

CS1350 High current potentiostat /galvanostat

Model CS1350 is the high current potentiostat. The maximum current output can be up to 5A, and potential control range is $\pm 10V$. It is an ideal tool for the people whose testing system requires high current. It contains a fast digital function generator, high-speed data acquisition circuitry, a potentiostat and a galvanostat. With high performance in stability and accuracy with advanced hardware and well-functioned software, it is a comprehensive research platform for corrosion, batteries, electrochemical analysis, sensor, life science and environmental chemistry etc.



Specifications

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Potential control range: $\pm 10V$	Current control range: $\pm 5A$
Potential control accuracy: $0.1\% \times \text{full range} \pm 1mV$	Current control accuracy: $0.1\% \times \text{full range}$
Potential resolution: $10\mu V$	Current sensitivity: $10pA$
Potential rise time: $< 1\mu S (< 10mA)$, $< 10\mu S (< 5A)$	Current range: $5A \sim 200pA$, 12 ranges
Reference electrode input impedance: $10^{12}\Omega 20pF$	Maximum current output: $5.0A$
Compliance voltage: $\pm 13V$	Current increment during scan: $1mA @ 1A/mS$
CV and LSV scan rate: $0.001mV \sim 10V/s$	Potential increment during scan: $0.076mV @ 1V/mS$
CA and CC pulse width: $0.0001 \sim 65000s$	DPV and NPV pulse width: $0.0001 \sim 1000s$
SWV frequency: $0.001 \sim 100KHz$	Minimum potential increment in CV: $0.075mV$
AD data acquisition: $16bit @ 1MHz$, $20bit @ 1kHz$	Potential and current range: automatic
DA resolution: 16bit, setup time: $1\mu s$	Low-pass filters: covering 8-decade
Communication Interface: USB	Instrument weight: $8Kg$
Size: $36 \times 38 \times 14 \text{ cm}$	
EIS (Electrochemical Impedance Spectroscopy)	
Signal generator	
Frequency range: $10\mu Hz \sim 1MHz$	AC amplitude: $1mV \sim 2500mV$

Frequency accuracy: 0.005%	DC Bias: -10V~+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 compensation	
Potential compensation range: -10V~+10V	Current compensation range: -1A~+1A
Bandwidth: 8-decade frequency range, automatic and manual setting	

Applications

- (1) Electrosynthesis, electrodeposition (electroplating), anodic oxidation, etc
- (2) Electrochemical analysis
- (3) New energy materials (Li-ion battery, solar cell, fuel cell, supercapacitors), advanced functional materials, and sensor
- (4) Corrosion study
- (5) Evaluation of corrosion inhibitor, water stabilizer, coating and cathodic protection efficiency.

Techniques - model CS1350

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)

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

Electrochemical Impedance Spectroscopy (EIS)

- EIS vs Frequency (IMP)
- EIS vs Time (IMPT)
- EIS vs Potential (IMPE)(Mott-Schottky)

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)

Extensions

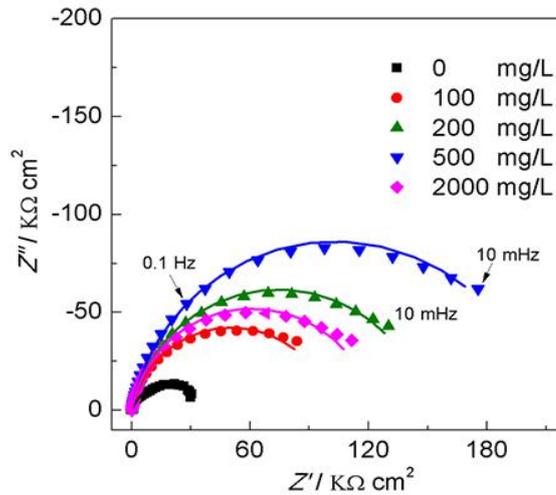
- Data Logger
- Electrochemical Stripping/ Deposition
- Bulk Electrolysis with Coulometry (BE)
- Rs measurement

Technical advantages

1. Impedance (EIS)

CS1350 potentiostat applies correlation integral algorithm and dual-channel over-sampling

