BiPotentiostat/BiGalvanostat with built-in EIS model CS2350M has two sets of built-in independent potentiostat /galvanostat. So it equals that you have 2 sets potentiostat in one instrument. Full floating module and electrical isolation design guarantee each channel is totally independent, which ensures accurate data. Each set provides full electrochemical techniques including EIS. Experiments can be conducted simultaneously in each channel. Besides this, the two channels can jointly complete experiment of two-working electrode system such as RRDE and Hydrogen diffusion. CS2350M bipotentiostat is the real double-channel potentiostat. It uses Ethernet connection. EIS module is included in both channels.

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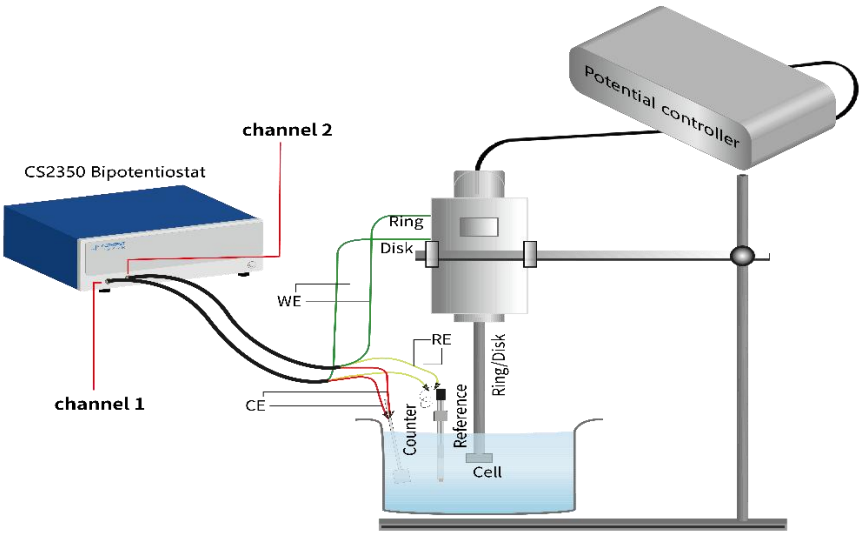
Applications

(1) Electrosythesis, electrodeposition (electroplating), anodic oxidation, electrolysis
(2) Electrocatalysis such as Oxygen reduction reaction (ORR), OER, HER, CO2 reduction.
(3) Li-ion battery, solar cell, fuel cell, supercapacitor, advanced function materials, sensor, etc
(4) Corrosion behavior of metals, and anti-corrosion evaluation
(5) Fast evaluation of inhibitor, water quality stabilizer, coating, and cathodic protection efficiency.

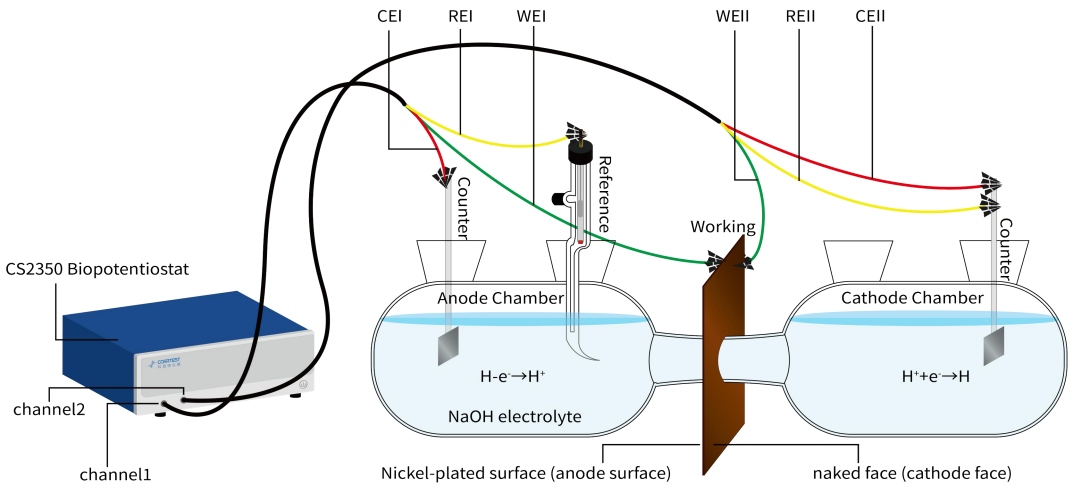
Rotating Ring-Disk Electrode (RRDE)

