EIS potentiostat/galvanostat/electrochemical workstation Model CS350 is the most advanced and comprehensive model among single channel models. It contains a fast digital function generator, high-speed data acquisition circuitry, a potentiostat and a galvanostat. It has more than 40 electrochemical methods including built-in EIS (frequency range 10μHz~1MHz). Max. current is ±2A, potential range is ±10V. It can be used for high current systems such as corrosion, the hot CO_2 reduction, and low current measurements as well. It supports 2-,3-,4-electrode system, and can run under floating or grounded mode.

Application

● Reaction mechanism of Electrosynthesis, electrodeposition, anodic oxidation, etc.

● Electrochemical analysis and sensor;

● New energy materials (Li-ion battery, solar cell, fuel cell, supercapacitors), advanced functional materials, photoelectronic materials;

● Corrosion study of metals in water, concrete and soil, etc;

● Fast evaluation of corrosion inhibitor, water stabilizer, coating and cathodic protection efficiency.

Hardware

Dual-channel high-speed 16bit/high-accuracy 24bit AD converter;

Built-in frequency response analyzer(FRA), frequency range: 10μHz~1MHz;

Built-in FPGA DDS digital signals synthesizer

High-power Potentiostat/Galvanostat/ZRA;

Potential control range:±10V; Compliance voltage:±21V;

Current control range:±2A ;

Potential resolution: 10μV; current resolution 1pA.

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%×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:$10^{12}\Omega$‖20pF
Current range: 2nA~2A, 10 ranges	Compliance voltage: ±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:1µs	Minimum potential increment in CV: 0.075mV
IMP frequency: 10µHz~1MHz	Low-pass filters: covering 8-decade
Operating System: Windows 2000/NT/XP/ 7/8/10	Interface: USB 2.0
Weight / Measurements: 6.5kg, 36.5 x 30.5 x16 cm	
EIS (Electrochemical Impedance Spectroscopy)	
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 - CS350

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)
- 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 Eletrolysis with Coulometry (BE)
- Rs measurement

Technical advantages

1. Impedance (EIS)

CS350potentiostat 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
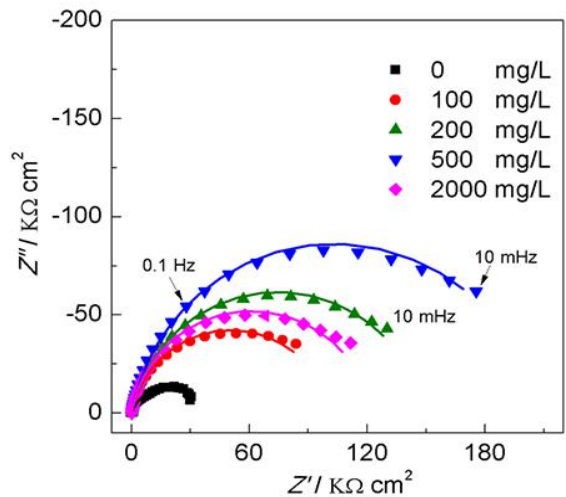
2. Polarization curve

