TONEXUS | HOSEM 皓升新能源

Development and Application of Polyanionic Cathode Materials and Sodium Compensators

共塑净零工业新未来

Toward Net-Zero, Beyond Industry

Contents

01 Company Profile

1.1 Tonexus Environmental Technology Overview

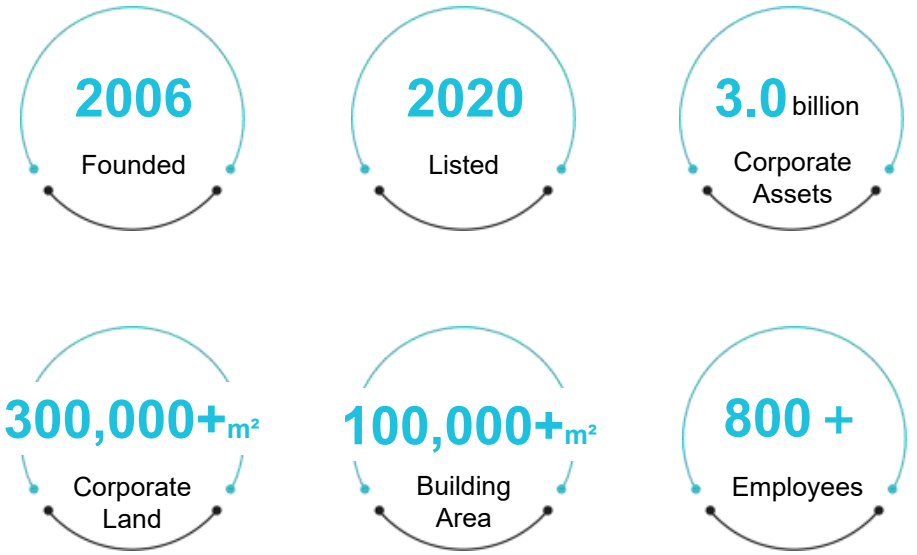
Tonexus listed on the Shenzhen Stock Exchange Main Board (003027), upholds the corporate philosophy of “Toward Net-Zero, Beyond Industry”. The company is committed to becoming a globally recognized strategic partner in pollution, carbon reduction and industrial net-zero, contributing Tonexus’s expertise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

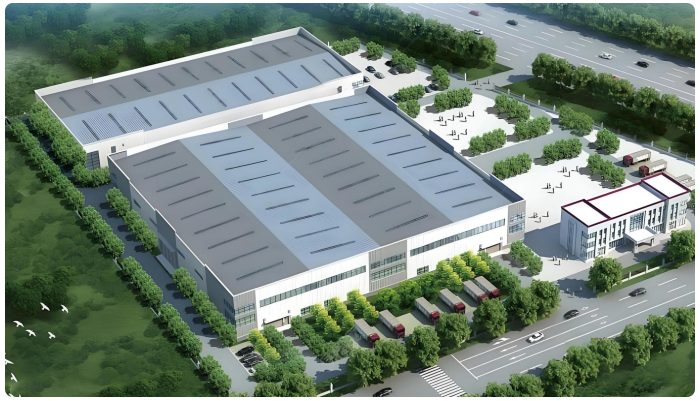
Business Scope:

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** m^2

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.

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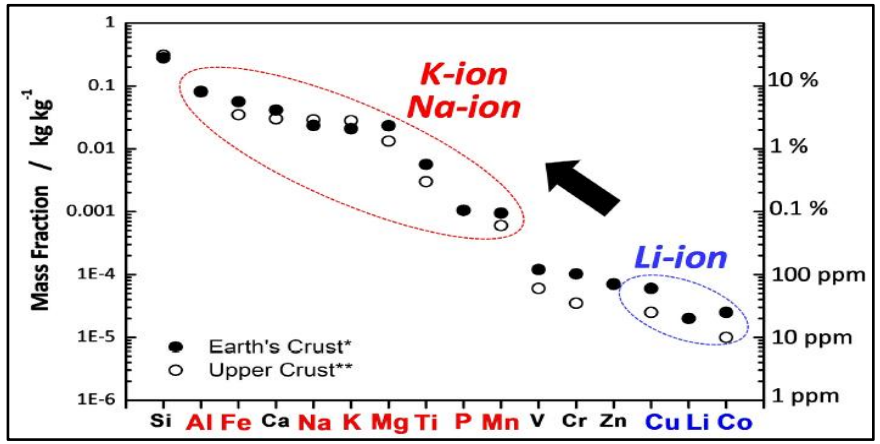
Division	Environmental Technology Sector	Low-carbon Technology Sector	Energy Technology Sector
Category	Atmospheric Governance	Carbon Capture, Storage and Utilization	Sodium-Ion Battery
Brand	TONEXUS	TONEXUS | TANNHEM	TONEXUS | HOSEM
Product	Flue Gas Treatment Engineering & Equipment; Tonexus Low-Temperature SCR Catalysts	Tonexus TXio Carbon Capture Process; Tonexus TX-1 CO_2 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

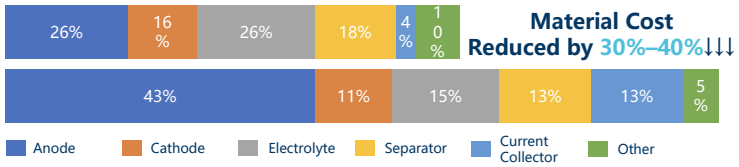


Sodium VS Lithium Resources	Element	Crustal Abundance	Distribution	Price (USD/Kg)
	Sodium	2.75%	Global	~0.3
	Lithium	0.0065%	75% in Americas	~21

