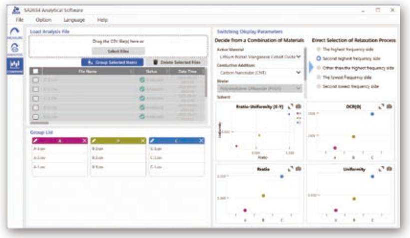
Analytical Software SA2634

Measurement screen

Analysis screen



Data comparison screen

System Configuration





Analytical Software SA2634	LCR Meter IM3536	Test Fixture SA9002	Electrode Cell SA9001 for NMP solvent	Electrode Cell SA9001-01 for aqueous solvents

Specifications

Analytical Software SA2634

System requirements (computer)	OS: Windows 10, Windows 11; RAM: 8 GB or more; storage: 1 GB or more of available space; display: resolution 1920 × 1080 or more is recommended; interface: USB 2.0/3.0, LAN; NET framework: 4.7.2 or more
Instrument to be controlled	LCR Meter IM3536
License authentication	Authentication method: USB license key (included accessory)
Language	English, Japanese
Measurement	Sweep frequency setting: 4 Hz to 8 MHz (when connected to IM3536); measurement signal level: 10 mV to 1 V (constant voltage [CV] mode); Nyquist plot display
Analysis	Analysis method: equivalent circuit analysis of impedance data Calculation parameters: DCR, Rratio, Uniformity of each relaxation

Electrode cell SA9001, SA9001-01

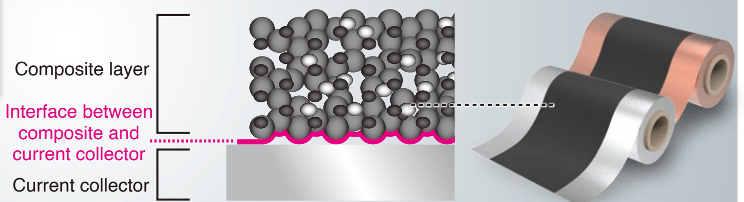
Dimensions	Approx. 27W × 42H × 37D mm (1.1W × 1.7H × 1.5D in.) (including the electrode)
Weight	Approx. 2.3 g (0.1 oz.)
Material	Container: polypropylene (PP); electrode: brass (base metal)
Capacity	Approx. 1 mL
Electrode pin	Diameter (area where liquid to be measured comes in contact): 3 mm ±0.1 mm Electrode interval: 6 mm ±0.3 mm Electrode surface treatment: nickel plating (SA9001), gold plating (SA9001-01)
Operating temperature and humidity range	23°C ±5°C (73°F ±9°F), 80% RH or less (non-condensing)
Storage temperature and humidity range	−10°C to 50°C (14°F to 122°F), 80% RH or less (non-condensing)
Operating environment	Indoors, altitude up to 2000 m (6562 ft.)
Quantity	50

Test fixture SA9002

Measurable frequency	DC to 10 MHz
Connectable sample	Electrode Cell SA9001 or SA9001-01
Residual impedance	Residual resistance during short circuit 200 mΩ or less (reference for 100 Hz) Inter-electrode stray capacitance 0.2 pF or less (reference for 1 MHz)
Dimensions	Approx. 98W × 38H × 24D mm (3.9W × 1.5H × 0.9D in.) (excluding protruding parts)
Weight	Approx. 210 g (7.4 oz.)
Weight	Shorting plate for compensation

Electrode Resistance Measurement System RM2610

Quantify electrode sheet composite layer and interface layer resistance of a completed electrode sheet.