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
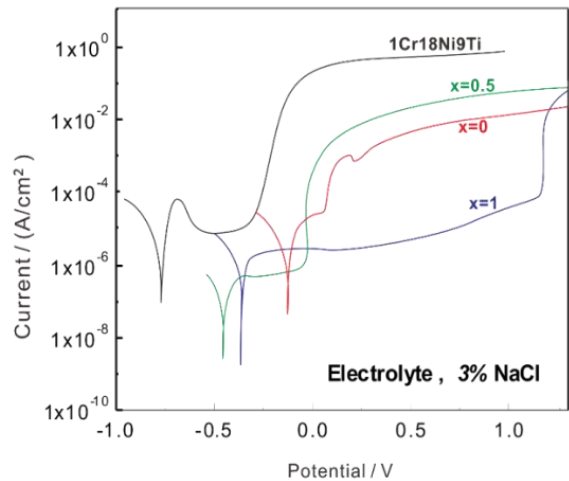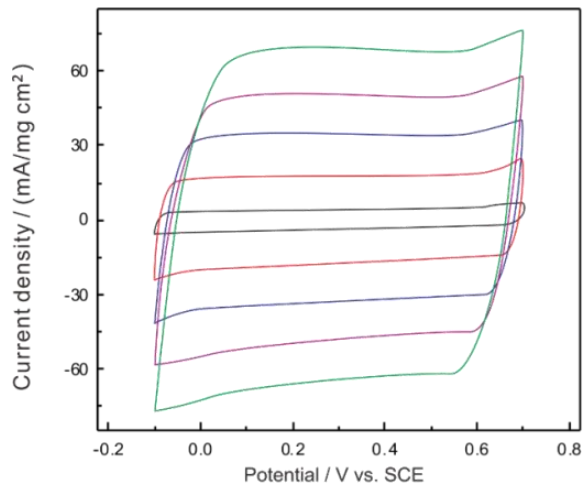
3. Voltammetry

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.
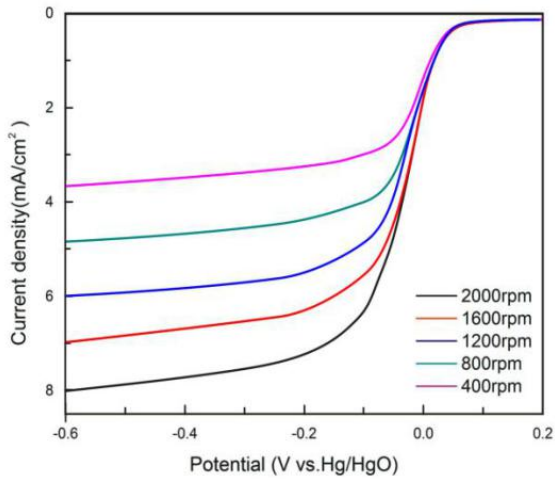
LSV: mesoporous carbon material in 0.1M KOH

CV of PPy supercapacitor in 0.5 mol/L H_2SO_4

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.
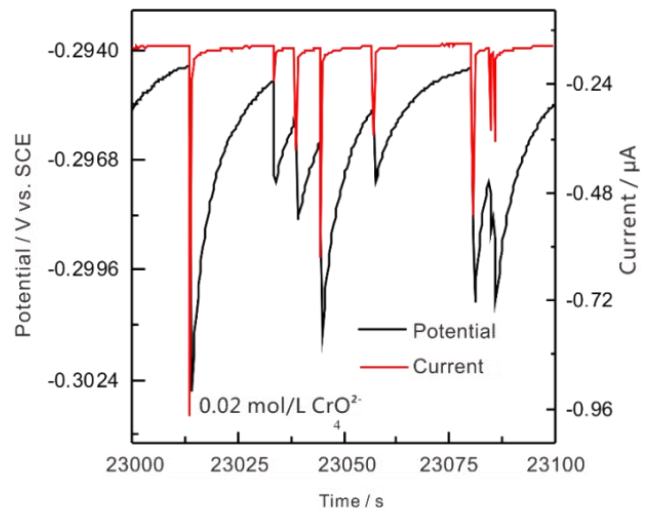
4. Full floating measurement

