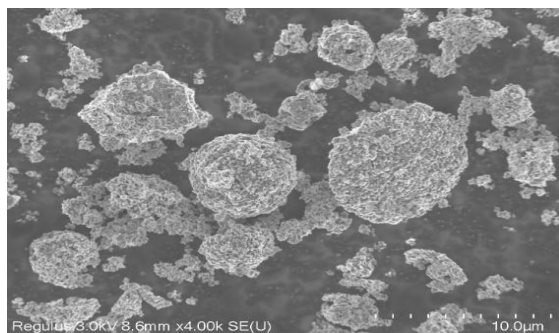
- **Energy density advantage**

S-NFPP: **>95%** vs. industry ~80% initial efficiency.

- **Cycle performance advantage**

Improved full-cell cycle life by forming a **sodium gradual-release layer** on the anode

- **cost advantage**

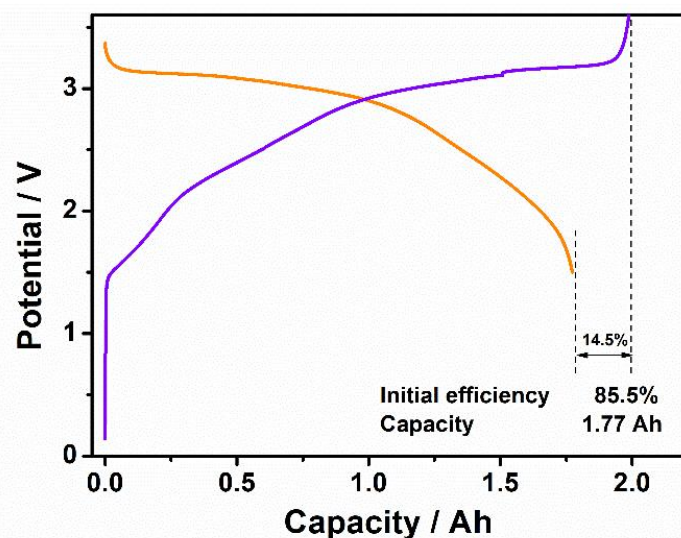


Type		TXHS-S-NFPP
Testing Voltage		1.5-4.2 V
Capacity	0.1C Initial charge	132.95 mAh/g
	0.1C Initial discharge	111.48 mAh/g
Particle Size/μm	D10;D50;D90	1.15; 5.31; 12.5
Tap density		1.25 g/cc
cific Surface Area		6.8 m ² /g
pH		10.74
Compaction Density		2.2~2.4
Carbon Content		1.6%