Current Collector Choice

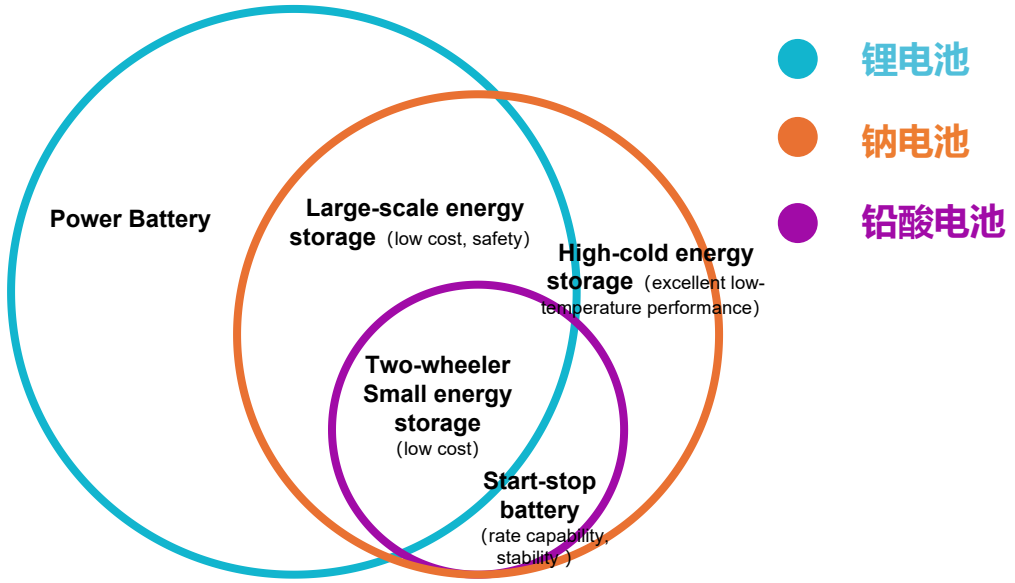
Sodium-ion: Aluminum foil (both electrodes, low cost)
Lithium-ion: Copper foil (anode, expensive)

Cost of sodium batteries VS Cost of Lithium batteries



Material Cost Reduced by 30%–40%↓↓↓

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

Current sodium-battery products

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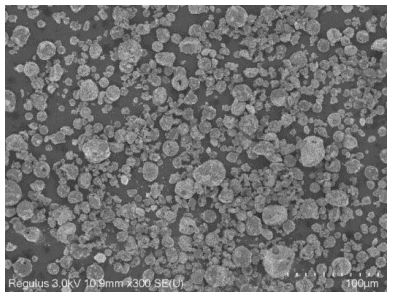
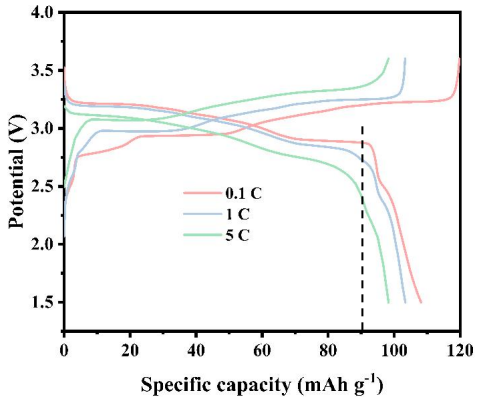
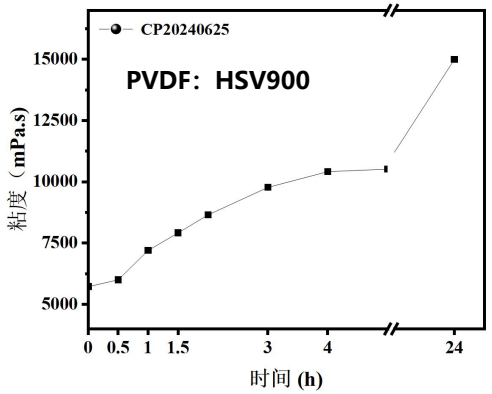
4.1 General-purpose NFPP

——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 m²/g
pH		9.9
Compaction Density		2.0~2.2
Carbon Content		1.82%

Current sodium-battery products

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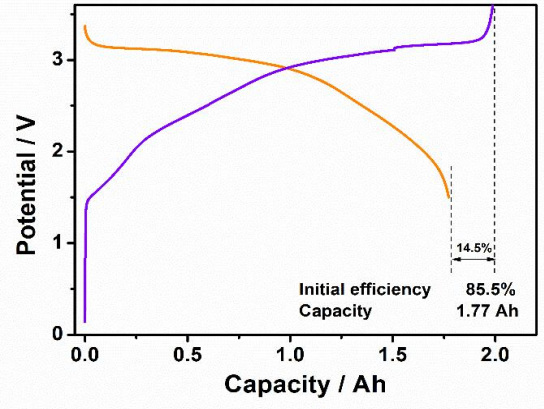
4.1 General-purpose NFPP

