Single-channel potentiostat/galvanostat with EIS Model CS1350pro 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. With 40+ electrochemical techniques, CS1350pro has been widely applied in corrosion, energy, material and analysis electrochemistry.

CS1350 pro is an upgraded version of the conventional single-channel electrochemical workstation CS350M with outstanding stability and accuracy, advanced hardware, and fully functional software. Maximum current can be as high as ±5A (without any booster).

Applications

-Energy materials (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, water splitting).

Specifications	
Support 2-, 3- or 4-electrode system	
Maximum current : ±5A	Potential control range: ±10V
Current control accuracy: 0.1%×full range	Potential control accuracy: 0.1%×full range±1mV
Current sensitivity:1pA	Potential resolution: 1μV
Rise time: <1μs (<10mA), <10μs (<2A)	Reference electrode input impedance:$10^{13}\Omega$||5pF
Current range: 2nA~5A, 10 ranges	Potential ranges: ±200mV, ±2V, ±5V, ±10V, 4 ranges
Compliance voltage:± 18V	CV and LSV scan rate: 0.001mV~10kV/s
CA and CC pulse width: 0.0001~65,000s	Current increment during scan: 1mA@1A/ms
Potential increment during scan: 0.02mV @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:20 bit	Minimum potential increment in CV: 0.02 mV
Current / potential range: Auto / Manual	Low-pass filters: covering 7-decade
Ground mode: Floating / Earthing, support ZRA	Interface: Ethernet & USB
Operating System: Windows 10/11	Power supply: 90~240V AC, 50/60Hz
Weight / Measurements: 6.5kg, 36 x 30 x16 cm	
EIS (Electrochemical Impedance Spectroscopy)	
Signal generator	
Frequency range:10 μHz~1 MHz	Signal resolution:0.1mV RMS
Frequency accuracy: 0.1%	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 - CS1350pro

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

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 testing

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)

Stripping Voltammetry

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

Extensions

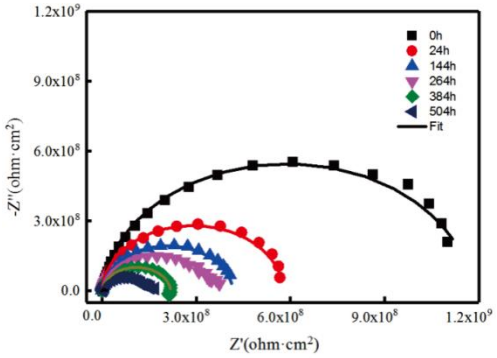
Data Logger,Electrochemical Stripping/ Deposition, Bulk Eletrolysis with Coulometry (BE), Rs Measurement

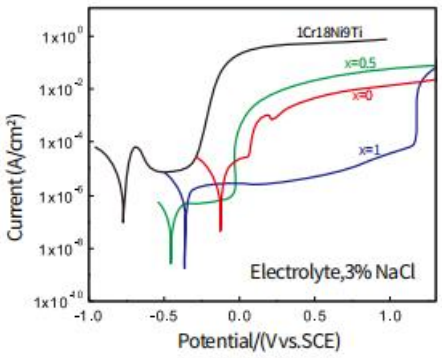
Applications

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.

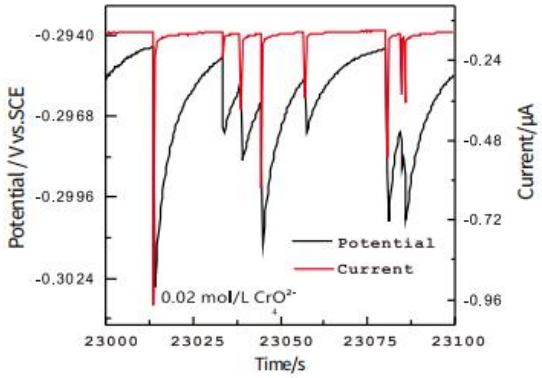
Due to their high input impedance($10^{13}\Omega$), they are especially suitable for EIS measurement of high-impedance systems like coating, concrete, and pure water.