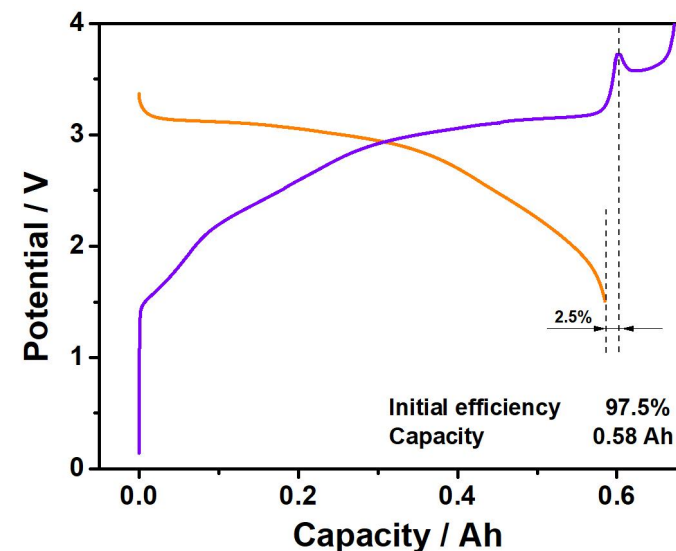
4.4 High Initial Charge S-NFPP

—Pouch battery Lab Test

Pouch battery with NFPP



Pouch battery with S-NFPP

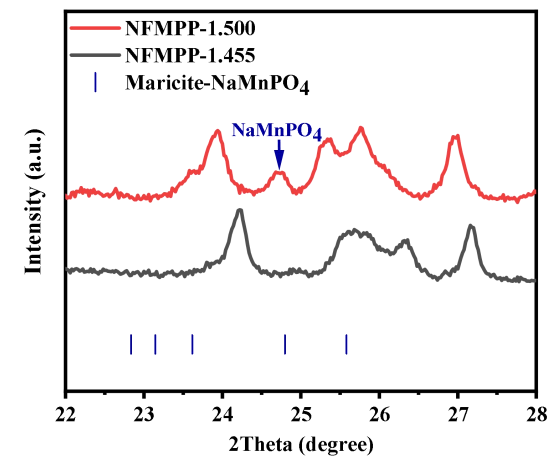
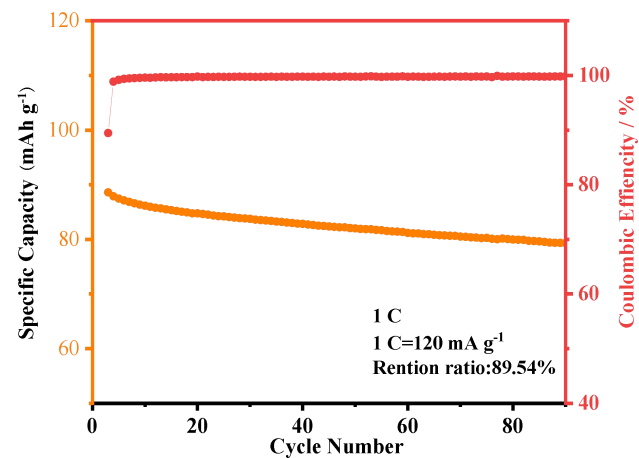
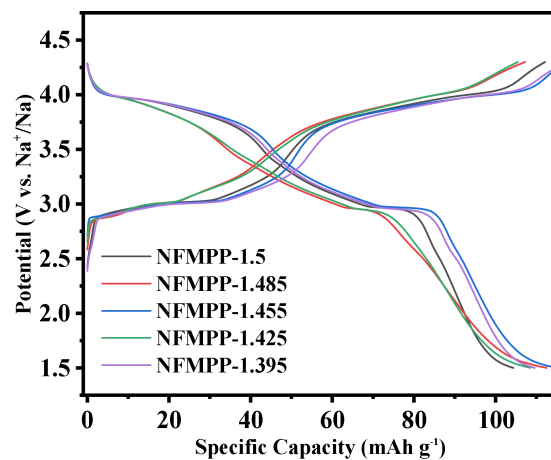
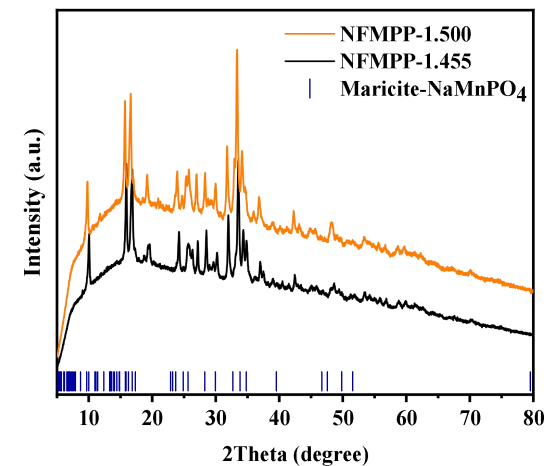
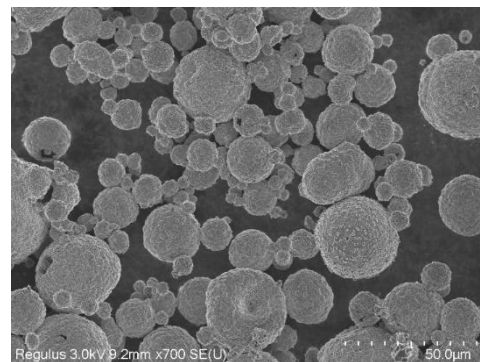
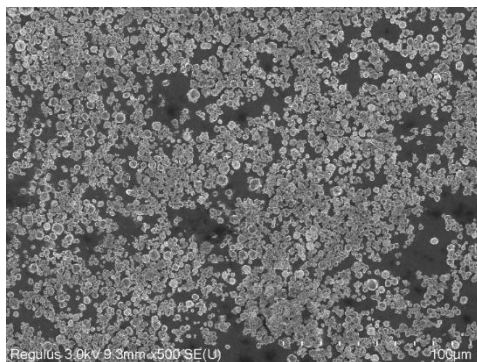