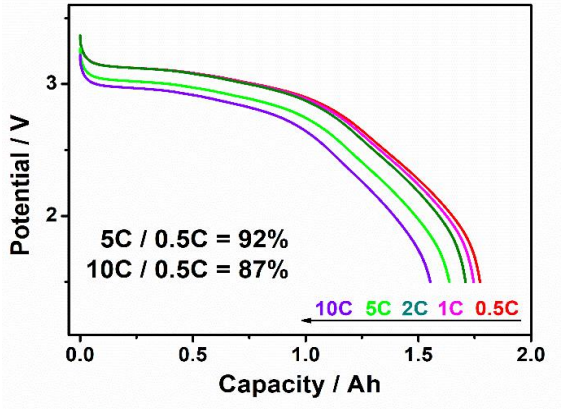
——Results of Independent Third-Party Testing

Initial Charge/Discharge Data



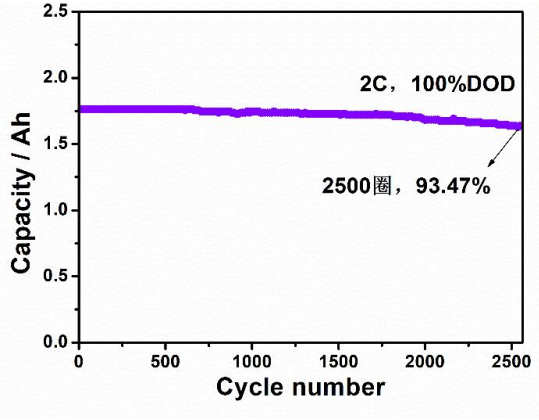
- Initial Coulombic Efficiency: 85.5%;
- Operating Voltage: ~3.0 V.

Rate Performance



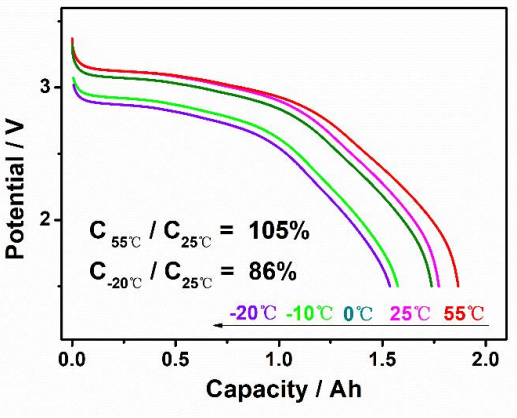
- Excellent Rate Performance, 92% capacity retention at 5C;
- 87% at 10C with only 0.2V voltage drop.

Cycle Performance



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

High/Low-Temp Performance



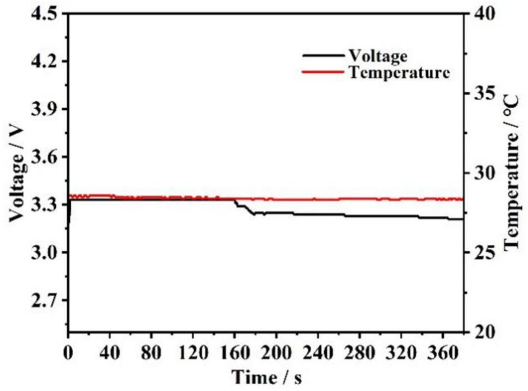
- Excellent low-temp performance; 86% capacity retention at -20°C.

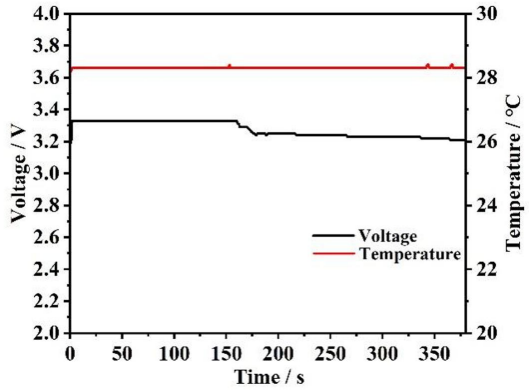
4.1 General-purpose NFPP

——Results of Independent Third-Party Testing

Nail penetration test

4mm nail　　6mm nail





No fire, even no temperature rise

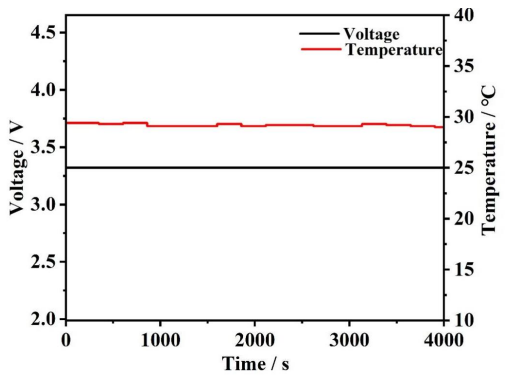
※ According to Chinese national standard GB/T 38031-2020 “Safety Requirements for Power Batteries of Electric Vehicles”, standardusing 4mm and 6mm steel nails, there was no smoke, fire or explosion during or one hour after the test; the results confirm full compliance with national safety standards.

