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CS360Pro

10MHz Single channel

Potentiostat/Galvanostat/Frequency Response Analyzer

Model CS360Pro single-channel potentiostat/galvanostat consists of a DDS arbitrary function generator, a potentiostat/galvanostat and an FRA. With the help of built-in dual 24-bit Delta-sigma AD converters, it achieves excellent stability and high potential (1μV) and current(1pA) resolutions. CS360Pro has been widely applied in corrosion, energy, material and analysis electrochemistry.

Applications

-Energy materials (Li-S battery, Li-ion battery, solar cell, fuel cell, supercapacitors, etc);
-Reactive mechanisms of electrosynthesis, electrodeposition (electroplating), anodic oxidation, electrolysis;
-Metallic corrosion; corrosion inhibitor, coating and cathodic protection efficiency;
-Electrocatalysis (HER, OER, ORR, CO_2RR, NRR).

Specifications	
Support 2-, 3- or 4-electrode system	Potential and current range: Automatic
Potential control range: ±10V	Current control range: ±2A
Potential control accuracy: 0.1%×range±1mV	Current control accuracy: 0.1%×range
Potential resolution: 1μV	Current sensitivity:1pA
Rise time: ⩽1μS	Reference electrode input impedance:10^{13}Ω||5pF
Current range: ±20pA ~ ±2 A, 12 ranges	Compliance voltage: ±30V
Maximum current output: 2A	CV and LSV scan rate: 0.001mV~10,000V/s
CA and CC pulse width: 0.0001~65,000s	Current increment during scan: 1mA@1A/ms
Potential increment during scan: 0.020mV@1V/ms	SWV frequency: 0.001~100 kHz
DPV and NPV pulse width: 0.001 ~ 100s	AD data acquisition:16bit@1 MHz,20bit@1 kHz
DA Resolution:20bit, setup time:1μs	Minimum potential increment in CV: 0.075mV
IMP frequency: 10μHz~10MHz	Low-pass filters: covering 7-decade
Operating System: Windows 10/11	Interface: USB 2.0 & RJ45
EIS (Electrochemical Impedance Spectroscopy)	
Signal generator	
Frequency range:10μHz~10MHz	AC amplitude:1mV~2500mV
DC Bias: -10~+10V	Output impedance: 50Ω
Waveform: sine wave, triangular wave and square wave	Wave distortion: <1%
Scanning mode: logarithmic/linear, increase/decrease	
Signal analyzer	
Integral time: minimum:10ms or the longest time of a cycle	Maximum:10^6 cycles or 10^5s
Measurement delay: 0~10^5s	
DC offset compensation	
Potential automatic compensation range: -10V~+10V	Current compensation range: -2A~+2A
Bandwidth: 8-decade frequency range, automatic and manual setting	

Techniques -CS360Pro

Stable polarization

- Open Circuit Potential (OCP)
- Potentiostatic (I-T curve)
- Galvanostatic
- Potentiodynamic (Tafel plot)
- Galvanodynamic (DGP)

Transient Polarization

- Multi Potential Steps
- Multi Current Steps
- Potential Stair-Step (VSTEP)
- Galvanic Stair-Step (ISTEP)

Chrono Method

- Chronopotentiometry (CP)
- Chronoamperametry (CA)
- Chronocaulometry (CC)

Voltammetry

- Linear Sweep Voltammetry (LSV)
- Cylic Voltammetry (CV)
- Staircase Voltammetry (SCV) #
- Square Wave Voltammetry (SWV) #
- Differential Pulse Voltammetry (DPV) #
- Normal Pulse Voltammetry (NPV) #
- Differential Normal Pulse Voltammetry (DNPV) #
- AC Voltammetry (ACV)
- 2^{nd} harmonic AC Voltammetry (SHACV)
- Fourier Transform AC Voltammetry (FTACV)

Electrochemical Impedance Spectroscopy (EIS)

- Potentiostatic EIS (Nyquist, Bode)
- Galvanostatic EIS
- Potentiostatic EIS (Optional freq.)
- Galvanostatic EIS(Optional freq.)
- Mott-Schottky
- Potentiostatic EIS vs. Time (Single freq.)
- Galvanostatic EIS vs. Time (Single freq.)