S-NFPP increases the full-cell's initial Coulombic efficiency from 85.5% to 97.5%.

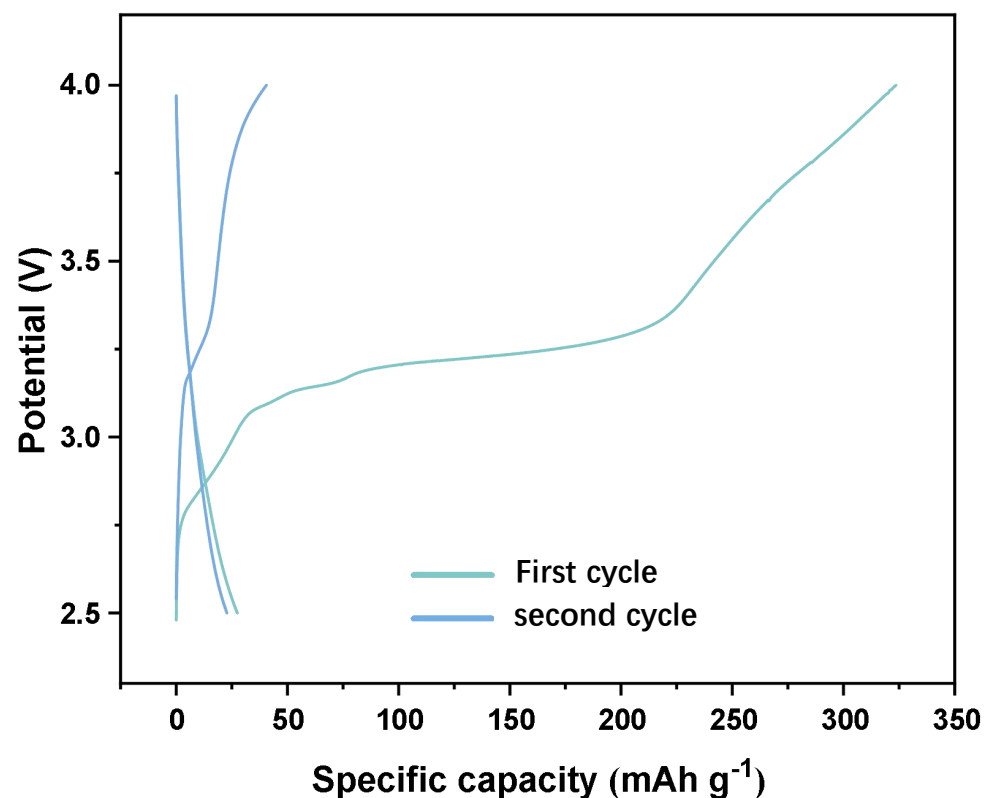
05 Introduction to Future Sodium-Ion Battery Products

- 5.1 High-Voltage Type NMFPP
- 5.2 New Gas-Free Sodium Compensator

5.1 High-voltage type NMFPP



5.2 New Gas-Free Sodium Compensator



- **Extremely low decomposition voltage**
Decomposition voltage under 3.5V (at 60% capacity) enables broad electrolyte compatibility.
- **Extremely high specific capacity**
Theoretical specific capacity: $>400 \text{ mAh/g}$; Actual specific capacity: 330 mAh/g .
- **Gas-Free During Decomposition**
- **cost advantage**
Low material cost with minimal impact on final cell cost.

