Coin-cell Automatic Assembly System

▶ CAAS Series

The Significance of Coin Cells

In the preliminary stages of lithium battery R&D for novel materials and fabrication processes, coin cells serve as essential platforms for fundamental electrochemical validation. The precision in cell assembly directly impacts the reliability of performance metrics (e.g., capacity retention, cycle stability) and determines the bench-scale feasibility of materials for commercial applications.

扣电制备工艺流程
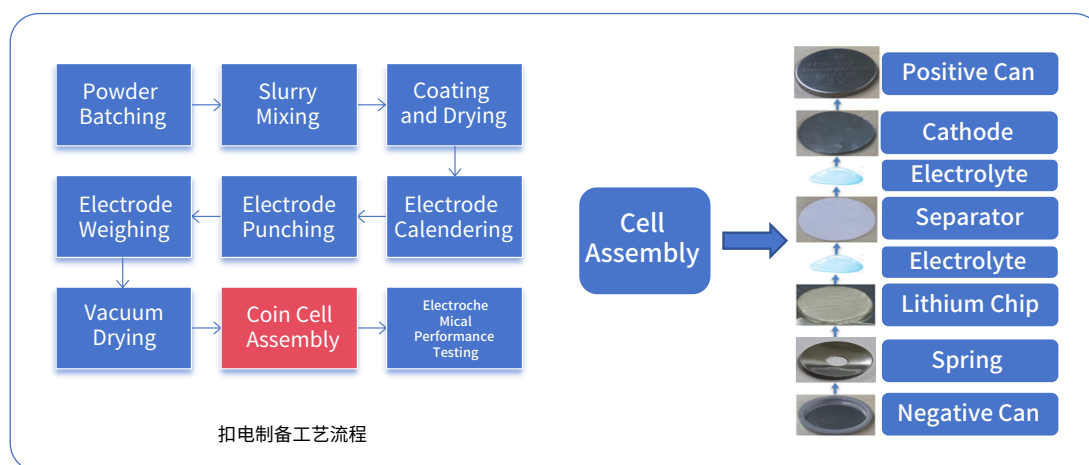
Pain Points Solved

- Enhance Assembly Consistency
- End-to-End Traceability
- Cut Labor Costs
- High-Throughput Assembly
- Reduce Repetitive Labor

Product Introduction

Automatic Coin Cell Assembly

Equipment Features: High-precision robotic arm + AI vision inspection + Automatic sealing device + High assembly throughput + Full-process traceability, enabling automated, high-precision assembly.

Application Scenario: Automated coin cell assembly — for systematic evaluation of the electrochemical performance of lithium/sodium battery cathode

### Automatic Coin Cell Assembly System CAAS (Compact Version)

Equipment Feature: Compatible with standard single-station, single-sided gloveboxes; integrates automatic electrolyte injection, automatic sealing, CCD positioning system, multi-station suction cups, etc.; Assembly throughput is customizable: 1-10 ea.
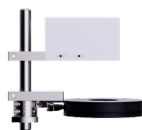
Application Scenario: Suitable for universities, research institutes requiring small-batch assembly of lithium/sodium-ion coin cells for testing purposes.
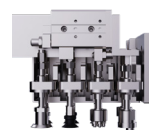
Main Functions

Adaptable to Customer
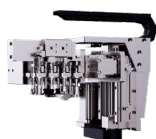
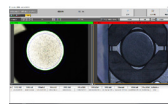| Rapid Assembly	High-Precision	Process Traceability	Multi Material Suction Cups

Multi-Throughput Assembly	Automatic Sealing Module	Automatic Liquid Injection	Data Processing Software

Integrated Glovebox

Rapid Assembly	High-Precision	Process Traceability	Automatic Liquid	Automatic Sealing

选配功能

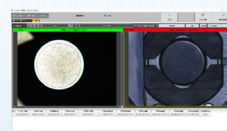| Batch Association	Mini Isolation	Online Voltage Testing	Automatic Lithium Chip

| Sentinel Management	High-Throughput	Data Processing Software
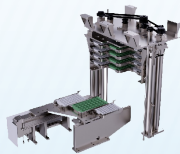
Equipment Expansion

High-Throughput Automatic Electrolyte Switching System

Equipment Features: Can interface with an automatic electrolyte formulation platform. The system enables automatic switching between 100 different electrolyte recipes, supports continuous assembly of 400 battery cells.