4.1 General-purpose NFPP

——Results of Independent Third-Party Testing

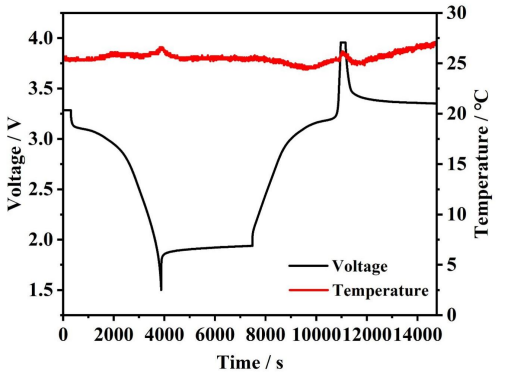
Crush Test

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.

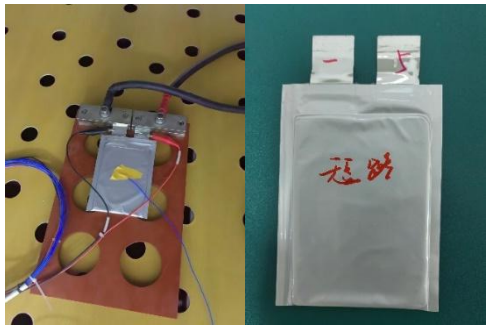


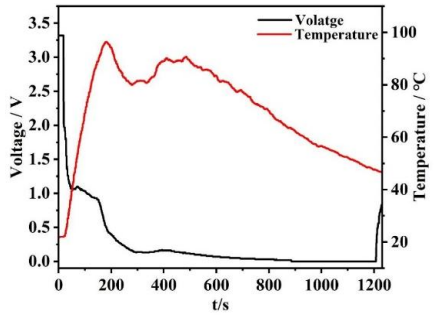
4.1 General-purpose NFPP

——Results of Independent Third-Party Testing

External Short Circuit Test

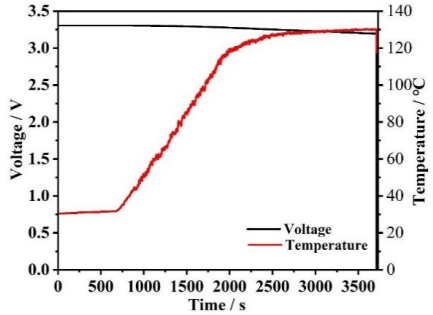
The external short-circuit test per GB/T 38031-2020 on a fully charged battery (10-minute short-circuit) was passed with no smoke, fire, or explosion during or one hour post-test, confirming safety compliance.





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

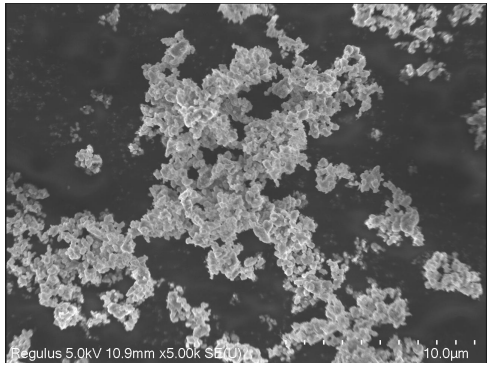
——50Ah Blade Battery Test Results

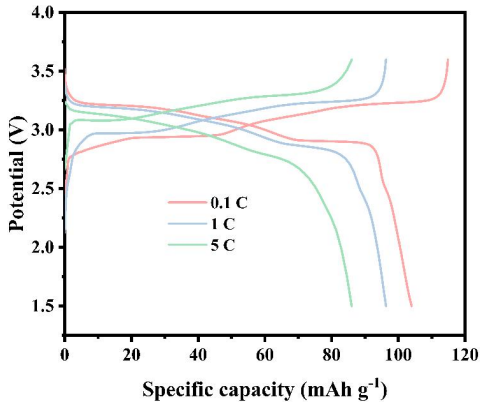
Test Item	Test Conditions	Test Results
Cycle Life	25℃，1C	80% after 10000 cycles
Rate Charge	2C/5C	98%、96%
Rate Discharge	3C/5C/10C	94%、90%、85.5%
Room Temp Storage	25℃，28 days	Capacity Retention: 93.0% Capacity Recovery: 98.8%
High Temp Storage	55℃，7 days	Capacity Retention: 96.0% Capacity Recovery: 99.0%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