06 R&D Strength and Development Plan

- 6.1 R&D Strength
- 6.2 R&D History
- 6.3 Future Plans

6.1 R&D Strength

Chief Scientist



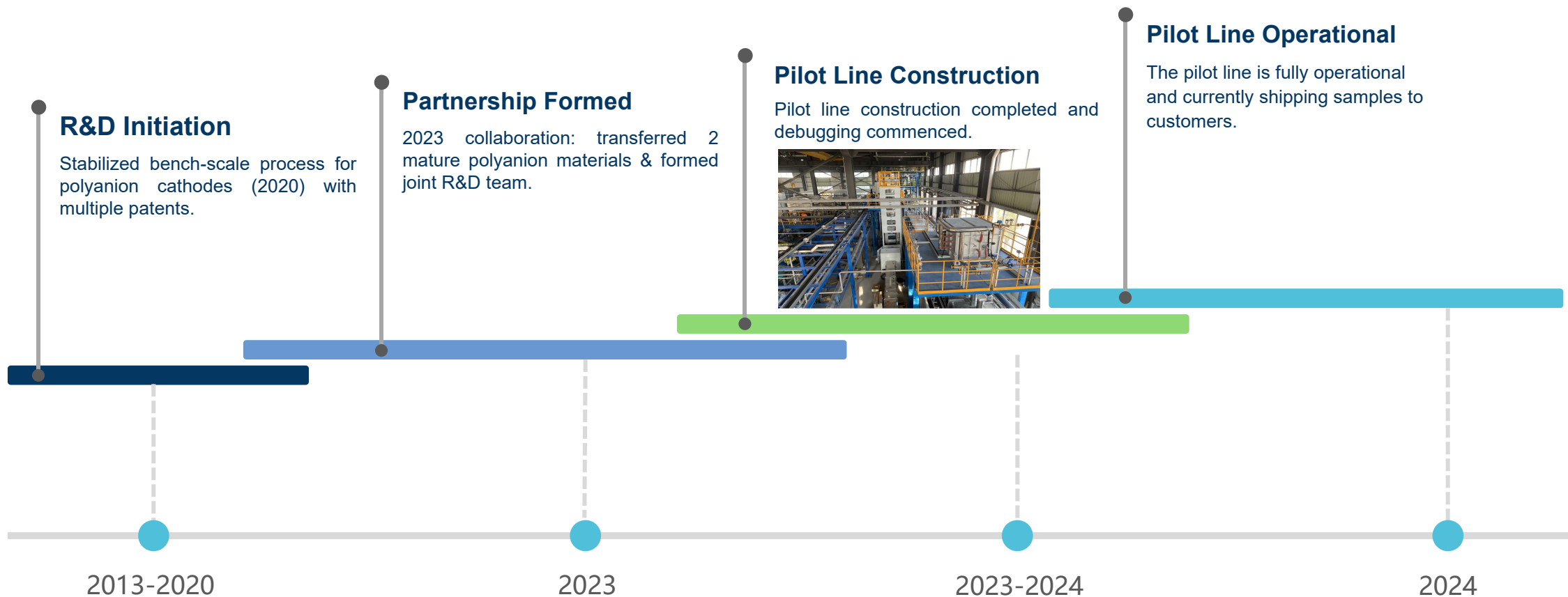
徐茂文

- Ph.D., Professor, Doctoral Supervisor, Postdoctoral Fellow at The University of Texas at Austin, USA
- Distinguished Professor of Bayu Scholars, Chongqing Talent—Leading Figure in Innovation and Entrepreneurship, Dean of the School of Materials and Energy, Southwest University
- Holder of 17 granted invention patents; Principal Investigator of 3 projects funded by the National Natural Science Foundation of China, and over 10 key research projects including those from the Ministry of Education and Chongqing Municipality
- Recipient of the Second Prize for Natural Science Award of Chongqing (Ranked First, 2020) and the Tang Lixin Outstanding Scholar Award, among other honors.