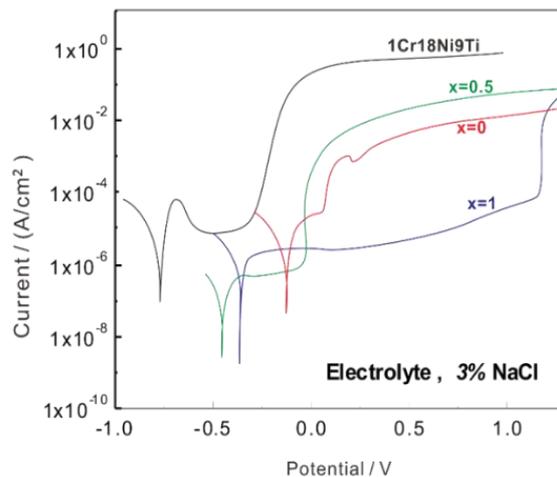
technique, and has strong anti-interference ability. It is suitable for EIS measurements of high-impedance system ($>10^9\Omega$, such as coating, concrete etc.).



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

2. Polarization curve

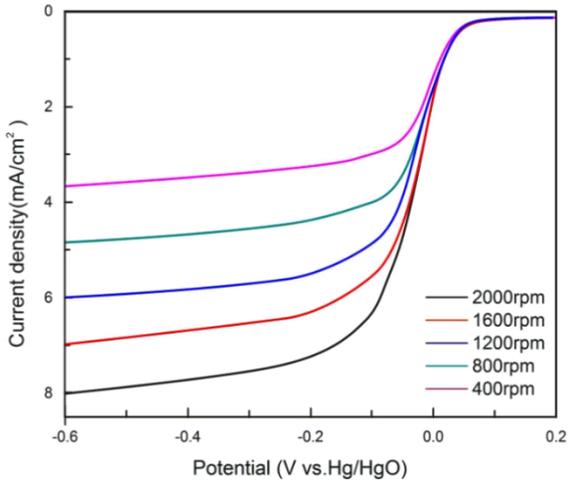
Tafel plot can be obtained. The user can set the anodic reversal current (passivation film breakdown current) of the cyclic polarization curve to obtain material's pitting potential and protection potential and evaluate the its susceptibility to intergranular corrosion. The software uses non-linear fitting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



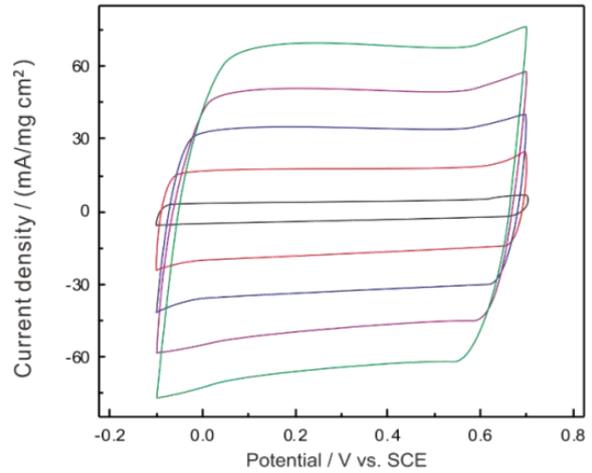
Polarization curve of Ti-based amorphous alloy & stainless steel in 3% NaCl solution

3. Voltammetry

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



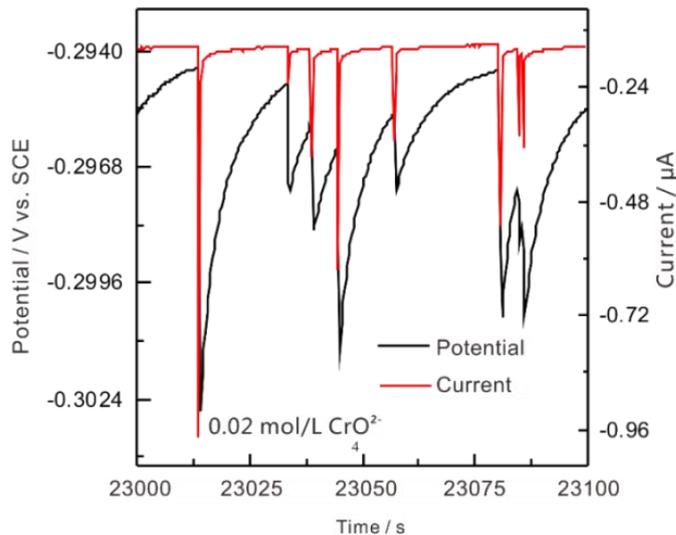
LSV: mesoporous carbon material in 0.1M KOH