Application Scenario: Suitable for coin cell assembly for electrolyte formulation verification and high-throughput battery assembly.
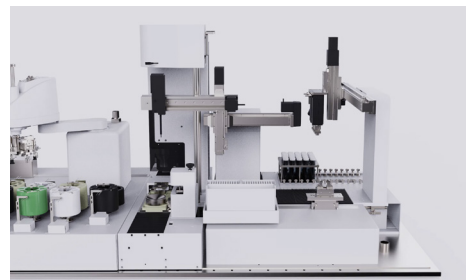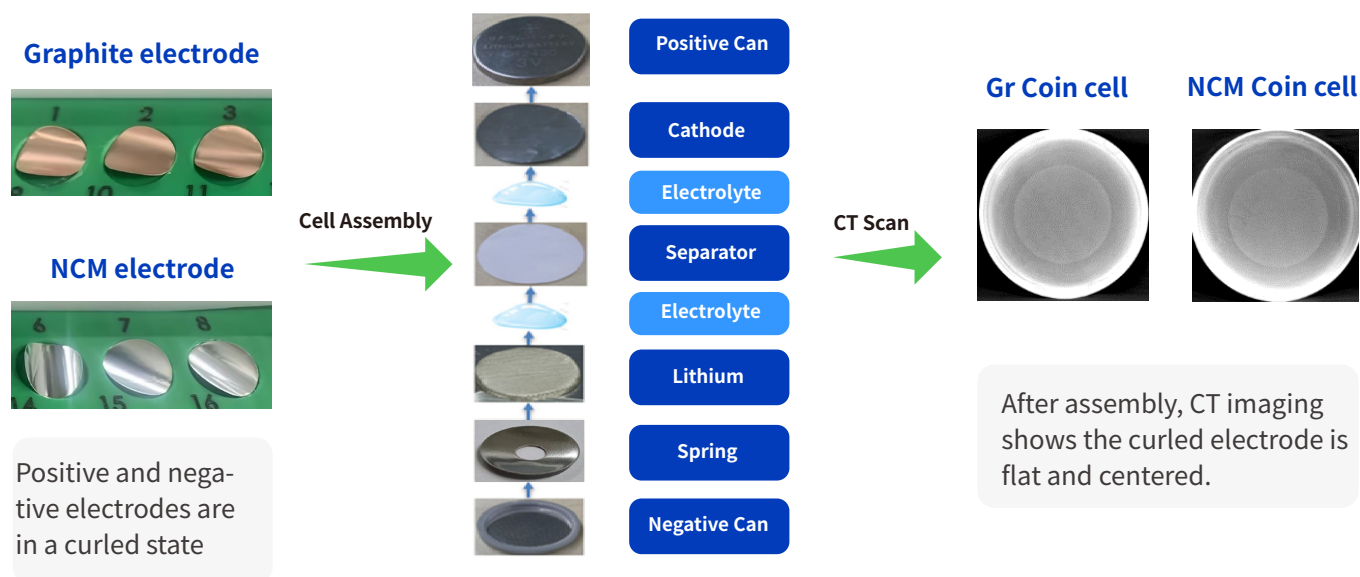
Liquid Injection Module

- High-precision liquid injection system with an accuracy of ±1 μL. Injection volume for a single cell is
- continuously adjustable from 0 to 200 μL.
- The injection tips can be automatically switched to prevent cross-contamination of electrolytes.

Application Cases

▶ Case 1: Curling Issue of Single-Sided Electrodes after Calendering and Punching

Graphite electrode

NCM electrode

Positive and negative electrodes are in a curled state

Cell Assembly

Positive Can
Cathode
Electrolyte
Separator
Electrolyte
Lithium
Spring
Negative Can

CT Scan

Gr Coin cell **NCM Coin cell**

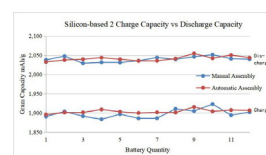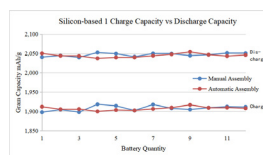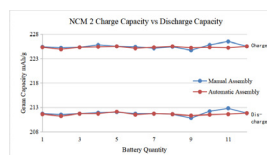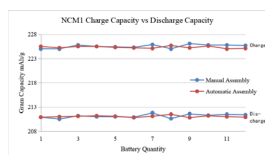After assembly, CT imaging shows the curled electrode is flat and centered.

Due to the curling of single-sided electrodes after calendering, the automatic assembly equipment ensures that the curled electrode remains flat and centered upon insertion into the casing through specialized assembly processes and a visual positioning system. This guarantees consistency in battery assembly.