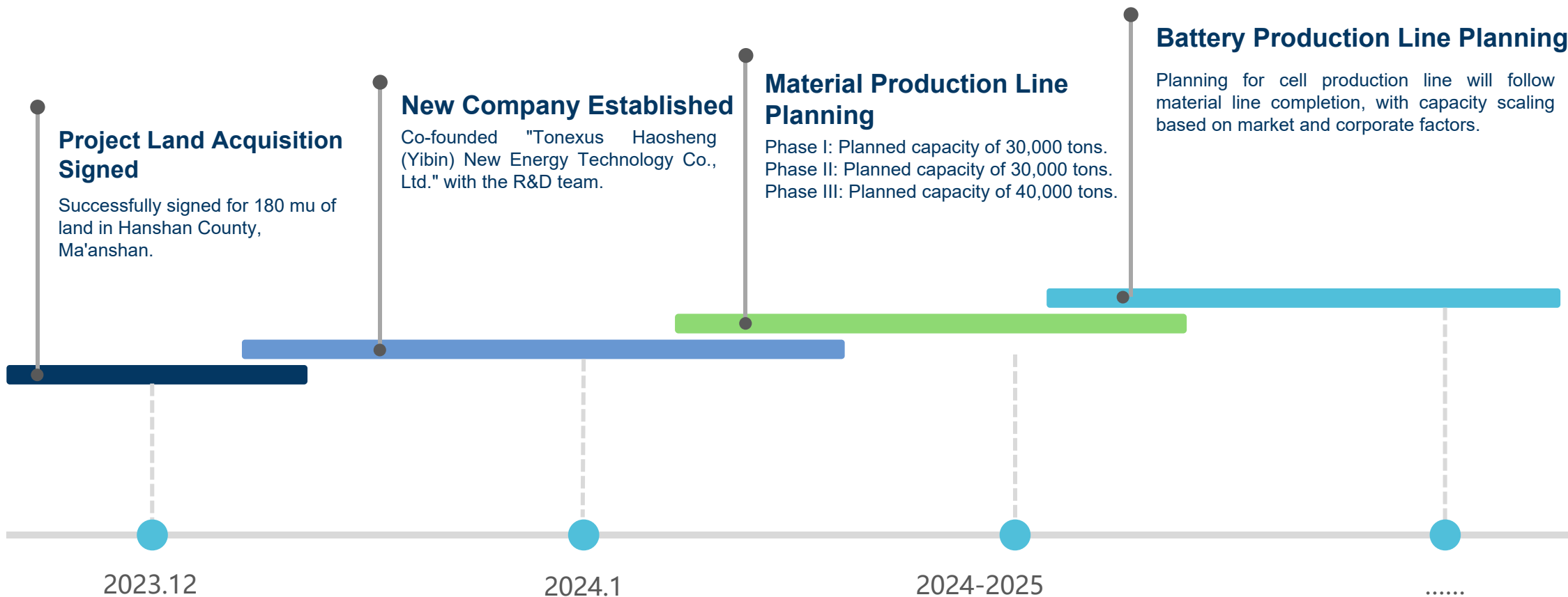
Patented Technology



6.2 R&D History



6.3 Future plan





Toward Net-Zero, Beyond Industry

Strategic Global Partner for Industrial
Decarbonization and Pollution Reduction



Official Website



LinkedIn

Company Address: Building B10, Financial Harbour, Baohe District, Hefei City, Anhui Province, China

Production base : Qingxi Industrial Park, Ma'anshan City, Anhui Province

Ma'anshan City, Anhui Province; Anhui Fine Chemical Industry Base

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Technical Contact: +86 18652973223 (Mr. Huang)

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Web: www.tonexus.com