CV of PPy supercapacitor in 0.5 mol/L H₂SO₄

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

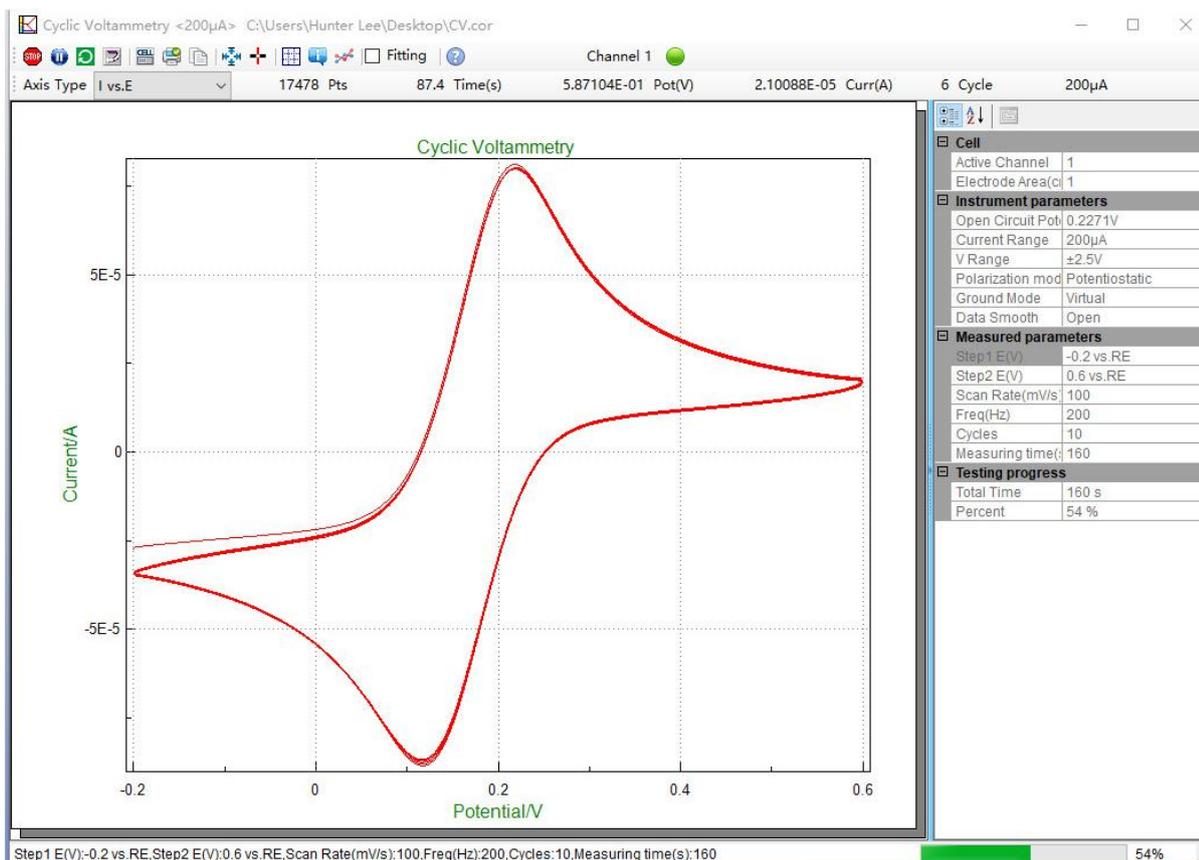
Full-floating mode be used for autoclave electrochemical measurements, on-line corrosion monitoring of metallic components under the ground (rebar in concrete, etc.)