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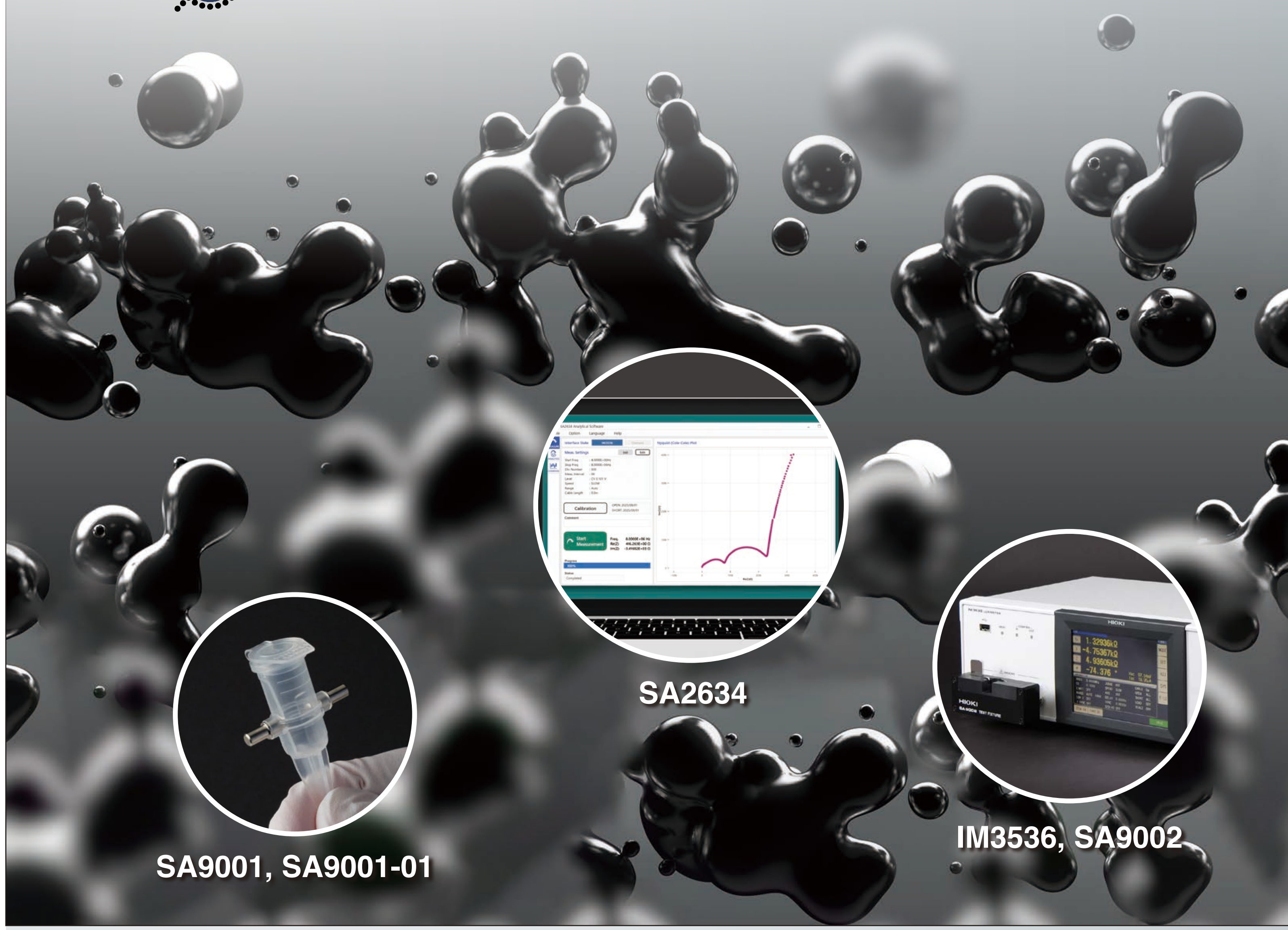
ANALYTICAL SOFTWARE SA2634 NEW

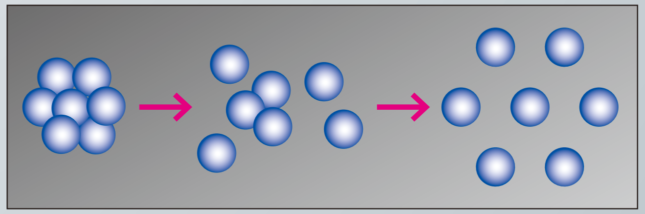
Slurry Analysis



Conductivity of Slurry through Quantitative Evaluation

Analytical Software SA2634 empowers battery researchers and quality assurance teams to objectively quantify the conductivity of lithium-ion battery (LiB) slurries. By providing clear metrics like **DCR, Rratio,** and **Uniformity,** it helps optimize R&D processes and production efficiency, enabling faster identification of high-performing slurries without relying on subjective assessments. This leads to superior electrode sheets and cells, reducing development time and improving overall battery yield.