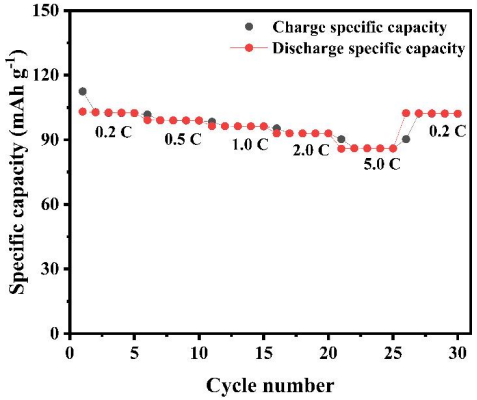
4.2 High Compaction density NFPP

——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



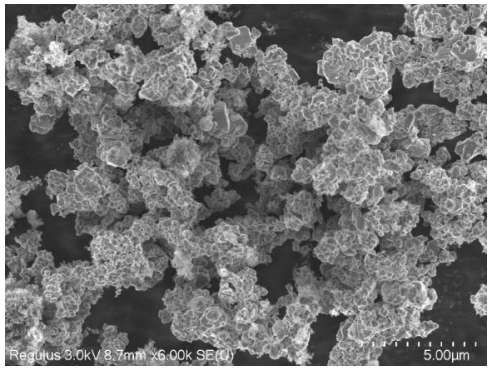


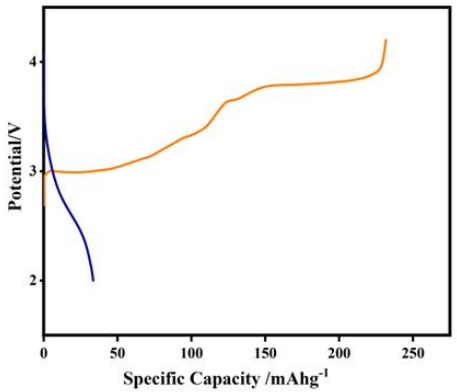


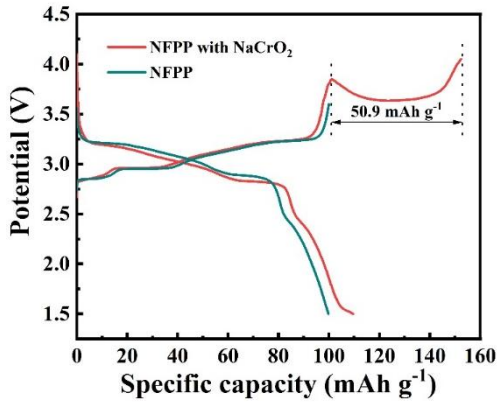
Type		TXHS-4
Testing Voltage		1.5-3.6 V
Capacity	0.1C Initial charge	114 mAh/g
	0.1C Initial discharge	104 mAh/g
Particle Size/μm	D10; D50; D90	0.6； 1.9； 7.1
Cycle performance		80% after 3000 cycles
Tap density		0.8 g/cc
Specific Surface Area		8.6 m^2/g
pH		10.2
Compaction Density		2.3~2.4
Carbon Content		1.62%

4.3 $NaCrO_2$ 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**





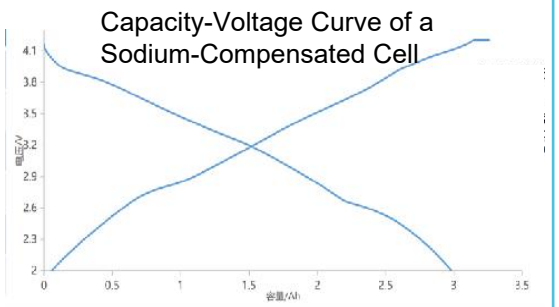


Type		TXHS-NCO-1
Testing Voltage		1-4.2 V
Capacity	**0.1C Initial charge**	225 mAh/g
	0.1C Initial discharge	35 mAh/g
Particle Size/μm	**D10; D50; D90**	0.5； 1.2； 5.2
decomposition tension		3.6 V(vs Na+/Na)
Full battery capacity	**Without $NaCrO_2$**	85 mAh/g
	With $NaCrO_2$	**110 mAh/g**

4.3 $NaCrO_2$ Sodium Compensator

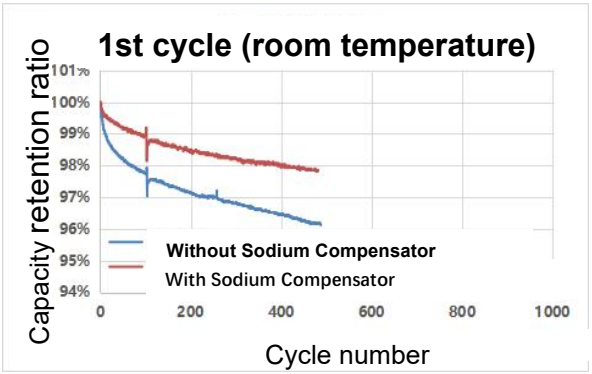
——Feedback from Customers Who Received Samples

Layered Oxide 424		Initial Coulombic Efficiency (ICE)	1st Charge Capacity	1st Discharge Capacity
4V	With additive	84%	153	128
	Without additive	82%	141	116
4.1V	With additive	85%	165	140
	Without additive	83%	155	128
4.2V	With additive	85%	170	146
	Without additive	85%	163	141



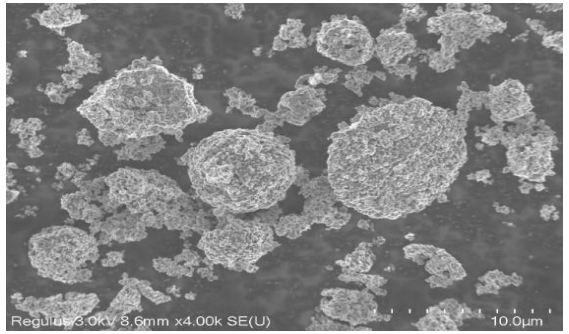
Sample	Total charge Capacity(mAh)	Discharge capacity (mAh)	Coulombic Efficiency(%)
NMC-1	25.61	19.32	75.42%
NMC-2	24.08	17.53	72.78%
NMC-Comp-1	26.82	24.90	92.84%
NMC-Comp-2	26.61	17.46	65.63%