Case 2: Comparison of Manual & Automatic Assembly

Assembly Comparison		Manual Assembly			Automatic Assembly		
Item		Charge capacity (mAh/g)	Discharge capacity (mAh/g)	Efficiency (%)	Charge capacity (mAh/g)	Discharge capacity (mAh/g)	Efficiency (%)
NCM-1	Range value	1.1	1.3	0.22%	0.7	0.7	0.26%
	Averange	225.525	211.142	93.62%	225.325	211.05	93.66%
	σ	0.384	0.396	0.001	0.226	0.198	0.001
	COV	0.17%	0.19%	0.07%	0.10%	0.09%	0.08%
NCM-2	Range value	1.8	2	0.23%	0.6	0.9	0.23%
	Averange	225.467	211.7833	93.93%	225.292	211.6083	93.93%
	σ	0.44	0.465	0.001	0.178	0.231	0.001
	COV	0.20%	0.22%	0.07%	0.08%	0.11%	0.07%

Assembly Comparison		Manual Assembly			Automatic Assembly		
Item		Charge capacity (mAh/g)	Discharge capacity (mAh/g)	Efficiency (%)	Charge capacity (mAh/g)	Discharge capacity (mAh/g)	Efficiency (%)
Silicon base-1	Range value	20.6	12.6	0.55%	17	16.8	0.25%
	Average	1908.4	2046.9083	93.24%	1907.592	2044.9083	93.28%
	σ	6.948	4.391	0.002	4.553	4.678	0.001
	COV	0.36%	0.21%	0.18%	0.24%	0.23%	0.07%
Silicon base-2	Range value	39.7	22.4	1.46%	19.9	22.2	0.38%
	Average	1897.85	2039.7833	93.02%	1903.992	2041.5667	93.26%
	σ	11.669	6.954	0.005	5.211	6.322	0.001
	COV	0.61%	0.34%	0.49%	0.27%	0.31%	0.11%

NCM1 Charge Capacity vs Discharge Capacity

NCM 2 Charge Capacity vs Discharge Capacity

Silicon-based 1 Charge Capacity vs Discharge Capacity
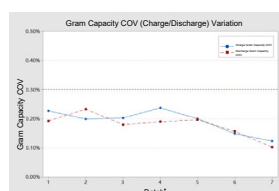

Silicon-based 2 Charge Capacity vs Discharge Capacity

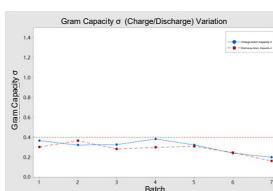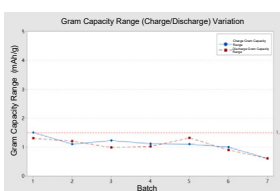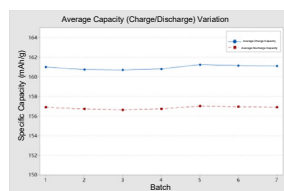**Summary**

- The range of charge/discharge specific capacity for NCM with automatic assembly is 0.6~0.9 mAh/g (σ ≈ 0.25), while with manual assembly it is 1~2 mAh/g (σ ≈ 0.4).

- The range of charge/discharge specific capacity for Si-based materials with automatic assembly is 15~20 mAh/g (σ ≈ 4~6), while with manual assembly it is 20~40 mAh/g (σ ≈ 5~10).

- The average coin cell specific capacity is similar between automatic and manual assembly, but the data stability of automatic assembly is superior to that of manual assembly.

Case 3: Automatic Coin Cell Assembly of LFP Cathodes

Category	Item	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
Range	Charge capacity (mAh/g)	1.5	1.1	1.2	1.1	1	0.6	0.4
	Discharge capacity (mAh/g)	1.3	1.2	1	1.3	0.9	0.6	0.5
	Coulombic Effi (%)	0.8	0.4	0.3	1.3	0.4	0.5	0.6
Average	Charge capacity (mAh/g)	161	160.7	160.7	161.3	161.1	161.1	161.1
	Discharge capacity (mAh/g)	156.9	156.7	156.6	157	156.9	156.9	156.9
	Coulombic Effi (%)	97.4	97.5	97.5	97.4	97.4	97.4	97.4
σ	Charge capacity (mAh/g)	0.37	0.32	0.33	0.38	0.24	0.2	0.12
	Discharge capacity (mAh/g)	0.31	0.36	0.29	0.3	0.25	0.16	0.12
	Coulombic Effi (%)	0.18	0.12	0.09	0.3	0.11	0.12	0.12
COV	Charge capacity (mAh/g)	0.23%	0.20%	0.21%	0.24%	0.15%	0.12%	0.10%
	Discharge capacity (mAh/g)	0.20%	0.23%	0.18%	0.19%	0.16%	0.10%	0.10%
	Coulombic Effi (%)	0.18%	0.12%	0.09%	0.31%	0.11%	0.12%	0.12%