Visualize the degree of dispersion in your slurry, revealing insights into conductive networks that directly impact battery performance.



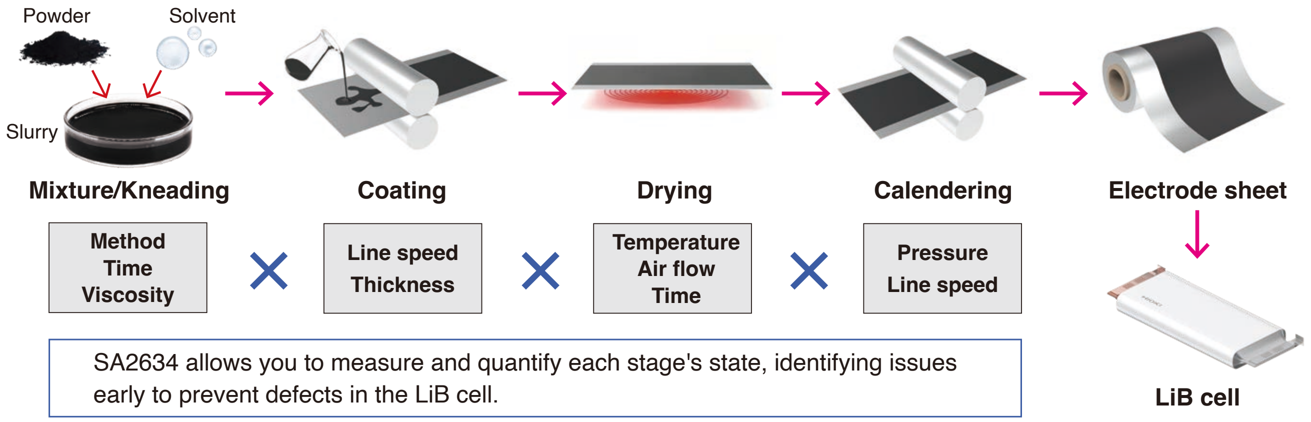
Slurry Analysis

Slurry Evaluation for Improving the Quality of Cells and Electrode Sheets.

Enhancing lithium-ion battery performance and yield starts with high-quality electrode sheets, which depend on optimized upstream slurry processes. SA2634 enables quantitative evaluation of slurry dispersion and conductivity—key factors influenced by material properties, formulation, mixing methods, and kneading time. This approach is based on quantitative science and provides researchers and QA managers with data-driven insights to refine processes, shortening development cycles and ensuring consistent battery quality.

Electrode Sheet Production

From powder and solvent to final electrode sheet, numerous parameters interact.

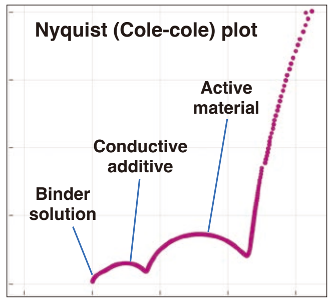


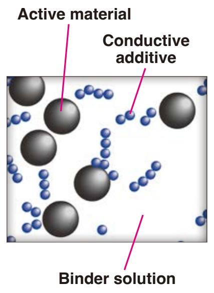
Evaluation in Small Quantities and Under Real-World Conditions

Assess cathode/anode slurries, conductive pastes, or CNT dispersions with as little as 1 mL—no pretreatment required. This efficiency accelerates your research by enabling rapid hypothesis testing and verification, minimizing waste while delivering reliable results on dispersion and conductive networks.