Oxidation/reduction reaction (ORR) study: while measuring the polarization curve of disk electrode in the main channel, apply a constant polarization potential on the ring electrode, and thus detect the intermediate products on the disk electrode. RRDE test becomes the typical method for ORR study. CS2350M can be connected to any RRDE equipment.



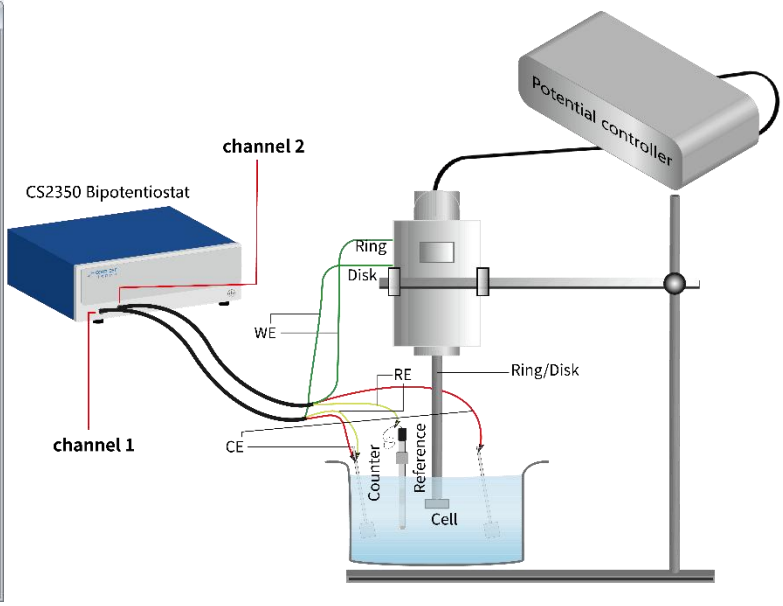
Hydrogen Diffusion Test (HDT)

CS2350M bipotentiostat is combined with H-cells. By measuring current of cathode hydrogen charging and hydrogen atoms anode oxidation, it can further calculate the diffusion coefficient of hydrogen atoms in metal and hydrogen flux.



Faradaic efficiency test

In electrocatalysis, the Faradaic efficiency is measured to evaluate the performance of the catalyst. The cable connection is shown in below picture. A constant current will be applied on the disk and occur OER and produce oxygen. A constant voltage is applied on the ring and it occurs ORR and consume oxygen. The Faradaic efficiency can be calculated based on disk current and ring current.



Specifications

Specifications	
Support 2-, 3- or 4-electrode system	Interface: Ethernet
Potential control range: Primary Channel: ±10V second Channel: ±10V	Current control range: ±1A in each channel
Potential control accuracy: 0.1%×full range±1mV	Current control accuracy: 0.1%×full range
Potential resolution: 10μV (>100Hz), 3μV (<10Hz)	Current sensitivity:1pA
Rise time: <1μS (<10mA), <10μS (<2A)	Reference electrode input impedance:1012Ω||20pF
Current range: 2nA~2A, 10 ranges	Compliance voltage: ±21V

Maximum current output: ±1A in each channel	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:1μs	Minimum potential increment in CV: 0.075mV
IMP frequency: 10μHz~1MHz	Low-pass filters: Covering 8-decade
Potential and current range: Automatic	Weight / Measurements: 6.5kg,36 x 30 x16cm
Operating System: Windows 7/8/10/11	
Electrochemical Impedance Spectroscopy (EIS)	
Signal generator	
Frequency range:10μHz~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 10^5s
Measurement delay:0~10^5s	
DC offset compensation	
Potential automatic compensation range: -10V~+10V	Current compensation range: -1A~+1A
Bandwidth: 8-decade frequency range, automatic and manual setting	