Corrosion Measurements

- Cyclic polarization curve (CPP)
- Linear polarization curve (LPR)
- Electrochemical Potentiokinetic Reactivation (EPR)
- Electrochemical Noise (EN)
- Zero resistance Ammeter (ZRA)

Battery test

- Battery Charge and Discharge
- Galvanostatic Charge and Discharge (GCD)
- Potentiostatic Charging and Discharging(PCD)
- Potentiostatic Intermittent Titration Technique (PITT)
- Galvanostatic Intermittent Titration Technique (GITT)

Amperometric

- Differential Pulse Amperometry (DPA)
- Double Differential Pulse Amperometry (DDPA)
- Triple Pulse Amperometry (TPA)
- Integrated Pulse Amperometric Detection (IPAD)

Extensions

- Electrochemical Stripping/ Deposition
- Bulk Eletrolysis with Coulometry (BE)
- Rs Measurement

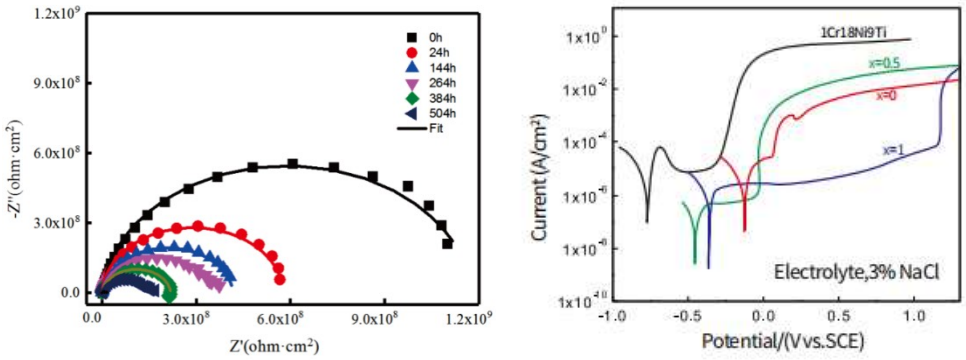
There is the corresponding stripping method

Applications

Corrosion Electrochemistry

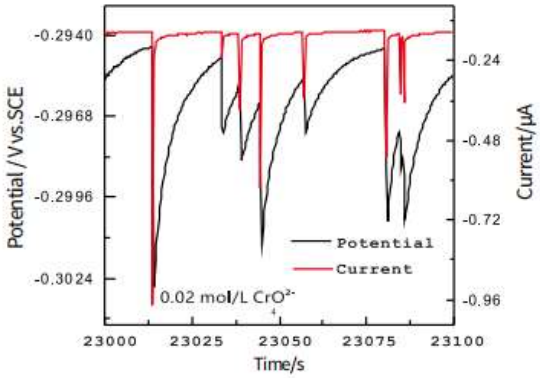
CS potentiostats/galvanostats support a variety of electrochemical techniques for corrosion, such as OCP recorder, potentiodynamic, EIS, cyclic polarization (CPP), LPR, hydrogen diffusion test, zero resistance ammeter (ZRA), electrochemical noise (ECN), etc.

Due to their high input impedance($10^{13}\Omega$), they are especially suitable for EIS measurement of high-impedance systems like coating, concrete, and pure water.



High-impedance coating ageing test in salt spray tests

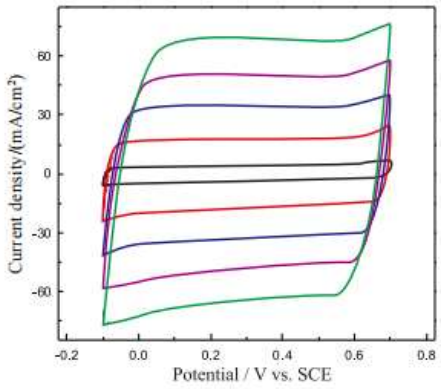
Polarization curves of Ti-alloy& stainless steel in 3%NaCl solution



ECN of low-carbon steel in 0.05mol/L Cl+0.1mol/L $NaHCO_3$

Energy & Battery Testing

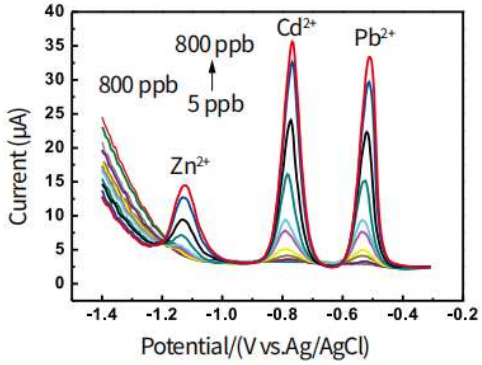
With versatile functions like linear sweep voltammetry (LSV), cyclic voltammetry (CV), galvanostatic charge/discharge (GCD), EIS (including potentiostatic and galvanostatic modes) with precise IR compensation, CS potentiostats are widely used in supercapacitor, Li-ion batteries, Li-S batteries, fuel cell, solar cell, solid-state batteries, flow batteries, and metal-air batteries, *etc*.