6. Software development kit (SDK)

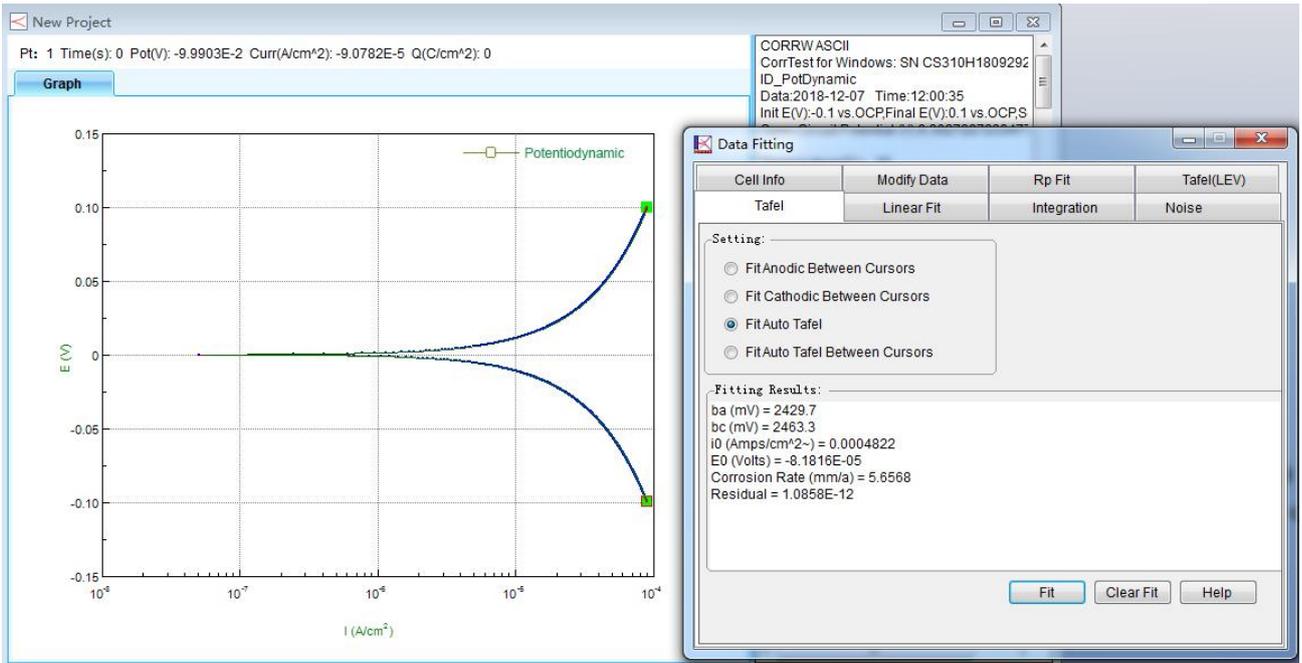
We are able to provide API functions and development examples. We can supply .dll file so that the customer can do the software second development in Labview or Visual Basic .NET.

