Automated Cell Assembly for Reliable Data

Introduction

The reliability and consistency of electrochemical cell data are crucial in research and development of energy storage systems. Inconsistent assembly of electrochemical cells has been a long-standing issue in the industry. Various methods, such as using multiple separator films or replacing tweezers with vacuum pens, have been proposed to enhance the consistency of coin cell data. However, these methods still come with substantial risk of variance and data outliers.[i,ii,iii]

Cellerate developed the Cell Assembly & Sealing System (CAS System) to address these challenges – a reliable benchtop machine designed specifically for precise coin cell assembly. This technical note highlights the results seen by teams using the CAS System in both academia and industry.

Case 1: Automation Reduces Variance in OCV

Vianode compared 500 graphite half-cells assembled by hand with 467 assembled using the CAS System (Figure 1). They found that manually assembled cells had 67% more variation in open circuit voltage (OCV) compared to those built using the CAS System. Notably, automatic assembly also achieved a cell failure rate of less than 2%.

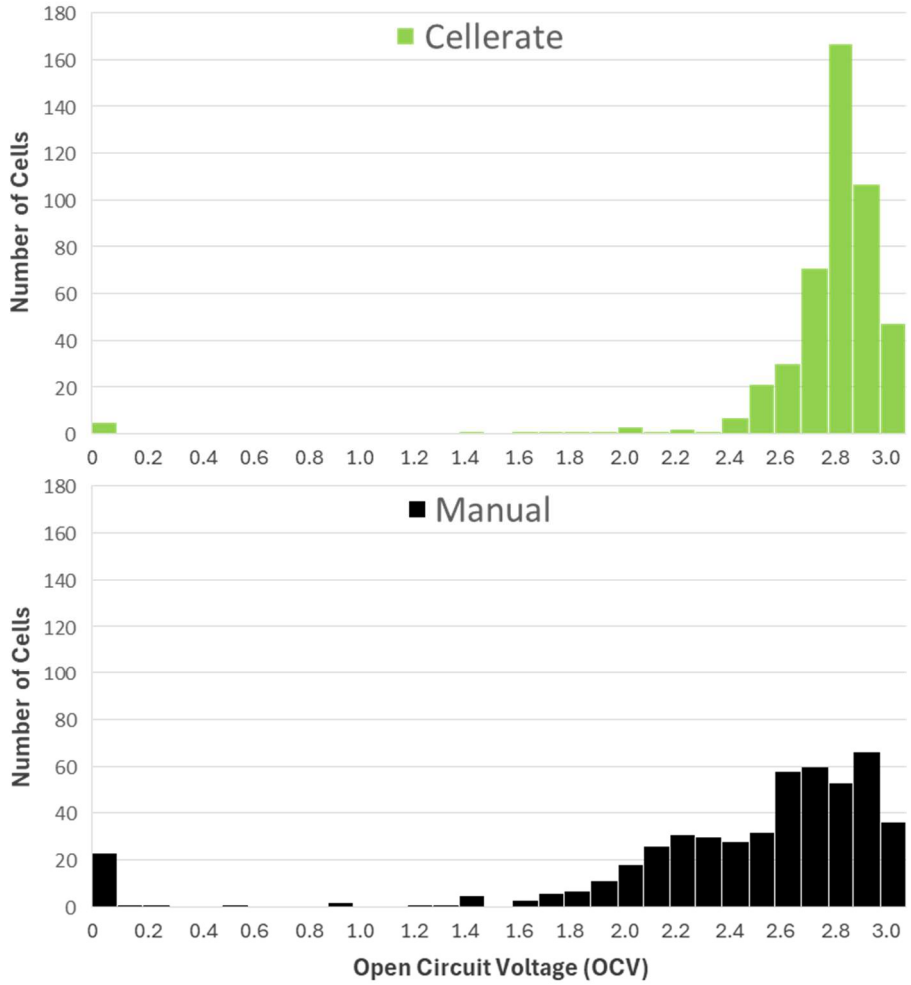

Figure 1 Data from 500 cells assembled by hand and 467 assembled using the CAS System.

Case 2: Consistent Performance on Customer Sites

This synthetic graphite manufacturer uses a Cellerate system for quality control, making 100 coin cells every day. Here they share data from a total of 127 cells, made by 8 technicians at various skill levels, showing they consistently achieve data with a standard deviation 0.2-0.3%.

Table 1 Data from 127 cells containing synthetic graphite and lithium chips.

Batch	Number of Cells	Standard Deviation in Specific Capacity	Standard Deviation in First Charge Efficiency
Graphite #1	10	0.23%	0.27%
Graphite #2	8	0.22%	0.18%
Graphite #3	39	0.33%	0.21%
Graphite #4	58	0.32%	0.32%
Graphite #5	12	0.23%	0.32%

Case 3: Upskilling Students with Prof. Jeff Dahn

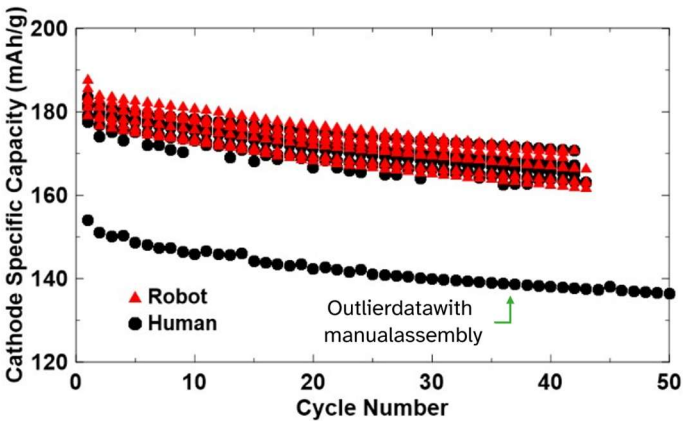

Figure 2 Cycling data from trial with Prof. Jeff Dahn. Automated assembly produced no outliers.

In a trial conducted with Prof. Jeff Dahn at Dalhousie University, students of various skill levels and experience tried making cells both manually and with the CAS System.

While 20% of manually assembled cells either short-circuited or showed low capacity, students using the CAS System achieved a 100% yield, with a low standard deviation of only 1%.

Conclusion

The results of these trials show that the Cellerate system can consistently produce high-quality coin cells for testing new materials. It cuts down on variance and ensures accurate test results, allowing researchers to allocate resources and plan their projects effectively. With its machine vision technology, the CAS System ensures exceptional quality control, allowing lab users to produce consistent, high-quality cells with minimal training.

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[i] Jason R. Croy *et al* 2016 *J. Electrochem. Soc.* **163** A2999

[ii] Jeff R. Dahn *et al* 2019 *J. Electrochem. Soc.* **166** A329

[iii] Fang Dai *et al* 2022 *Commun. Mater.* **3** 64