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

5. 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. 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.
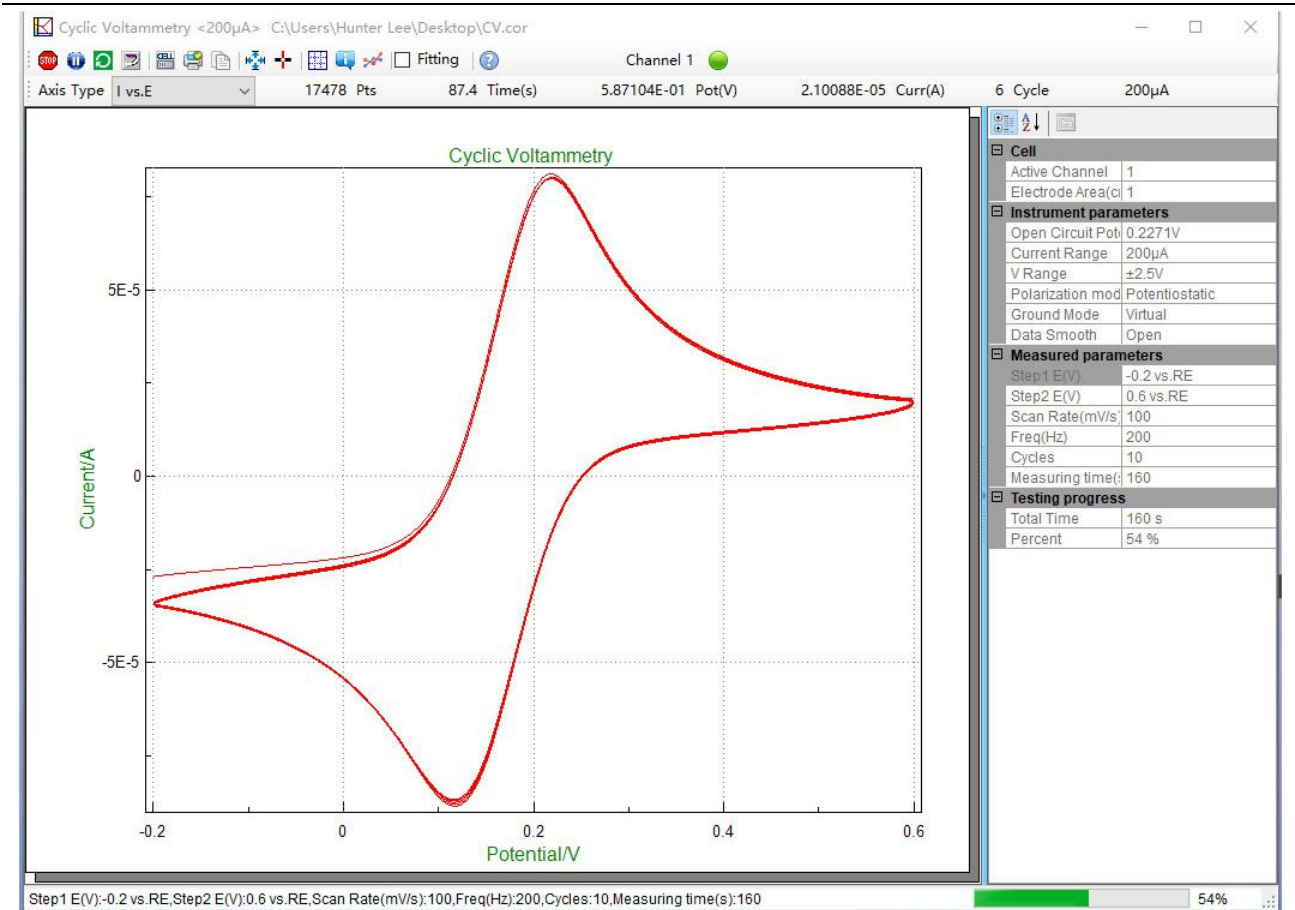
Tafel plot and corrosion rate:

