

Model CS350M EIS potentiostat /galvanostat / electrochemical workstation consists of DDS arbitrary function generator, high power potentiostat/galvanostat, dual-channel correlation analyzer, dual-channel high-speed 16bit/high-precision 24bit AD converter and extension interfaces. Max. current is $\pm 2A$, potential range is $\pm 10V$. EIS frequency range is 10uHz~1MHz. It can be used for various electrochemical fields such as corrosion, energy, material and electroanalysis. The current can be boosted up to 20A/40A with a current booster CS2020B/CS2040B.



Applications

- Study of Energy materials (Li-ion battery, solar cell, fuel cell, supercapacitors), advanced functional materials
- Electrocatalysis (HER, OER, ORR, CO₂RR, NRR)
- Corrosion study and corrosion resistance evaluation of metals; quick evaluation of corrosion inhibitors, coatings, and cathodic protection efficiency
- Electrosynthesis, electroplating/electrodeposition, anode oxidation, electrolysis

Specifications	
Support 2-, 3- or 4-electrode system	Potential and current range: Automatic
Potential control range: $\pm 10V$	Current control range: $\pm 2A$
Potential control accuracy: 0.1% \times full range $\pm 1mV$	Current control accuracy: 0.1% \times full range
Potential resolution: 10 μV (>100Hz), 3 μV (<10Hz)	Current sensitivity: 1pA
Rise time: <1 μs (<10mA), <10 μs (<2A)	Reference electrode input impedance: 10 ¹² Ω 20pF
Current range: 2nA~2A, 10 ranges	Compliance voltage: $\pm 21V$
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: 0.076mV@1V/ms	SWV frequency: 0.001~100 kHz
DPV and NPV pulse width: 0.0001~1000s	AD data acquisition: 16bit@1 MHz, 20bit@1 kHz
DA Resolution: 16bit, setup time: 1 μs	Minimum potential increment in CV: 0.075mV
IMP frequency: 10 μHz ~1MHz	Low-pass filters: covering 8-decade
Operating System: Windows 10/11	Interface: USB 2.0
Weight / Measurements: 6.5kg, 36.5 x 30.5 x 16 cm	
EIS (Electrochemical Impedance Spectroscopy)	
Signal generator	
Frequency range: 10 μHz ~1MHz	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 ⁵ s
Measurement delay: 0~10 ⁵ s	
DC offset compensation	
Potential automatic compensation range: -10V~+10V	Current compensation range: -1A~+1A
Bandwidth: 8-decade frequency range, automatic and manual setting	

Techniques -CS350M

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)
- Chronoamperometry (CA)
- Chronocoulometry (CC)

Voltammetry

- Linear Sweep Voltammetry (LSV)
- Cyclic 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)
- 2nd 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)

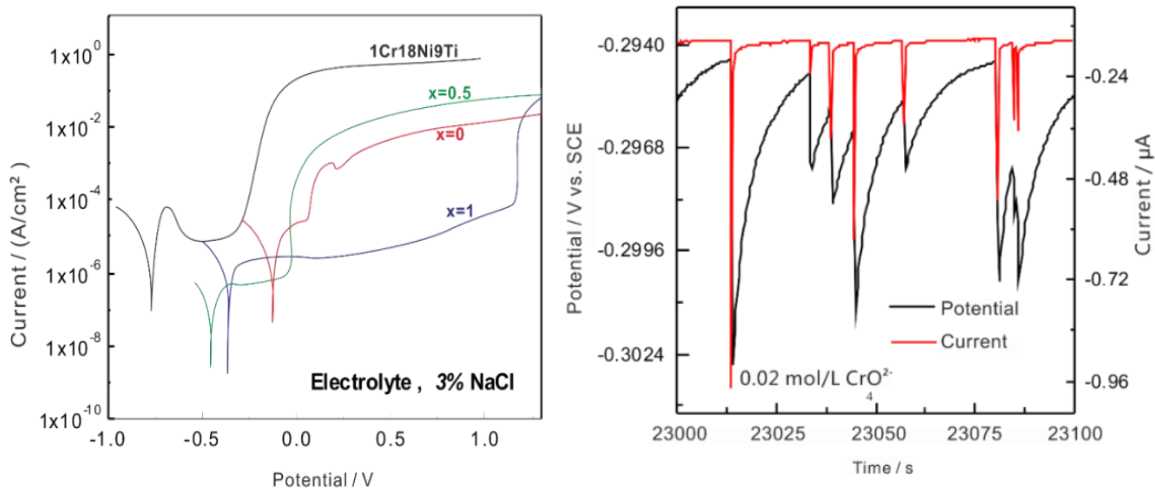
Extensions

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

There is the corresponding stripping method.