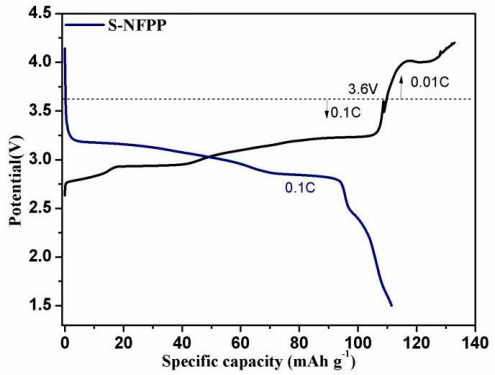
Solution	Solution A	Solution B	
	Reference	Reference +Additive	
0.2C Charge Capacity (mAh/g)	115.21	121.05	
0.2C Discharge Capacity (mAh/g)	94.55	99.55	
Initial Efficiency (%)	82.07%	82.25%	Without sodium compensation
0.33C Grading Capacity (mAh/g)	92.5	96.08	99.05
0.5C Grading Capacity (mAh/g)	91.6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

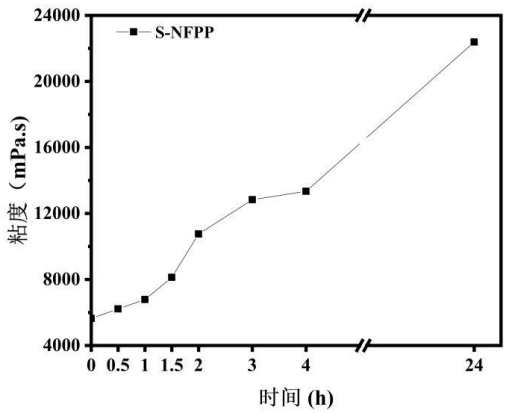


4.4 High Initial Charge S-NFPP

- **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**





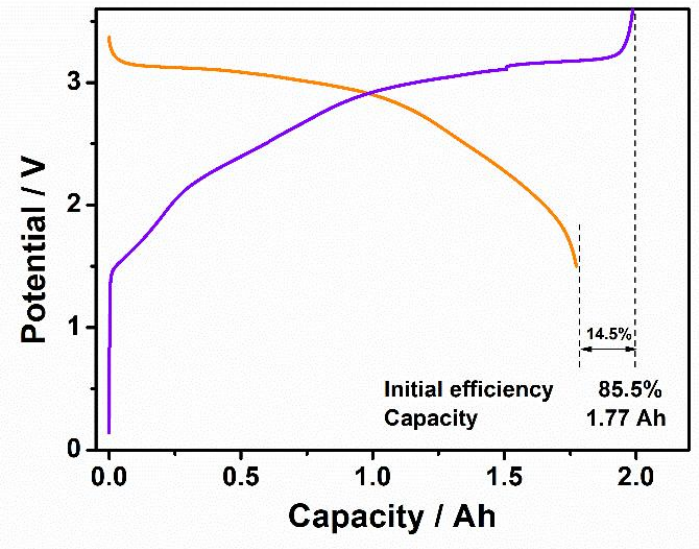


Type		TXHS-S-NFPP
Testing Voltage		1.5-4.2 V
Capacity	0.1C Initial charge	132.95 mAh/g
	0.1C Initial discharge	111.48 mAh/g
Particle Size/μm	D10;D50;D90	1.15; 5.31; 12.5
Tap density		1.25 g/cc
cific Surface Area		6.8 m^2/g
pH		10.74
Compaction Density		2.2~2.4
Carbon Content		1.6%