CV of PPy supercapacitor in 0.5 mol/L H_2SO_4 solution

Analytical Electrochemistry

CS potentiostats include comprehensive voltammetric methods such as NPV, DPV, DNPV, SWV, and ACV, which make them ideal for quantitative analysis of trace elements via the intrinsic Voltammetry stripping techniques.

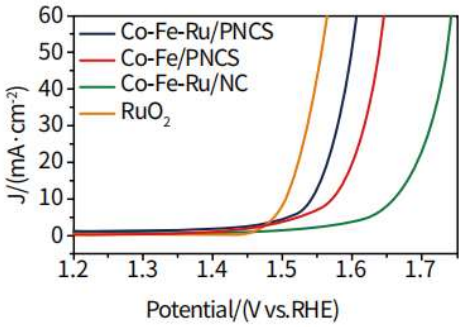


Stripping voltammetric curves in the solution dissolved with Pb^{2+}, Cd^{2+}, and Zn^{2+} ions

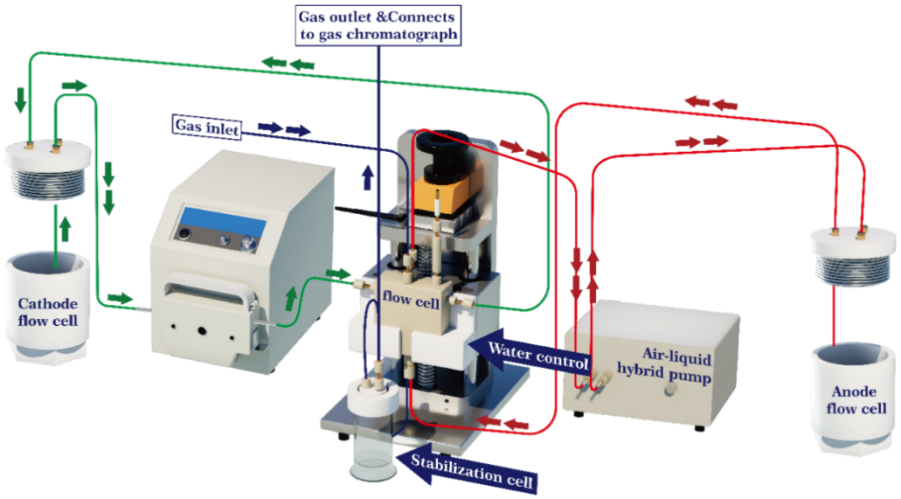
Electrocatalysis

Based on CV and LSV techniques, CS potentiostats can carry out long-term tests for ORR, OER, HER, and CO_2 reduction, which is crucial for evaluating catalyst stability. In addition, the CS2350M bi-potentiostat and multichannel potentiostat specialize in Faradaic efficiency synchronous measurement.

CS potentiostats can measure the half-wave potential (ORR) and overpotential (HER, OER) of catalysts and calculate the power density and energy density of Redox peaks.



LSV curves of various catalysts in alkaline solution



Electrochemical Sensor

Thanks to the high current sensitivity(100fA) and voltage resolution(1 μV), the CS potentiostat can be used for the R&D of biosensors and electrochemical sensors.

Technical Advantages

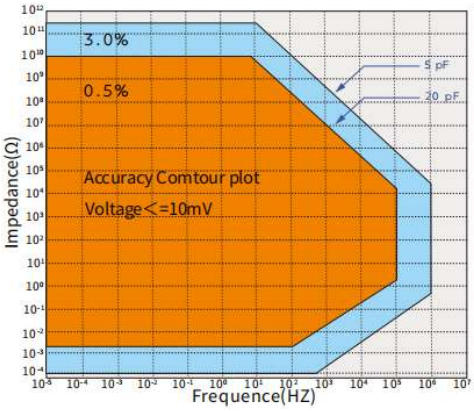
Switchable floating and earthing mode

All CS potentiostats/galvanostats can switch between the floating and earthing modes, and this strategy is beneficial for studying electrochemical systems in which the working electrodes are intrinsically ground, such as autoclaves, in-site concrete structures and multi-working electrodes requiring isolation, etc.