Application

Corrosion: Corrtest potentiostat includes all the electrochemical techniques for corrosion measurement such as OCP, polarization curve (potentiodynamic), EIS, Cyclic polarization CPP (passivation curve), Electrochemical Potentiokinetic Reactivation (EPR), Hydrogen diffusion test, ZRA, Electrochemical noise, etc. It can be used to study metal corrosion mechanism and corrosion resistance, and evaluate the coating durability and sacrificial anode current efficiency. It can also be used for rapid screening of corrosion inhibitors, fungicides, etc.

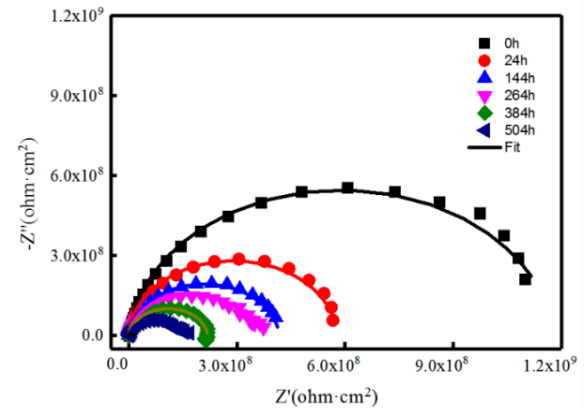


Left: Polarization curves of Ti-alloy & stainless steel in 3% NaCl solution

Right: EN of low-carbon steel in 0.05 mol/L Cl⁻ + 0.1 mol/L NaHCO₃

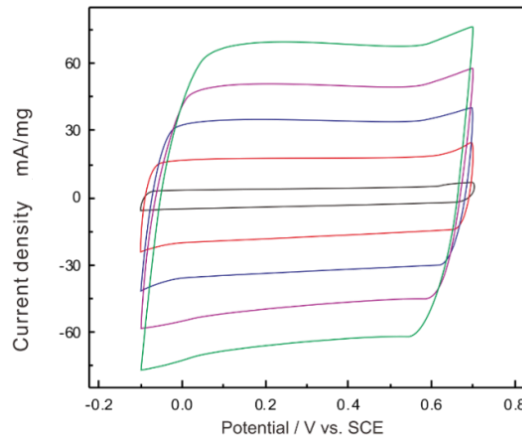
It uses correlation integral algorithm and dual-channel over-sampling technique, and has strong anti-interference ability. The internal resistance of the instrument is up to $10^{13}\Omega$. It's suitable for EIS measurements of high-impedance system (such as coating, concrete etc)

Salt spray aging test of high impedance coating



Energy

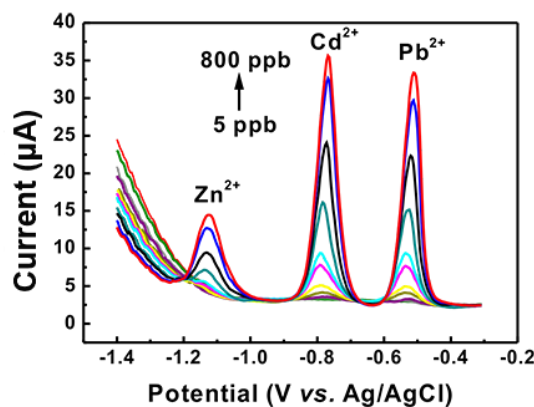
With techniques LSV, CV, galvanostatic charge and discharge (GCD), Constant potential/ current EIS, and precise IR compensation circuit, Corrtest potentiostats are widely used in supercapacitor, Li-ion batteries, sodium-ion batteries, fuel cell, Li-S batteries, solar cell, solid-state batteries, flow batteries, metal-air batteries etc. It is an excellent scientific tool for researchers in the fields of energy and materials.