Techniques

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)
- 2nd harmonic AC Voltammetry (SHACV)
- Fourier Transform AC Voltammetry (FTACV)

Electrochemical Impedance Spectroscopy (EIS)

- EIS vs Frequency (Nyquist, Bode)
- Galvanostatic EIS
- EIS vs Potential (IMPE)(Mott-Schottky)
- EIS vs Time (IMPT)
- Galvanostatic EIS vs Time

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
- Potentiostatic Intermittent Titration Technique
- Galvanostatic Intermittent Titration Technique

Bipotentiostat

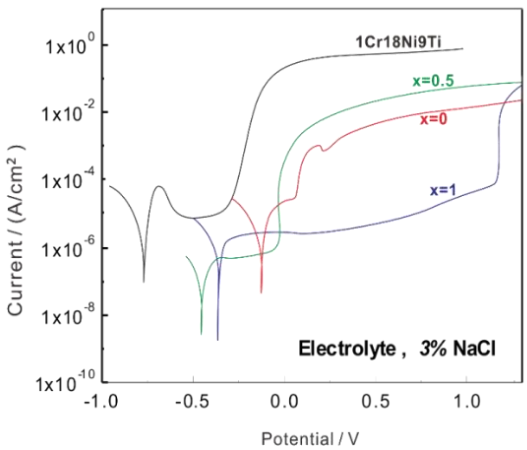
- Hydrogen Diffusion Test (HDT)
- Rotating Ring Disk Electrode(RRDE)
- Faradaic efficiencyTest(FE)

Amperometric

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

Stripping Voltammetry

- Potentiostatic Stripping
- Linear Stripping
- Staircase Stripping
- Square Wave Stripping
- Differential Pulse Voltammetry Stripping
- Normal Pulse Voltammetry Stripping
- Differential Normal Pulse Voltammetry Stripping



Technical advantages

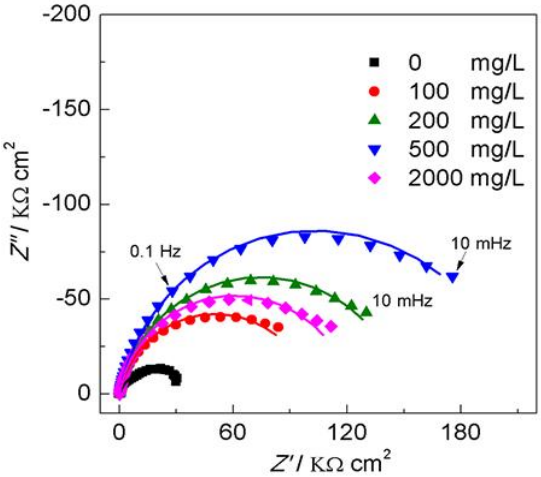
1. Impedance (EIS)

CS2350M bipotentiostat applies correlation integral algorithm and dual-channel over-sampling technique, and has strong anti-interference ability. It is suitable for EIS measurements of high-impedance system (>$10^9\Omega$, such as coating, concrete etc.).

EIS of AA6063 Al alloy in Ce^{3+} containing 3% NaCl solution

2. Polarization curve

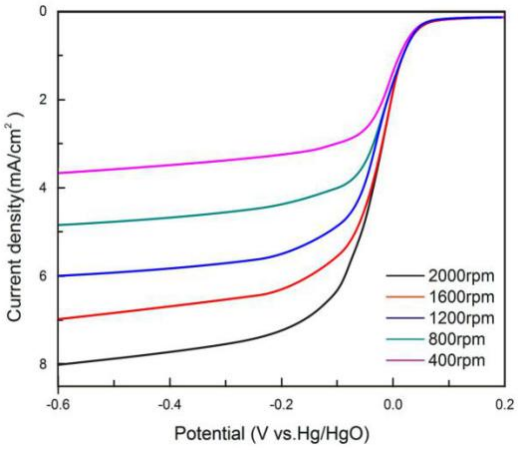
Tafel plot can be obtained. The user can set the anodic reversal current (passivation film breakdown current) of the cyclic polarization curve to obtain material's pitting potential and protection potential and evaluate the its susceptibility to intergranular corrosion. The software uses non-linear fitting to analyze polarization curve, and can make fast evaluation of material's anti-corrosion ability and inhibitors.