Average Capacity (Charge/Discharge) Variation

Gram Capacity Range (Charge/Discharge) Variation

Gram Capacity σ (Charge/Discharge) Variation

Gram Capacity COV (Charge/Discharge) Variation

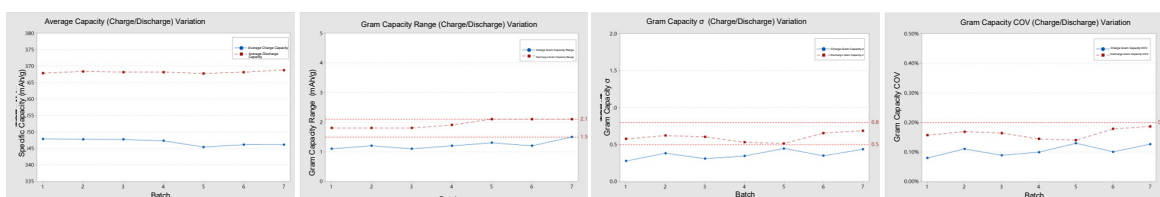**Summary**

- The standard deviation (σ) for the charge/discharge specific capacity of each group is less than 0.4.

- The range for the charge/discharge specific capacity of each group is less than 1.5 mAh/g.

- The coefficient of variation (COV) for the charge/discharge specific capacity of each group is less than 0.3%.

Case 4: Automatic Coin Cell Assembly of Graphite Anodes

Category	Item	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
Range	Charge capacity (mAh/g)	1.1	1.2	1.1	1.2	1.3	1.2	1.5
	Discharge capacity (mAh/g)	1.8	1.8	1.8	1.9	2.1	2.1	2.1
	Coulombic Effi (%)	0.4	0.5	0.5	0.4	0.5	0.7	0.6
Average	Charge capacity (mAh/g)	347.9	347.8	347.7	347.3	345.4	346.2	346.1
	Discharge capacity (mAh/g)	367.8	368.4	368.2	368.2	367.7	368.2	368.8
	Coulombic Effi (%)	94.6	94.4	94.4	94.3	93.9	94	93.8
σ	Charge capacity (mAh/g)	0.28	0.38	0.31	0.34	0.45	0.35	0.44
	Discharge capacity (mAh/g)	0.57	0.62	0.6	0.53	0.51	0.65	0.69
	Coulombic Effi (%)	0.13	0.15	0.14	0.13	0.13	0.17	0.15
COV	Charge capacity (mAh/g)	0.08%	0.11%	0.09%	0.10%	0.13%	0.10%	0.13%
	Discharge capacity (mAh/g)	0.16%	0.17%	0.16%	0.14%	0.14%	0.18%	0.19%
	Coulombic Effi (%)	0.14%	0.16%	0.15%	0.13%	0.14%	0.18%	0.16%

Summary

- The standard deviation (σ) for the discharge specific capacity in each group is less than 0.8, and for the charge specific capacity, it is less than 0.5.

- The range for the discharge specific capacity in each group is less than 2.1 mAh/g, and for the charge specific capacity, it is less than 1.5 mAh/g.

- The coefficient of variation (COV) for both charge and discharge specific capacity in each group is less than 0.2%.

Model and Parameters

Model	CAAS1000	CAAS1000G/M	CAAS1100G/M	CAAS1200G/M
Picture				
Batch Assembly Capacity	1~10ea	1~10ea	40ea	200ea
Assembly Accuracy	±0.4mm	±0.2mm		
Assembly Efficiency	2min/ea	1~1.5min/ea		
Assembly Efficiency	• Compatible with customer standard glove boxes • Modular robotic arm • Vision detection and positioning system • Automatic sealing machine • Automatic Electrolyte dispensing	• Compatible with customer standard glove boxes • Modular robotic arm • Vision detection and positioning system • Automatic sealing machine • Automatic Electrolyte dispensing	• Integrated double-sided four-station glove box • High-precision robotic arm • High-throughput assembly • Vision detection and positioning system • Automatic sealing machine • Automatic Electrolyte dispensing • Multi-module function options	

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