Software Features

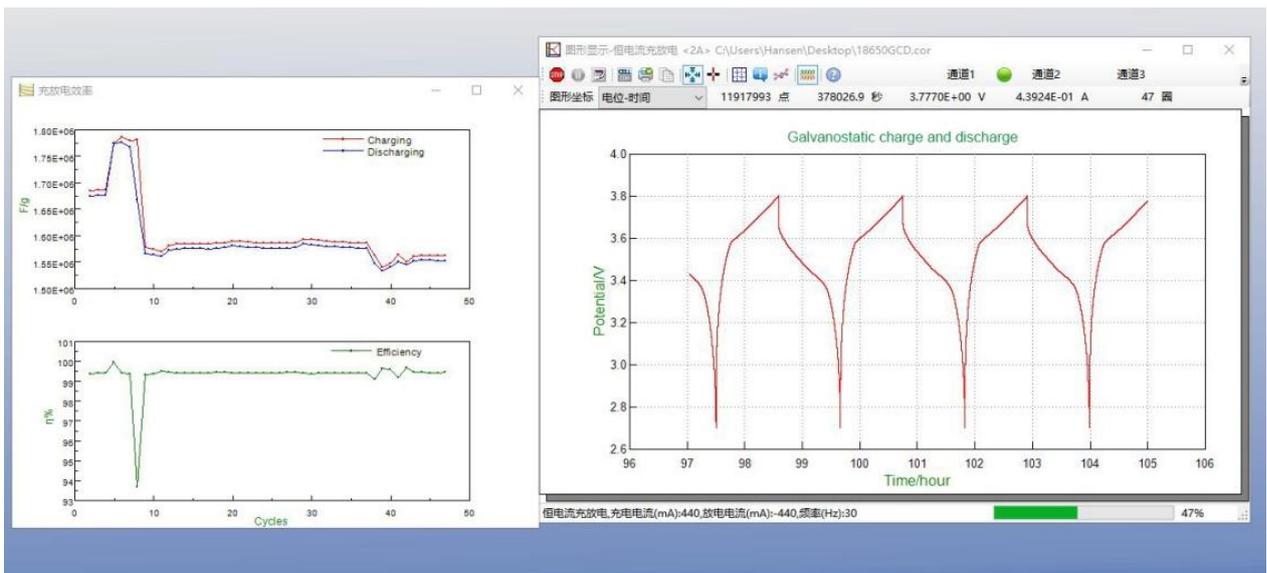
Cyclic voltammetry: CS studio software provides users a versatile smoothing/differential/integration kit, which can complete the calculation of peak height, peak area and peak potential of CV curves. In CV technique, during the data analysis, there is function of selecting exact cycle(s) to show. You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