CV curve of PPY supercapacitor in 0.5 mol/L H₂SO₄ solution

Electroanalysis

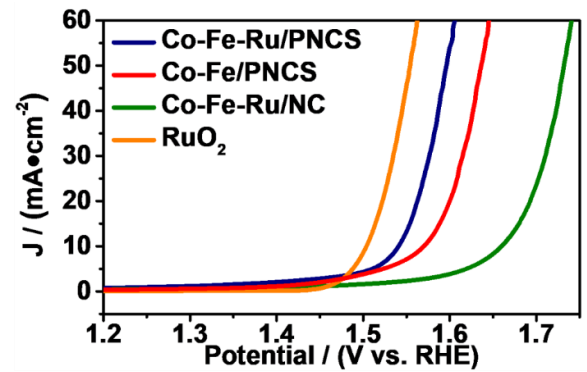
Corrtest potentiostat includes all the voltammetric methods such as NPV, DNPV, SWV, ACV, and can be used for fast analysis of the trace elements in the solution. Voltammetry stripping methods can do the Quantitative analysis according to the stripping peak current.



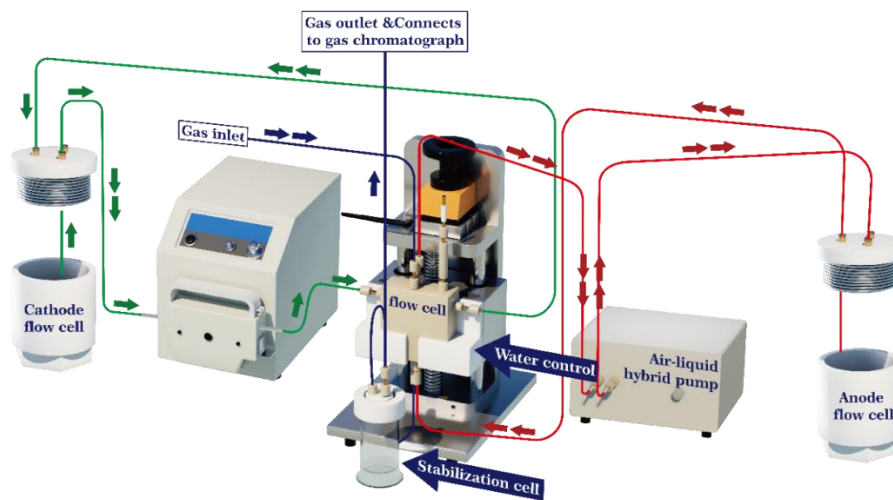
Stripping voltammetric curves in solution of different Pb²⁺, Cd²⁺, Zn²⁺ concentration

Electro-catalysis

- Corrttest potentiostat can measure the half-wave potential (ORR), overpotential (HER, OER) of the catalyst, and has the function of peak power density and energy density calculation.
- Long-term cyclic measurement for ORR, OER, HER, CO₂RR by techniques such as cyclic voltammetry, potentiostatic, galvanostatic. Faraday efficiency can be measured with a bipotentiostat.



LSV curve of catalysts in alkaline solution



- Maximum current can be 20A and compliance voltage can be 30V, and with IR compensation technique, Corrttest potentiostat can precisely measure the overpotential of the electrode, which is a big advantage in electrocatalysis field.

Advantages

Full floating

All Corrttest potentiostats / galvanostats are designed as full-floating, and can be used for electrochemical study of working electrode connecting to earth, such as autoclave, metal part in bridge, concrete

Real-time data storage

Experiment data can be stored in real time. Even if the test is interrupted by a power failure, the data will be automatically saved. The data is compatible with Excel, Origin, and can be directly opened.

EIS

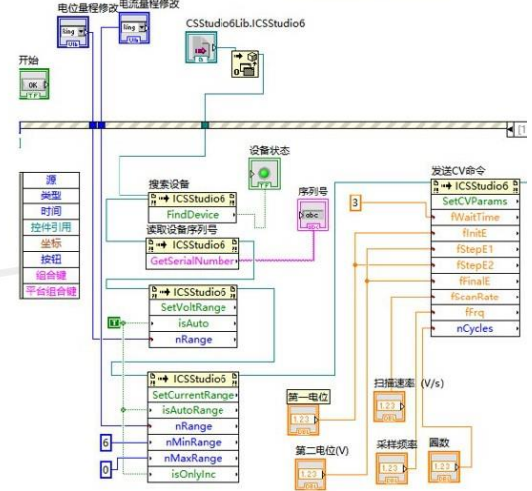
- Corrttest potentiostat uses correlation integral algorithm and dual-channel over-sampling technique, and has strong anti-interference ability. The internal resistance of the instrument is up to $10^{13}\Omega$. It's suitable for EIS measurements of high-impedance system (such as coating, concrete etc.)
- With constant current carrier and DC bias technology, Corrttest potentiostat can be used for battery impedance measurement under charge and discharge state, suitable for ultra-low resistance system (such as 18650 battery, soft pack battery, battery core...)