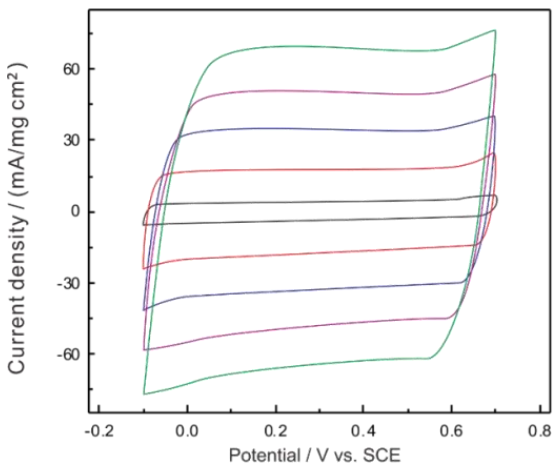
Polarization curve of Ti-based amorphous alloy & stainless steel in 3%NaCl solution

3. Voltammetry

Linear Sweep Voltammetry (LSV), Cyclic Voltammetry (CV), SCV, SWV, DPV, NPV, ACV, Stripping voltammetry etc. It integrates calculation of peak area, peak current and standard curve analysis.



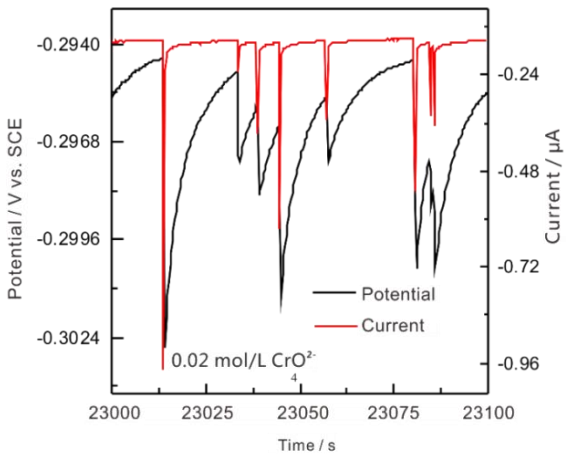
LSV: mesoporous carbon material in 0.1M KOH



CV of PPy supercapacitor in 0.5 mol/L H_2SO_4

4. Electrochemical Noise

With high-resistance follower and zero-resistance ammeter, it measures the natural potential/current fluctuations in corrosion system. It can be used to study pitting corrosion, galvanic corrosion, crevice corrosion, and stress corrosion cracking etc. Based on calculation of noise resistance and pitting index, it can complete localized corrosion monitoring.