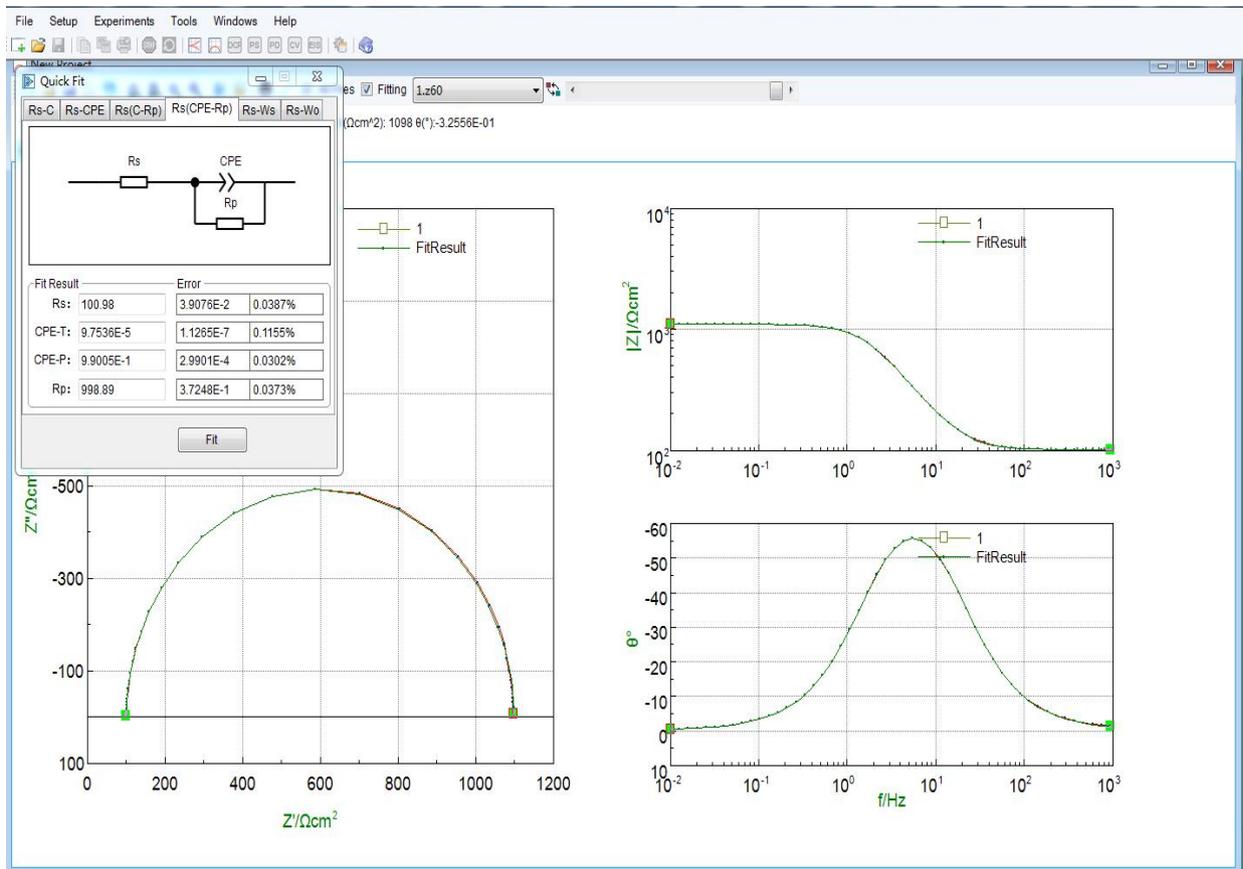


Battery test and analysis: charge & discharge efficiency, capacity, specific capacitance, charge & discharge energy.



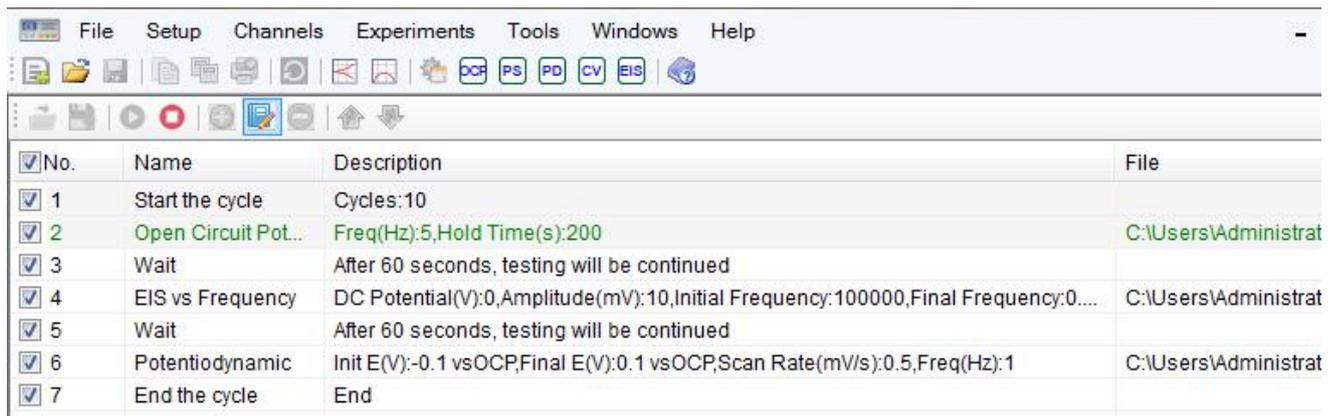
EIS analysis: Bode, Nyquist, Mott-Schottky plot

During EIS data analysis, there is built-in fitting function to draw the custom equivalent circuit. Firstly, draw the equivalent circuit, use the "Quick Fit" to obtain the parameters' value, and then substitute the value into the equivalent circuit.



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

Combined measurements: It facilitates the automation of experiments and save time. You can choose several techniques, and set the wait time, the start time, and the cycles. Choose the experiments you want to run, then you can make auto measurement of the set experiments as you want without having to wait in the lab.



No.	Name	Description	File
1	Start the cycle	Cycles:10	
2	Open Circuit Pot...	Freq(Hz):5, Hold Time(s):200	C:\Users\Administrat
3	Wait	After 60 seconds, testing will be continued	
4	EIS vs Frequency	DC Potential(V):0, Amplitude(mV):10, Initial Frequency:100000, Final Frequency:0....	C:\Users\Administrat
5	Wait	After 60 seconds, testing will be continued	
6	Potentiodynamic	Init E(V):-0.1 vs OCP, Final E(V):0.1 vs OCP, Scan Rate(mV/s):0.5, Freq(Hz):1	C:\Users\Administrat
7	End the cycle	End	

Data open: You can open the data files by txt format in notepad. Data can also be opened in Origin