Multi electrode system

- Support 2-, 3-, 4-electrode system, can be used to test battery internal resistance or 4-electrode thin film impedance measurement
- With Zero resistance ammeter for galvanic current measurement

Software development kit(SDK)

We can provide secondary development interfaces, API general interfaces and development examples, and can realize data call for Labview, C, C++, C#, VC and other program, which is convenient for secondary development and test methods customization.



High current, high compliance options

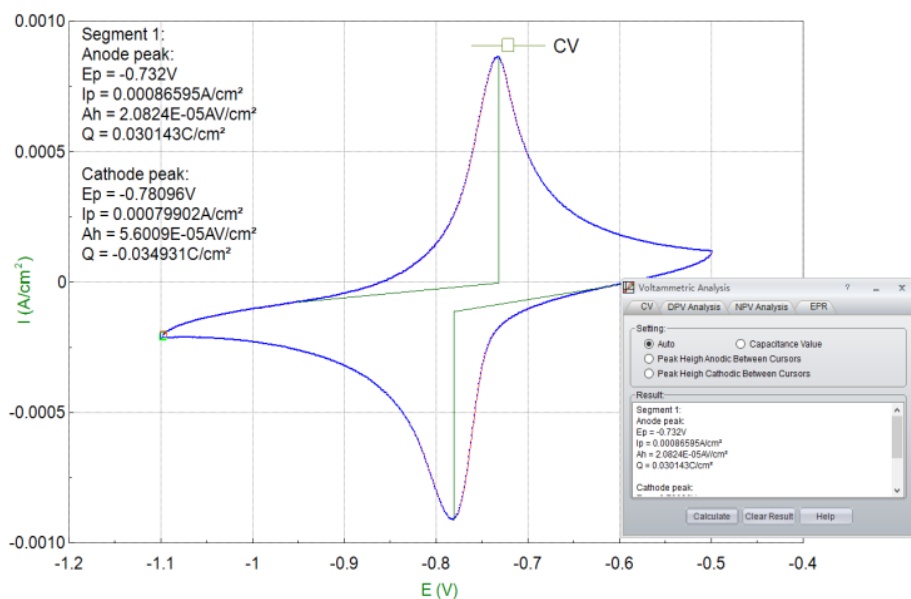
- With the CS2020B/CS2040B booster, the current can be boosted to 20A/40A, which meets the requirement in fuel cell, power battery, electroplating, etc
- Can customize the instrument to be 30V high compliance voltage, which meets the test requirement in low-conductivity solutions (organic system, concrete system etc), especially suitable for carbon and nitrogen reduction study.



Versatile data analysis

CS Studio is the software for Corrttest potentiostat for experiment control and data analysis. It can do: multi-parameter Tafel curve fitting, derivation, integration and peak height analysis of voltammetric curve, EIS equivalent circuit customization and impedance spectrum fitting, etc.

- Multi-parameters Polarization curve
- EIS fitting
- Electrochemical noise analysis
- Pseudo capacitance calculation
- GCD specific capacitance, efficiency
- Mott-Schottky plot analysis
- CV analysis



Combination test

CS studio software supports the combination test for various experiments to achieve flexible and

unattended test. You can set the parameters for each experiment in advance, and set the intervals, wait time etc between each experiment.