High-impedance coating ageing test in salt spray tests

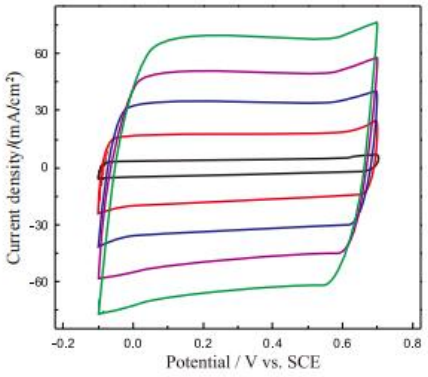
Polarization curves of Ti-alloy& stainless steel in 3%NaCl solution



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 EIS and galvanostatic EIS) with precise IR compensation, CS potentiostats are widely used in supercapacitor, Li-ion batteries, Li-S batteries, Sodium-ion batteries, Zn-ion batteries, fuel cell, solar cell, solid-state batteries, and metal-air batteries, *etc*.

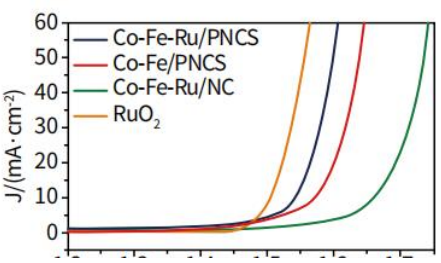


CV of PPy supercapacitor in 0.5 mol/L H_2SO_4 solution

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.

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

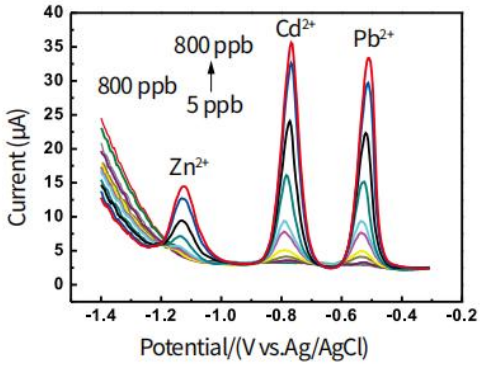


LSV curves of various catalysts in alkaline solution

energy density of Redox peaks.

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

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. This strategy is beneficial for studying electrochemical systems where the working electrodes are intrinsically ground, such as autoclaves, in-site concrete structures and multi-working electrodes requiring isolation, etc.

High-bandwidth EIS

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

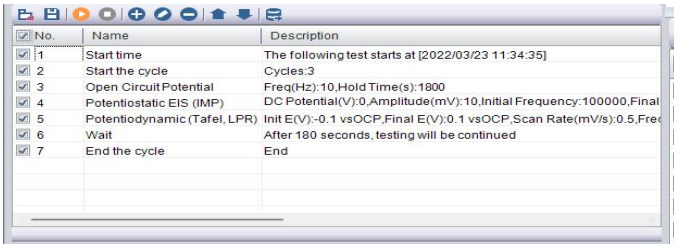
Based on the DC bias compensation technique, CS potentiostats can conduct EIS tests under charge/discharge state of batteries, making them suitable for ultra-low resistance systems, such as power batteries, fuel cells, water-splitting equipment, etc.

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.

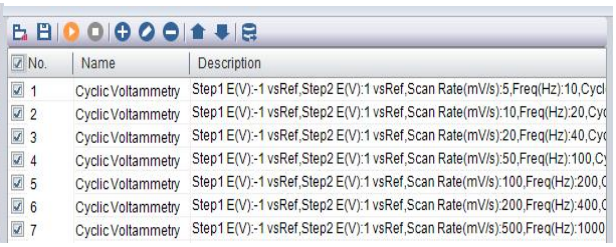
User-defined sequence test

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.