Impedance Measurement

The dedicated electrode cell and test fixture minimize measurement noise for highly reproducible impedance data. SA2634-controlled sweeps take about one minute, capturing slurry state with minimal change during analysis—ideal for dynamic materials in battery research.

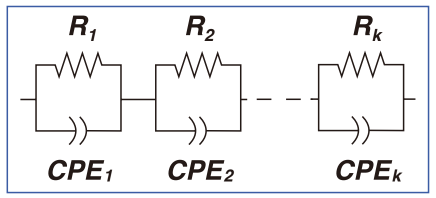




Equivalent Circuit Analysis

SA2634 automates complex equivalent circuit creation and initial value setting, handling up to 1000 files at once. This streamlines batch processing for efficient comparisons, turning raw impedance data into meaningful evaluations without deep expertise in analysis techniques.

Electrical Equivalent Circuit (EEC)



Quantitative Indexing

The three indicators, "DCR," "Ratio," and "Uniformity," are derived from the analysis results. These indicators enable quantitative evaluation and also function as a common language between departments and partner companies.

DCR (DC resistance)	Rratio (Resistance ratio)	Uniformity
Total slurry resistance (Ω)	Percentage of conductive material's resistive component in DCR (value ≤1)	Distribution of relaxation by conductive material (value ≤1)
$\mathrm{DCR} \equiv \sum_{m=1}^{k} R_m$	$\mathrm{Rratio}_\lambda \equiv \frac{R_\lambda}{\mathrm{DCR}}$	$\mathrm{Uniformity}_\lambda \equiv \mathrm{CPE}_\lambda$ index p

λ: any of 1 through k

Application: Optimizing CNT Dispersions with Analysis of Slurry and Electrode Sheets

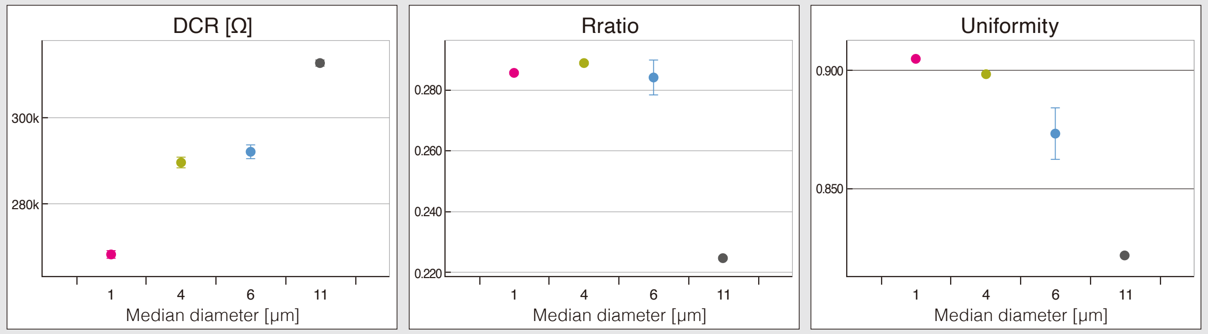
Background

Carbon nanotubes (CNTs) offer excellent conductivity but agglomerate easily, making uniform dispersion critical for LiB slurries. SA2634 helps identify optimal dispersions by quantifying electronic conductivity in slurries and correlating it to electrode sheet resistance, guiding researchers toward better formulations.