No.	Name	Description
1	Start time	The following test starts at [2022/03/23 11:34:35]
2	Start the cycle	Cycles:3
3	Open Circuit Potential	Freq(Hz):10, Hold Time(s):1800
4	Potentiostatic EIS (IMP)	DC Potential(V):0, Amplitude(mV):10, Initial Frequency:100000, Final
5	Potentiodynamic (Tafel, LPR)	Init E(V):-0.1 vsOCP, Final E(V):0.1 vsOCP, Scan Rate(mV/s):0.5, Freq
6	Wait	After 180 seconds, testing will be continued
7	End the cycle	End

Combination Test: corrosion tests

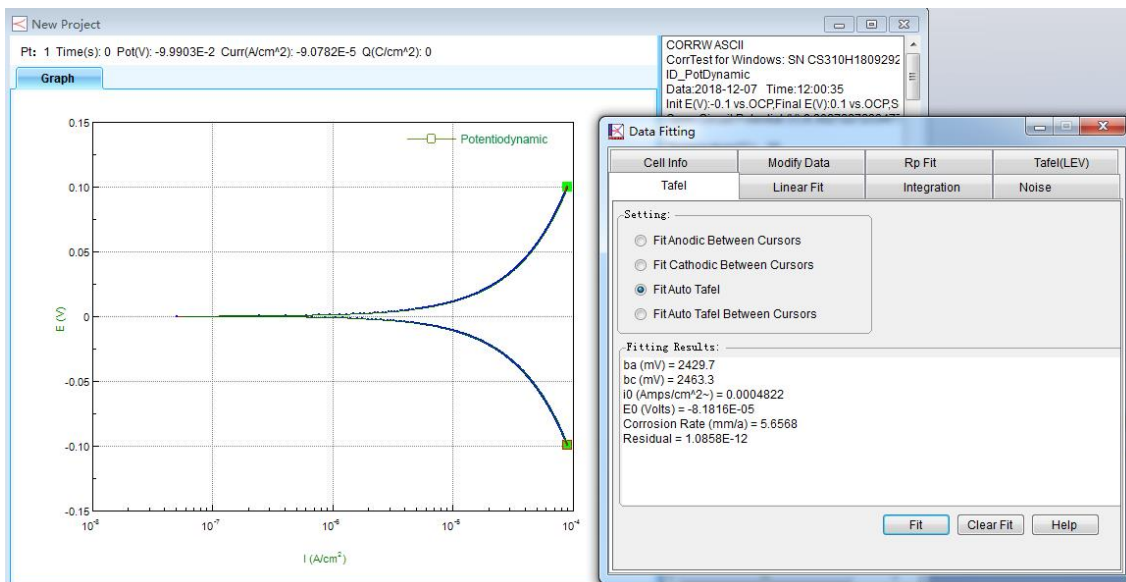
No.	Name	Description
1	Cyclic Voltammety	Step1 E(V):-1 vsRef, Step2 E(V):1 vsRef, Scan Rate(mV/s):5, Freq(Hz):10, Cyclic
2	Cyclic Voltammety	Step1 E(V):-1 vsRef, Step2 E(V):1 vsRef, Scan Rate(mV/s):10, Freq(Hz):20, Cyclic
3	Cyclic Voltammety	Step1 E(V):-1 vsRef, Step2 E(V):1 vsRef, Scan Rate(mV/s):20, Freq(Hz):40, Cyclic
4	Cyclic Voltammety	Step1 E(V):-1 vsRef, Step2 E(V):1 vsRef, Scan Rate(mV/s):50, Freq(Hz):100, Cyclic
5	Cyclic Voltammety	Step1 E(V):-1 vsRef, Step2 E(V):1 vsRef, Scan Rate(mV/s):100, Freq(Hz):200, Cyclic
6	Cyclic Voltammety	Step1 E(V):-1 vsRef, Step2 E(V):1 vsRef, Scan Rate(mV/s):200, Freq(Hz):400, Cyclic
7	Cyclic Voltammety	Step1 E(V):-1 vsRef, Step2 E(V):1 vsRef, Scan Rate(mV/s):500, Freq(Hz):1000, Cyclic