5. Full floating measurement

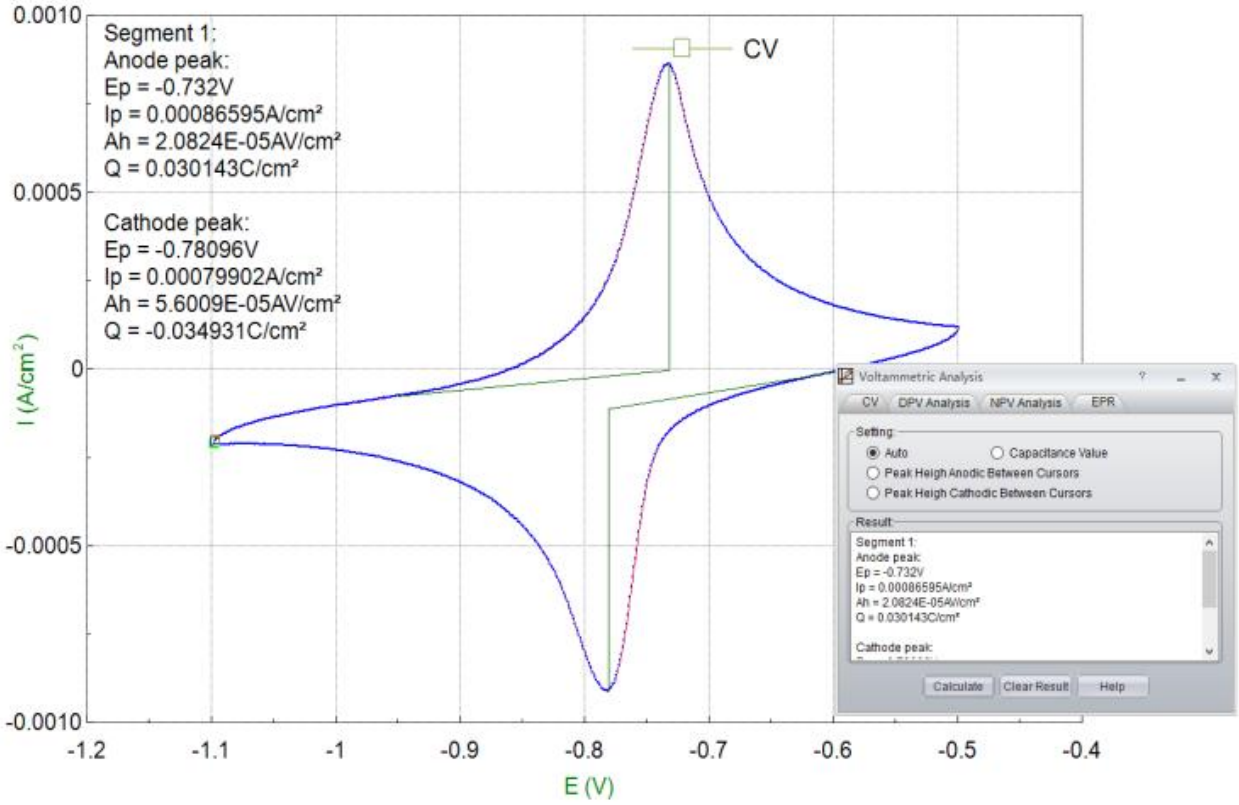
Full-floating mode be used for autoclave electrochemical measurements, on-line corrosion monitoring of metallic components under the ground (rebar in concrete, etc.)

6. Software development kit (SDK)

We are able to provide API functions and development examples, which facilitates some users' requirements for secondary development and self-defined measurements. We can provide .dll file.