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.
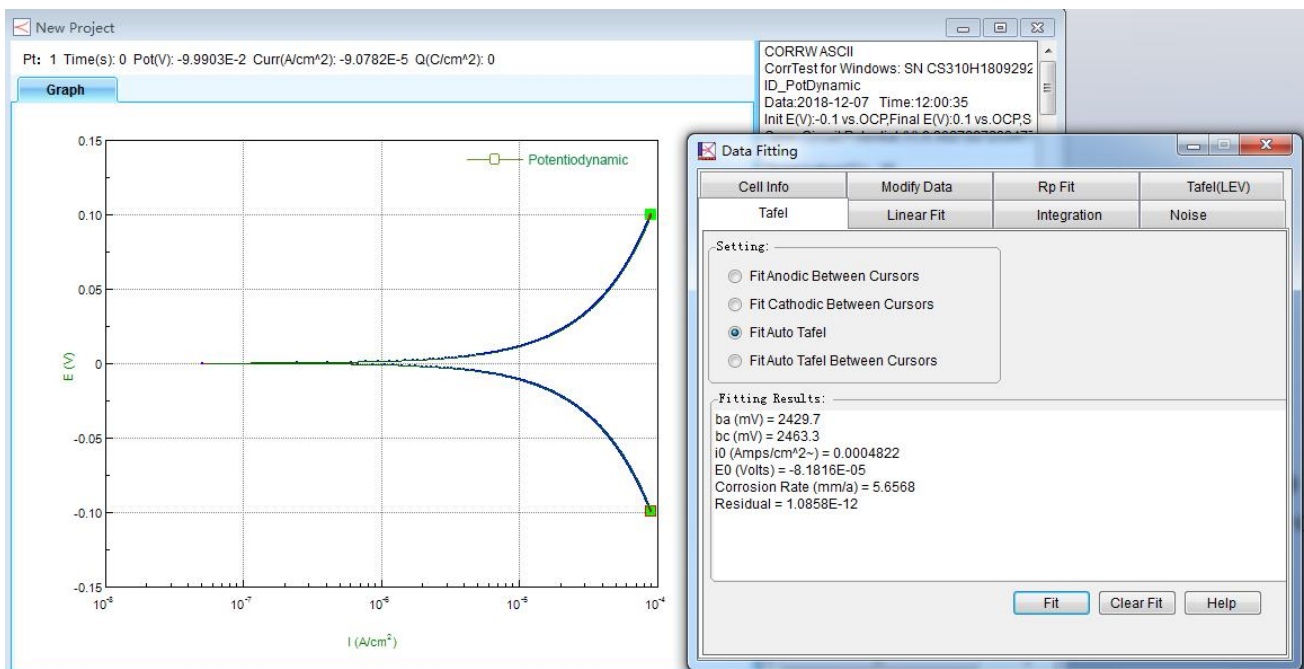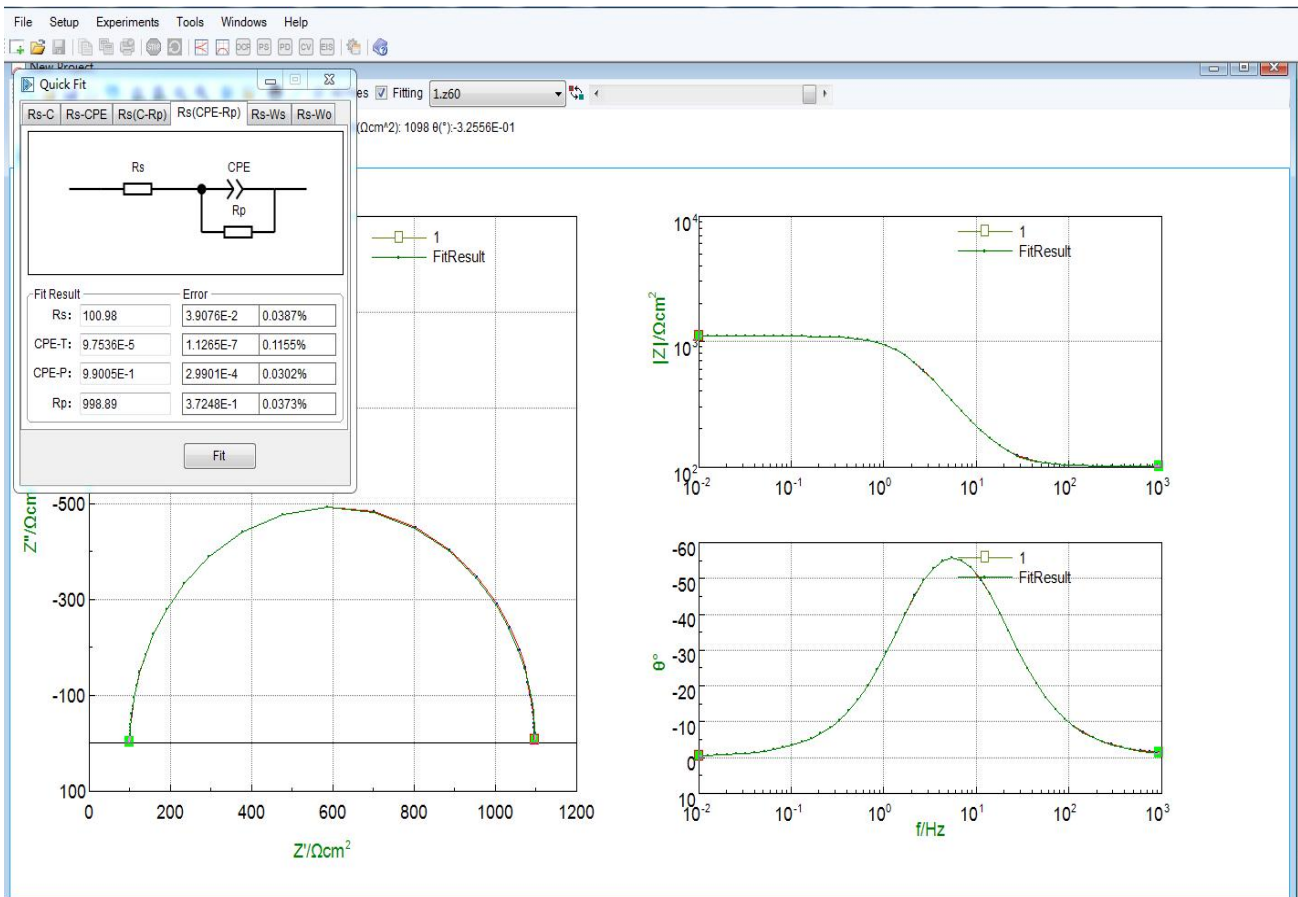