Combination Test: Pseudo capacitor tests

Software Features

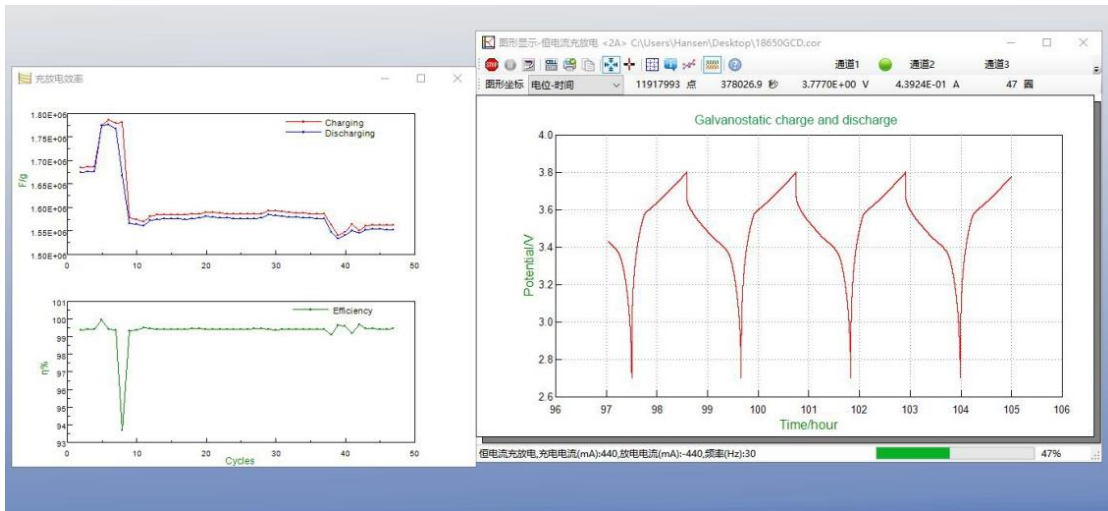
Cyclic voltammetry: CS studio software provides users a versatile smoothing/differential/ integration kit, which can complete the calculation of peak height, peak area and peak potential of CV curves. In CV technique, during the data analysis, there is function of selecting exact cycle(s) to show.

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 EN measurements.



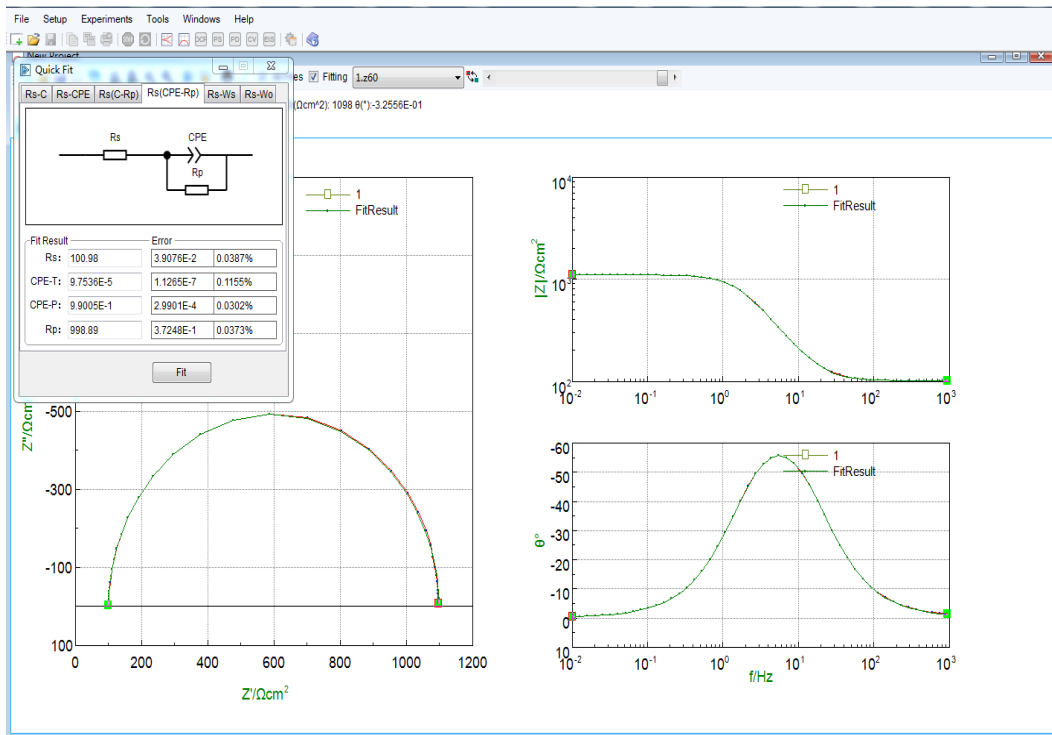
Battery Test and analysis:

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.



Standard supply-CS350M

Instrument host CS350M

CS studio software

Power cable x1

USB cable x1

Cell/electrode cable x2

Dummy cell(1kΩ||100μF) x1

Manual