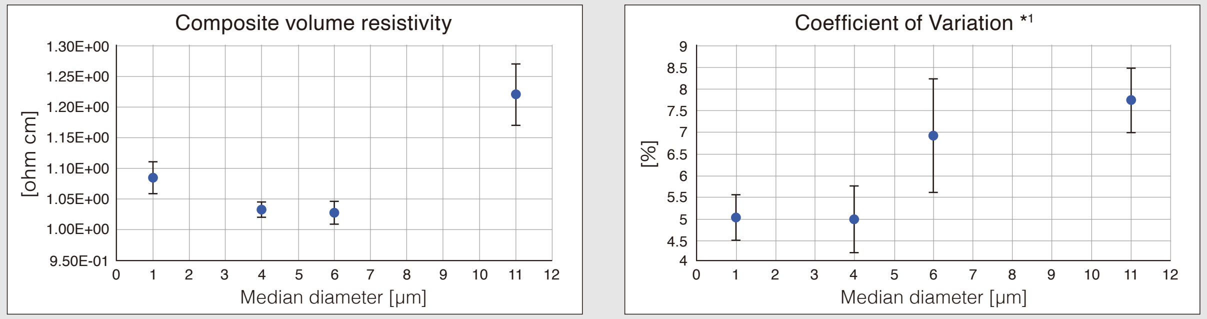
Procedure

- Prepared four CNT dispersions with varying mixing times. Measure the particle-size distribution of each and classify them by median diameter.
- Formed cathode slurries (same ratio):
  Active Material (NMC): 94%, Conductive Additive (CNT): 1.5%, Binder (PVDF + Dispersant): 4.5%
- Analyzed each slurry with SA2634 to output DCR, Ratio, and Uniformity.
- Produced electrode sheets from each slurry and measured resistance characteristics.

Slurry measurement results



Electrode sheet measurement results



*1 Measurement value "Variation-V" output by Hioki RM2610 is a numerical value that indicates the variation in the measured potential/voltage distribution

Inspection

Slurry

Short → Long (Kneading time)

- **Median diameter 11 μm:** High DCR, low Ratio
  Deduction: insufficient CNT conductive paths (Fig. 1 "Short path formation")
- **Median diameter 4 μm and 6 μm:** DCR decreases, Ratio rises
  Deduction: CNT conductive paths have formed (Fig. 1 "Long path formation")
- **Median diameter 1 μm:** DCR and Ratio decrease
  Deduction: small particle sizes of CNT cause re-agglomeration (Fig. 1 "Agglomeration")
- **Uniformity increases:** High uniformity means that the CNT is closer to even spacing and size (see Fig. 2).
  Deduction: since DCR and Ratio points to agglomeration, high Uniformity means the agglomerated CNT has even spacing and size.

Electrode Sheet

- The composite volume resistivity is lower for samples made from 4 and 6 μm
- The coefficient of variation is as low for samples made from 1 and 4 μm

Deduction:

Low volume resistivity is good due to low resistance. Low coefficient of variation is good because it shows the composite material is uniformly mixed. Therefore the electrode sheets made with 4 μm are the best because both of these parameters are low.

Slurries with high tendencies in the three indicators of DCR, Ratio, and Uniformity form excellent electrode sheets. This aligns with the assessment from electrode sheet analysis.

Interpret the conductive path formed in the slurry from three quantitative indicators

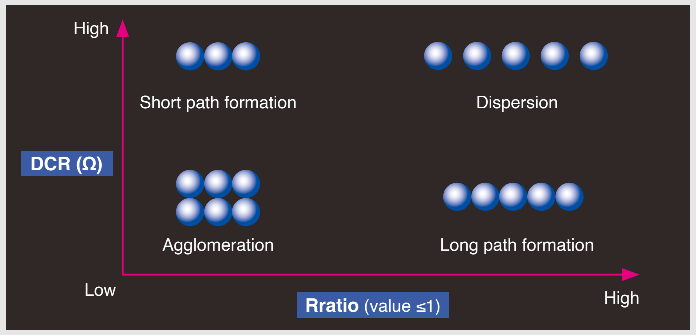


Fig. 1. Identifying Conductive Path States with DCR and Ratio

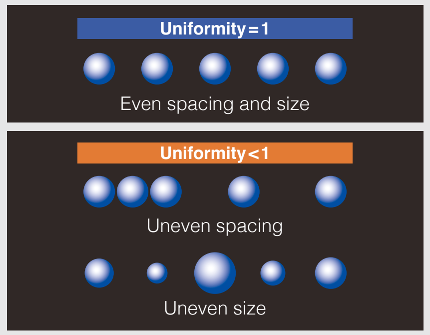


Fig. 2. Ideal Uniformity vs 2 Possible States of Low Uniformity