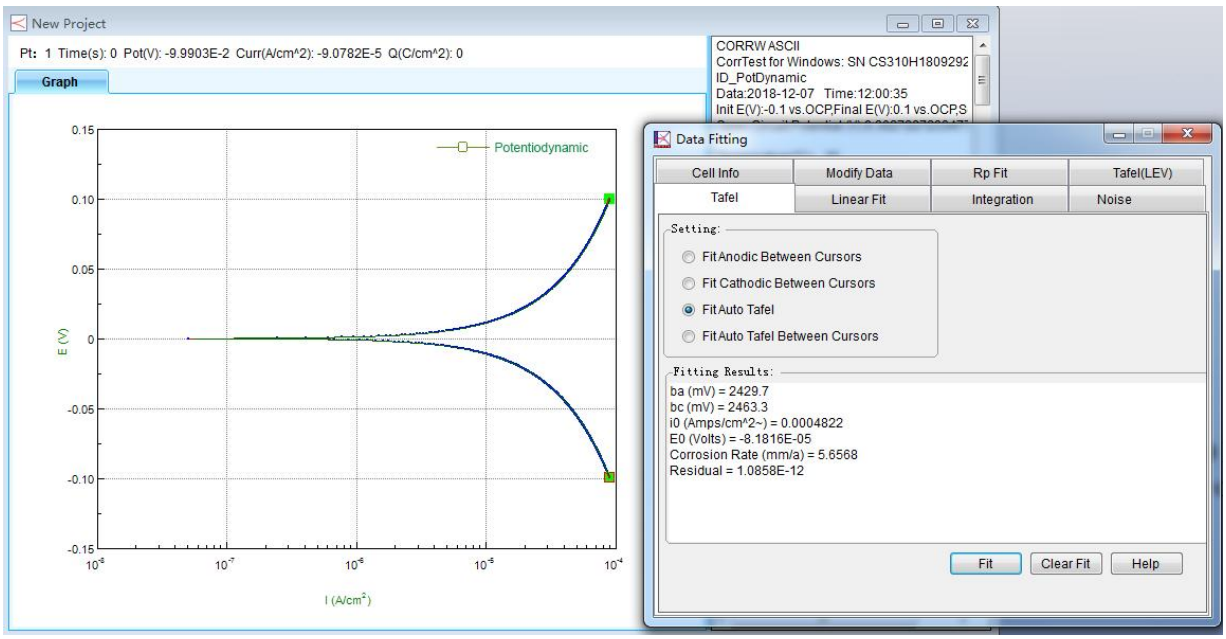
Software Features

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. During the data analysis, there is function of selecting exact cycle(s) to show. You can choose to see a cycle or some cycles as you want. You can also export data or vector graph of an exact cycle or several cycles.



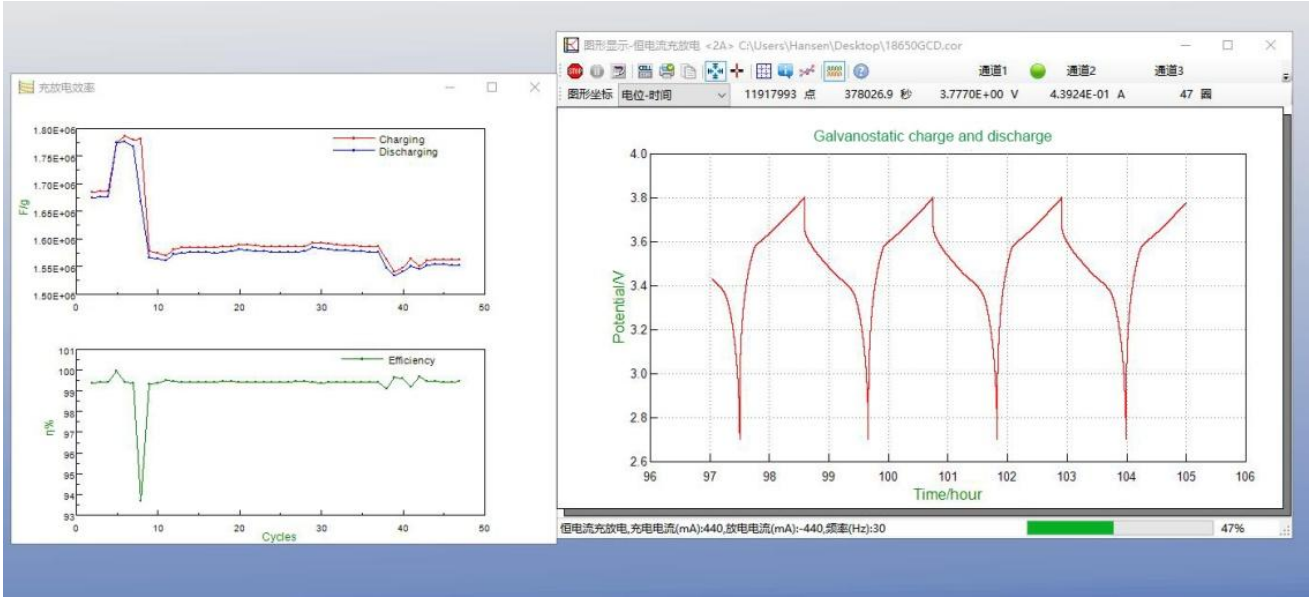
Tafel plot and corrosion rate:

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 electrochemical noise measurements.