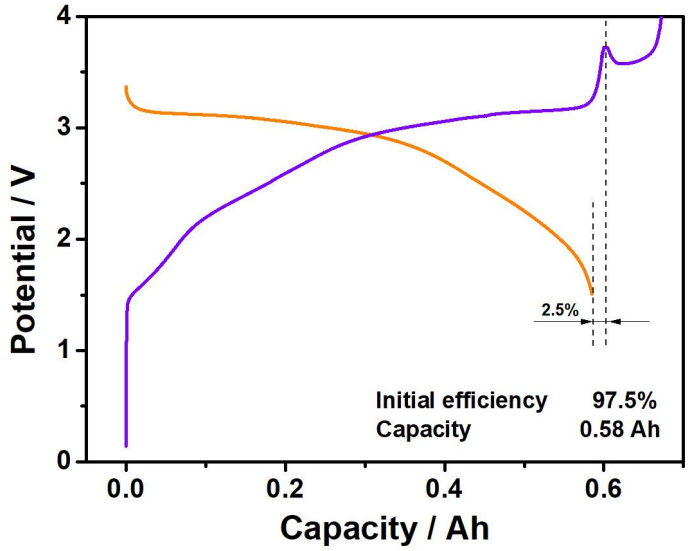
4.4 High Initial Charge S-NFPP

——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

Introduction to Future Sodium-Ion Battery Products

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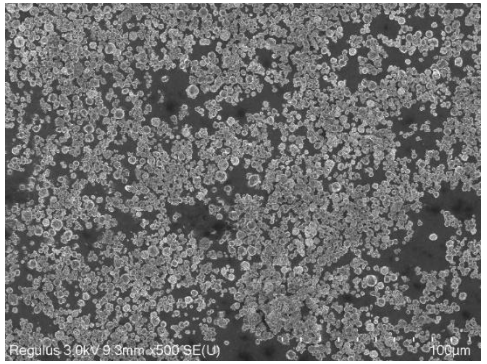
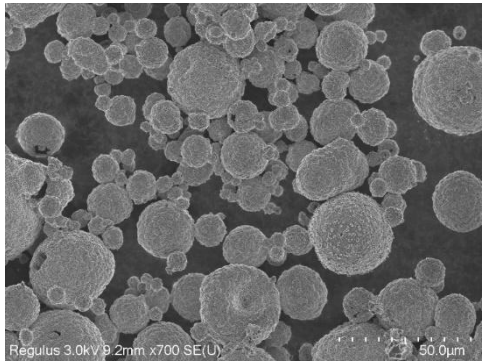
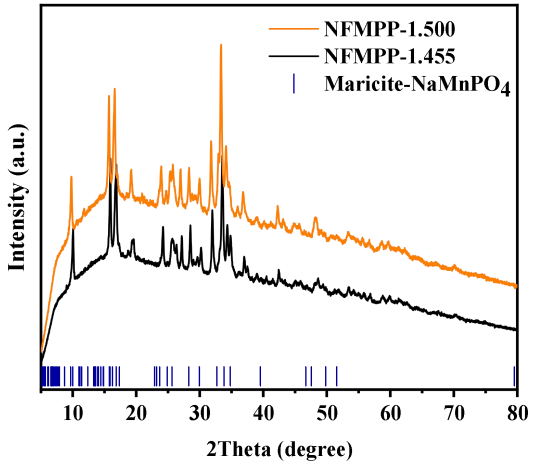
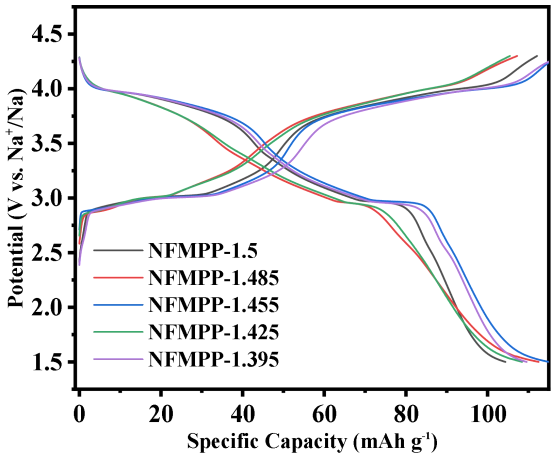
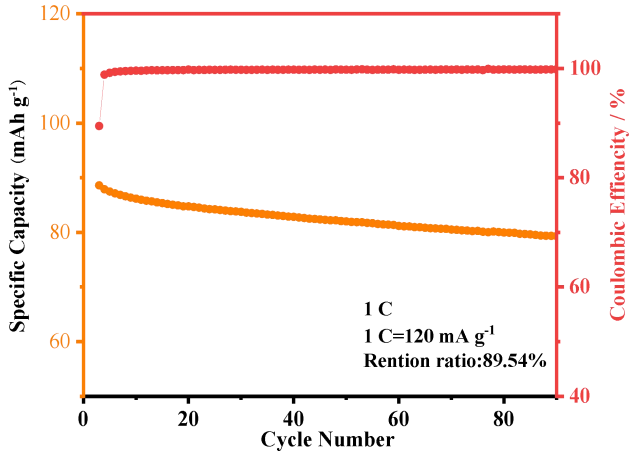
5.1 High-voltage type NMFPP