High-bandwidth EIS

With the help of built-in digital FRA and arbitrary signal generator, as well as the high input impedance (10^{13} Ω), the CS potentiostat is particularly suitable for EIS measurements of high-impedance systems (such as coating, membrane, concrete, etc.)

Based on the DC bias compensation technique, CS potentiostats can conduct EIS tests under different charge/discharge states of batteries, making them suitable for ultra-low resistance systems, such as power batteries, fuel cells, water-splitting equipment, etc.



Multiple electrode configurations

CS potentiostats support 2-, 3-, or 4-electrode configurations and can measure the galvanic current via built-in zero resistance ammeter circuits.

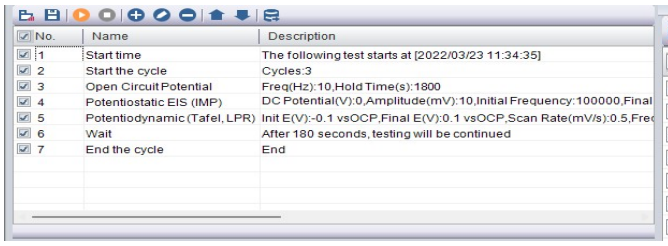
Independent multiple channels

For CS 310X multi-channel potentiostat, each channel is completely independent. It can be used for the electrochemistry measurements of multiple cells or multiple working electrodes in a cell.

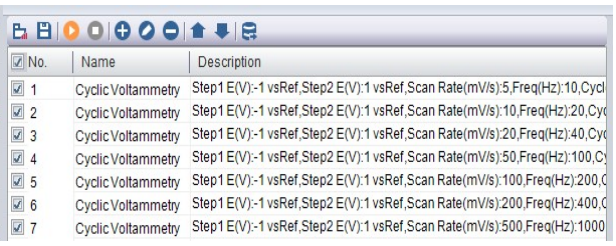
CS2350M Bipotentiostat/multi-channel potentiostat can be used for the RRDE test, dual-cell hydrogen diffusion test.

User-defined sequence test

CS Studio 6.0 for Windows software supports user-defined sequence tests ("combination test"), which can facilitate automatic testing according to user-defined experiment sequences.



Sequence Test: corrosion tests



Sequence Test: Pseudocapacitor tests

Power booster

Through CS1020B/CS1050B/CS10100B booster, the CS potentiostats can extend their output current up to ±20A/50A/100A, meeting the growing requirements in fuel cells, power batteries, electroplating etc

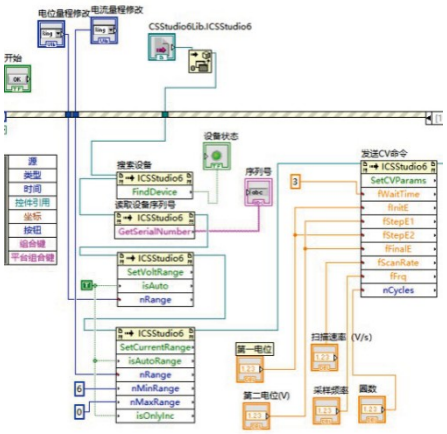
The compliance voltage of single-channel potentiostat can be customized(±30V),suitable for carbon/nitrogen electrochemical reduction.

With a multiplexer, the CS single-channel potentiostats can be extended to 16~32 channels for high throughput testing.

CS potentiostats can work with a CST520 arrayed electrode mapper to study the non-uniform corrosion of metal samples under deposits, coatings and anti-rust oils.

Software development kit (SDK)

All CS potentiostats run under the control of CS Studio 6.0 for Windows (CSS 6.0). The CSS6.0 supports third-party languages, such as LabVIEW, C, C++, C#, VC, Python and others. Some API general interfaces and development examples can be supplied with the CS potentiostats. Through the SDK, customers can implement user-defined test methods.



Real-time data saving

CSS 6.0 saves experimental data timely, even if the experiment is accidentally interrupted by a power failure or computer shutdown. CSS 6.0 supports several data formats compatible with Originpro and Microsoft Excel.

Versatile data analysis functions

CSS 6.0 provides robust functions, including various electrochemical measurements and data analysis. It can complete Tafel plot fitting, CV derivation, integration and peak height analysis, EIS equivalent circuit fitting, etc.