Battery Test and analysis:

charge & discharge efficiency, capacity, specific capacitance, charge & discharge energy.
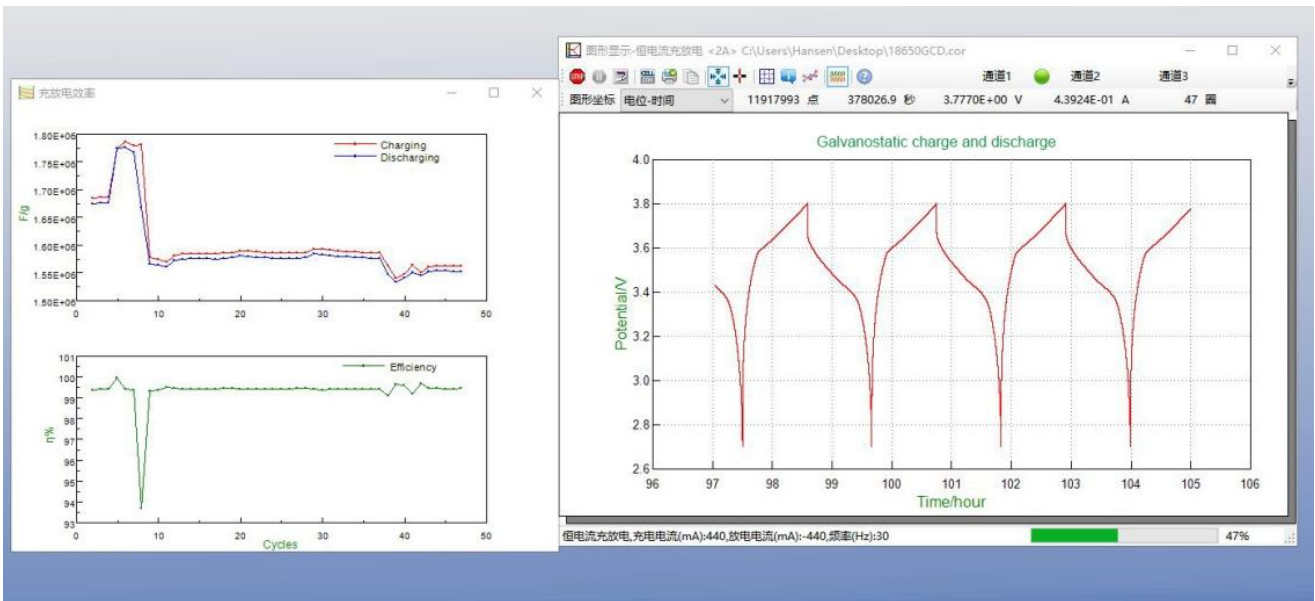
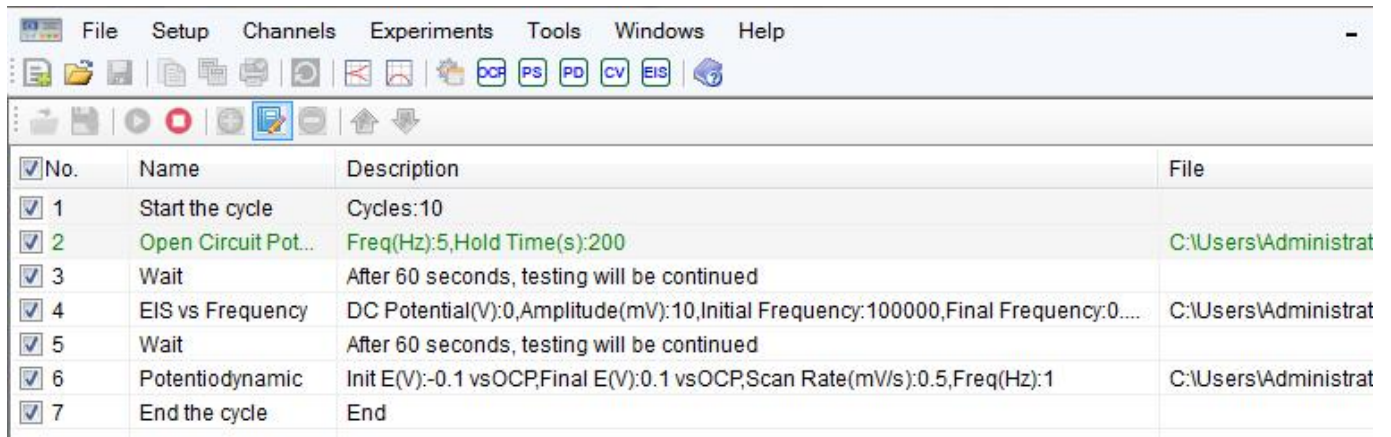**EIS analysis:** Bode, Nyquist, Mott-Schottky plot

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: it can facilitate the automation of experiments and save time. With the unique function of combination test, 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. This function is especially useful if you have multi experiments to run and save your time greatly.

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 vsOCP,Final E(V):0.1 vsOCP,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

Standard supply list –Model CS350

Instrument host CS350 x1

CS studio software x1

Power cable x1,

USB cable x1,

Cell cable x2

Dummy cell x1,

Manual x1

After-sales Service:

1. Warranty period: **5 years**. During this period, all service incl. repair is **TOTALLY FREE**.

2. Provide installation guidance and manual, software installation video.

3. Lifetime free software upgrading of the same model and technical service