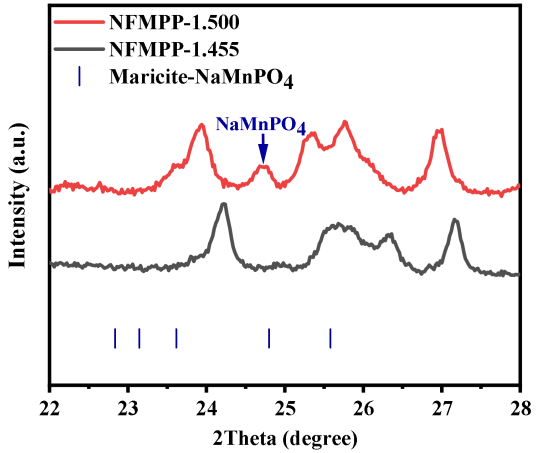




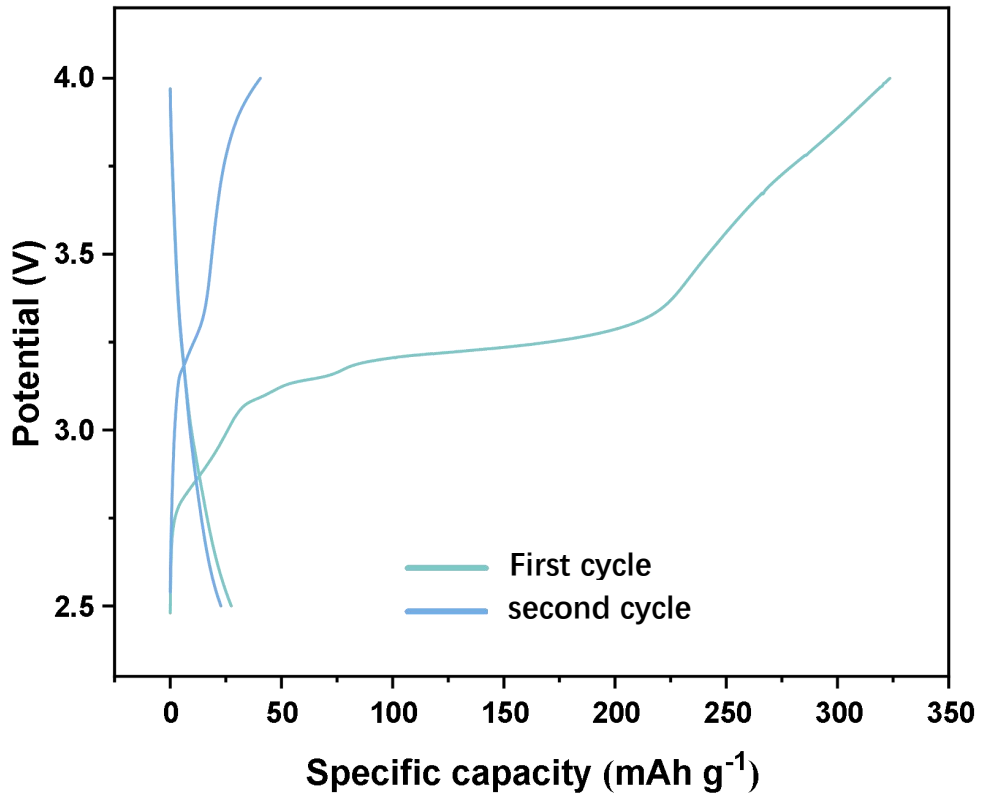








5.2 New Gas-Free Sodium Compensator



- **Extremely low decomposition voltage**

  Decomposition voltage under 3.5V (at 60% capacity) enables broad electrolyte compatibility.

- **Extremely high specific capacity**

  Theoretical specific capacity: >400 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

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

R&D Initiation

Stabilized bench-scale process for polyanion cathodes (2020) with multiple patents.

Partnership Formed

2023 collaboration: transferred 2 mature polyanion materials & formed joint R&D team.

Pilot Line Construction

Pilot line construction completed and debugging commenced.

Pilot Line Operational

The pilot line is fully operational and currently shipping samples to customers.

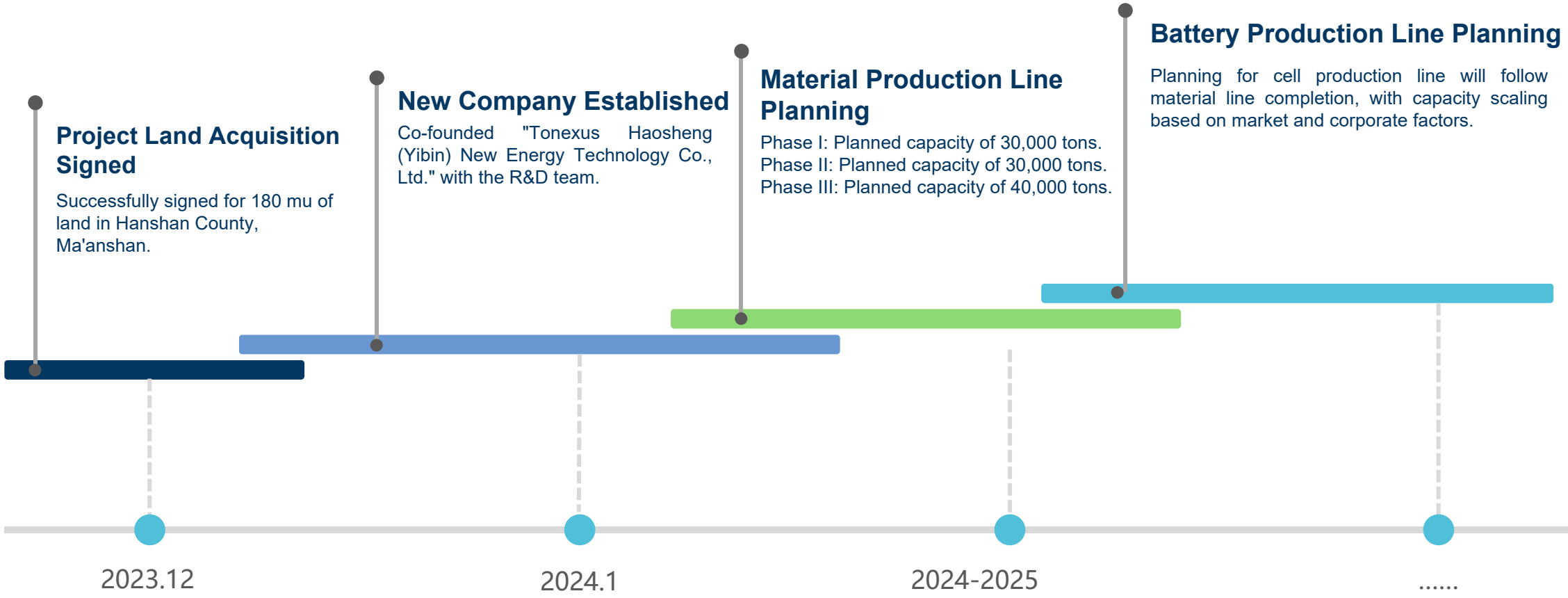
2013-2020

2023

2023-2024

2024

6.3 Future plan



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Toward Net-Zero, Beyond Industry

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