3, 4 parameter polarization curve fitting.

EIS fitting

Electrochemical noise spectrum analysis

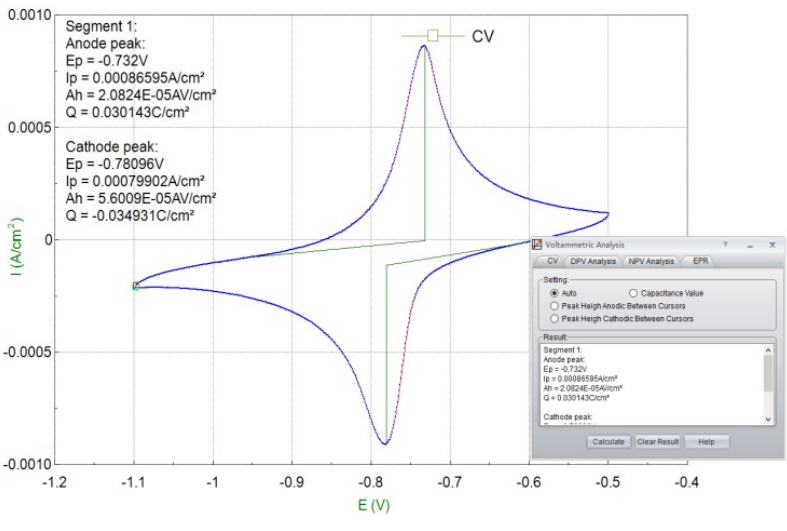
Pseudo-capacitance calculation

GCD-specific capacitance, efficiency calculation

Mott-Schottky analysis

CV curve analysis

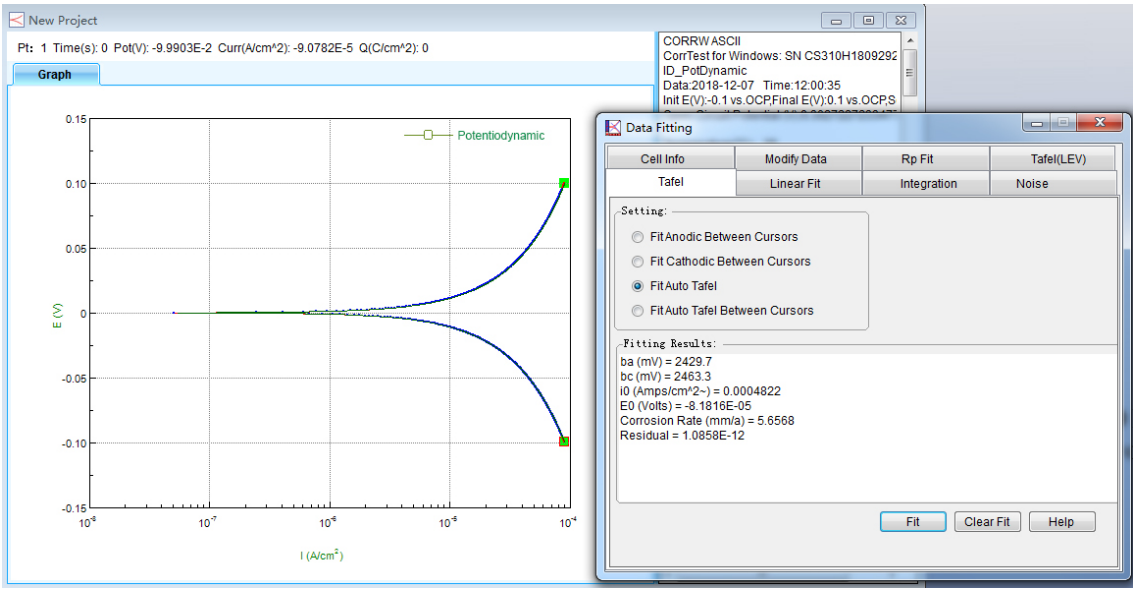
Activation/re-passivation curve analysis