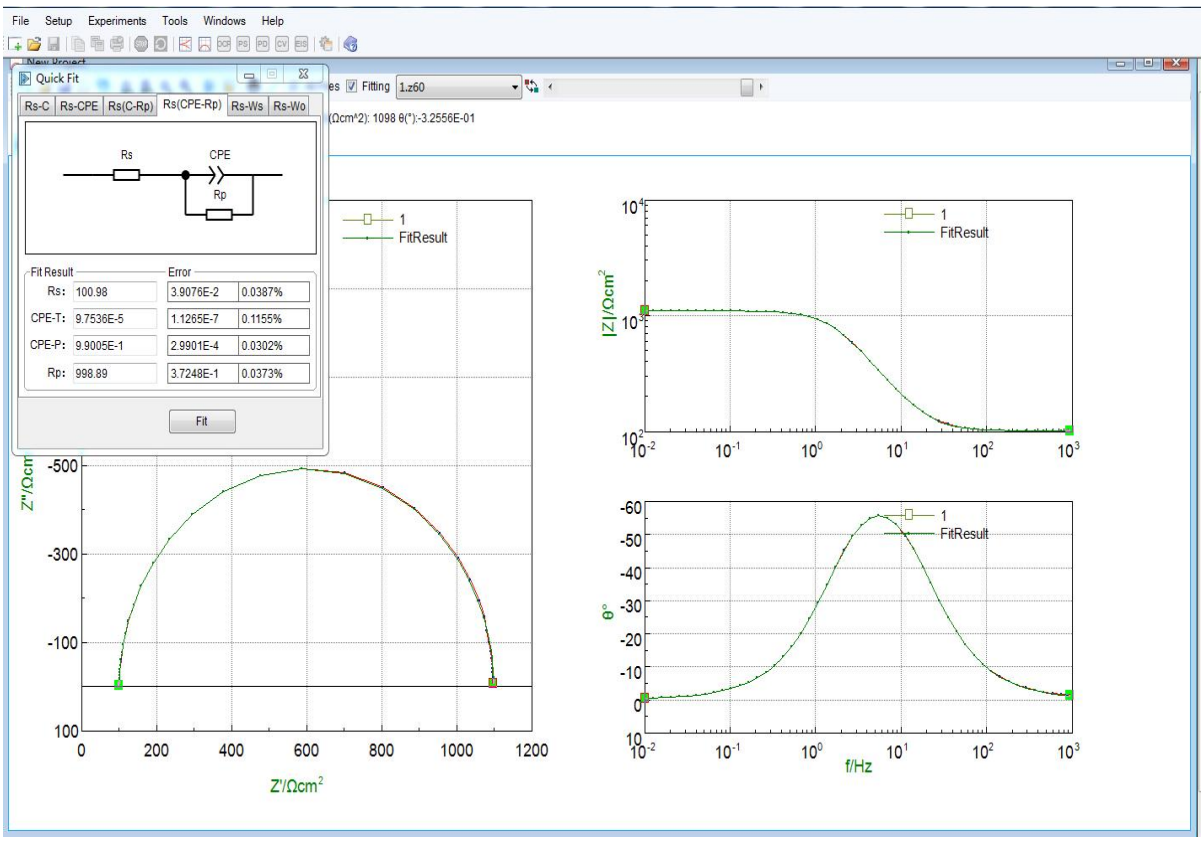
Battery Test and analysis:

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



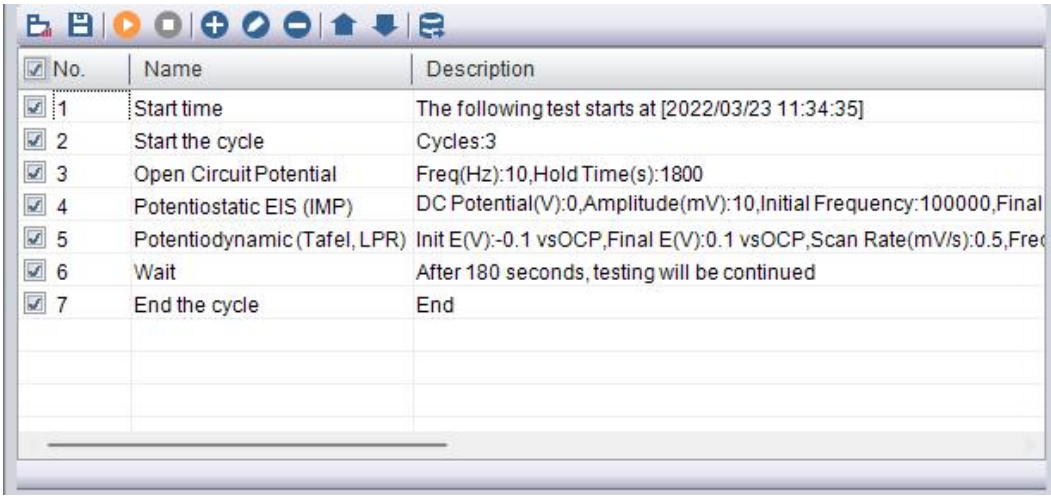
EIS analysis: Bode, Nyquist, Mott-Schottky plot

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



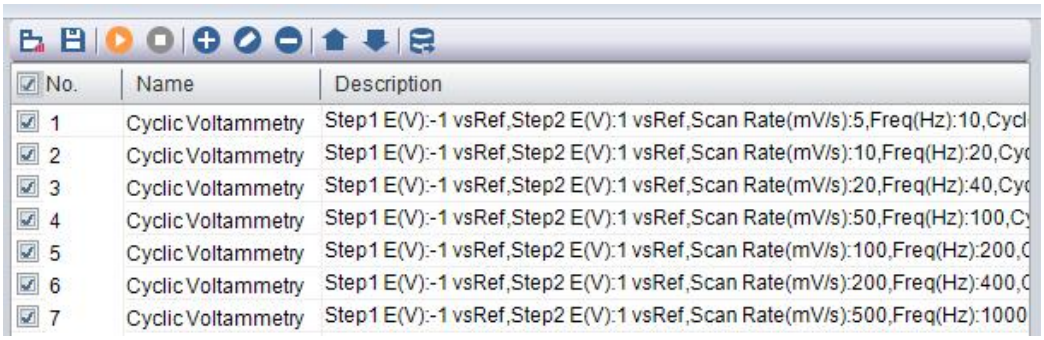
Real time saving of data: The data can be automatically saved even in case of sudden power off.

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 Voltammetry	Step1 E(V):-1 vsRef,Step2 E(V):1 vsRef,Scan Rate(mV/s):5,Freq(Hz):10,Cycl
2	Cyclic Voltammetry	Step1 E(V):-1 vsRef,Step2 E(V):1 vsRef,Scan Rate(mV/s):10,Freq(Hz):20,Cyc
3	Cyclic Voltammetry	Step1 E(V):-1 vsRef,Step2 E(V):1 vsRef,Scan Rate(mV/s):20,Freq(Hz):40,Cyc
4	Cyclic Voltammetry	Step1 E(V):-1 vsRef,Step2 E(V):1 vsRef,Scan Rate(mV/s):50,Freq(Hz):100,Cy
5	Cyclic Voltammetry	Step1 E(V):-1 vsRef,Step2 E(V):1 vsRef,Scan Rate(mV/s):100,Freq(Hz):200,C
6	Cyclic Voltammetry	Step1 E(V):-1 vsRef,Step2 E(V):1 vsRef,Scan Rate(mV/s):200,Freq(Hz):400,C
7	Cyclic Voltammetry	Step1 E(V):-1 vsRef,Step2 E(V):1 vsRef,Scan Rate(mV/s):500,Freq(Hz):1000

Combination Test: Pseudocapacitor tests

EIS BiPotentiostat / BiGalvanostat (2-channel) model CS2350M

Standard supply Include:

Instrument **CS2350M** x1

CS studio software x1Power cable x1,

Ethernet cable x1,

Electrode cable x 4

Dummy cell (1kΩ||100μF) x2

After-sales Service (All the after service is FREE)**

1. Warranty period: 5 years.
2. Provide installation guide, manual, software installation video, and training videos.
3. Lifetime free software upgrading of the same model and technical service.
4. **Free** repair service

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