Software Features

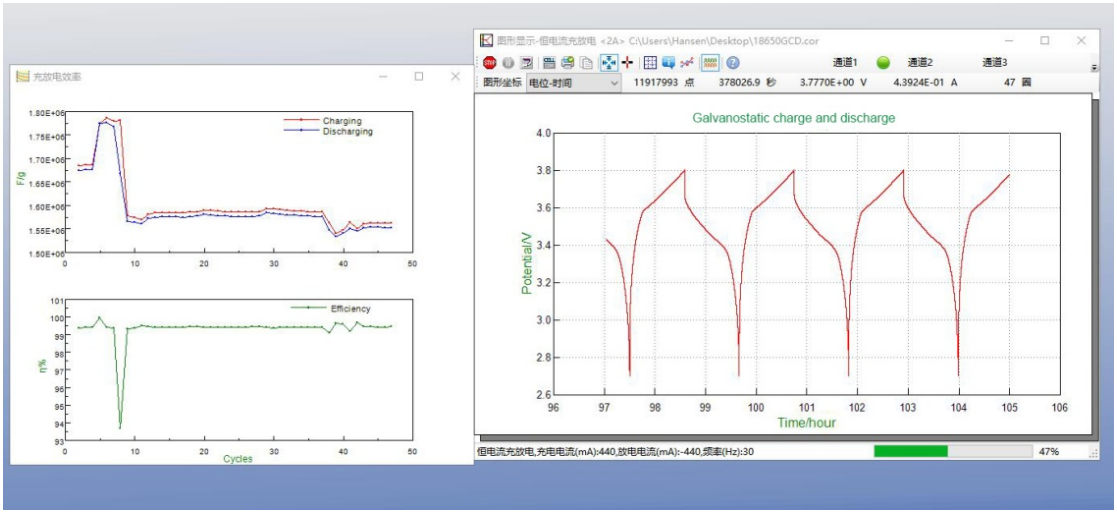
Cyclic voltammetry: CS studio software provides users a versatile smoothing/differential/ integration kit, which can complete the calculation of peak height, peak area and peak potential of CV curves. In CV technique, during the data analysis, there is function of selecting exact cycle(s) to show.

Tafel plot and corrosion rate: CS studio also provides powerful non-linear fitting on Butler-Volmer equation of polarization curve. It can calculate Tafel slope, corrosion current density, limitation current, polarization resistance, corrosion rate. It can also calculate the power spectrum density, noise resistance and noise spectrum resistance based on the ECN measurements.



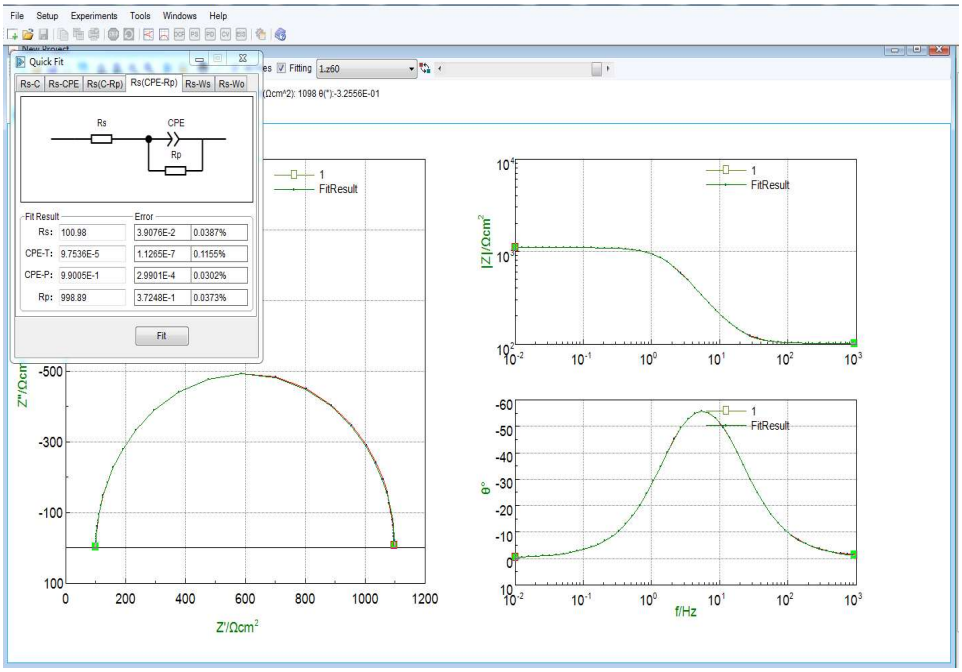
Battery Test and analysis:

charge & discharge efficiency, capacity, specific capacitance, charge & discharge energy.



EIS analysis: Bode, Nyquist, Mott-Schottky plot

During EIS data analysis, there is built-in fitting function to draw the custom equivalent circuit.



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