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,Fre
6	Wait	After 180 seconds, testing will be continued
7	End the cycle	End

Sequence 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,C
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

Sequence Test: Pseudocapacitor tests

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.

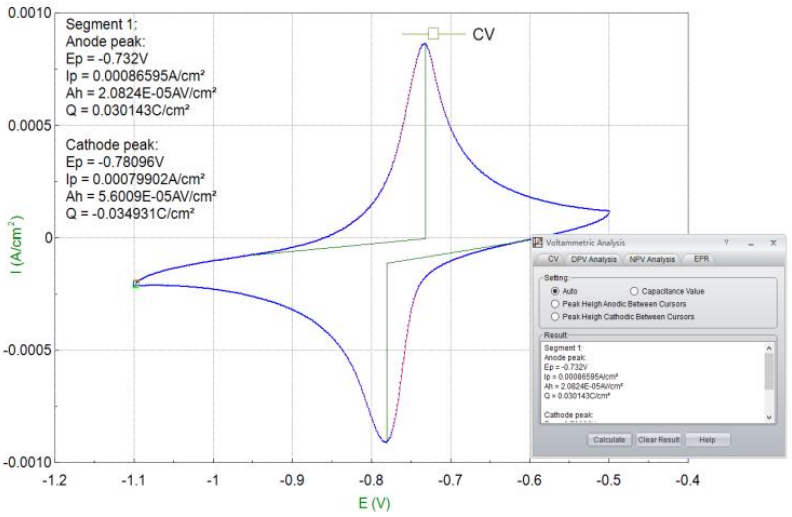
Real-time data saving

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.

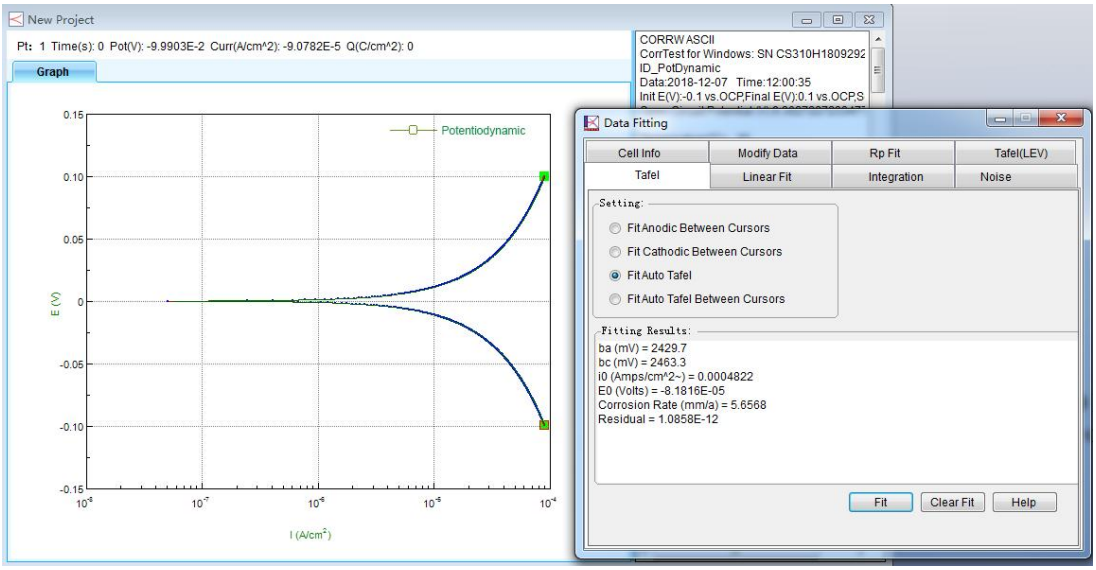
3, 4 parameter polarization curve fitting.
EIS equivalent circuit fitting
Electrochemical noise spectrum analysis
Pseudo-capacitance calculation
GCD - specific capacitance, efficiency calculation
Mott-Schottky analysis
CV curve analysis
Activation/re-passivation curve analysis



Software Features

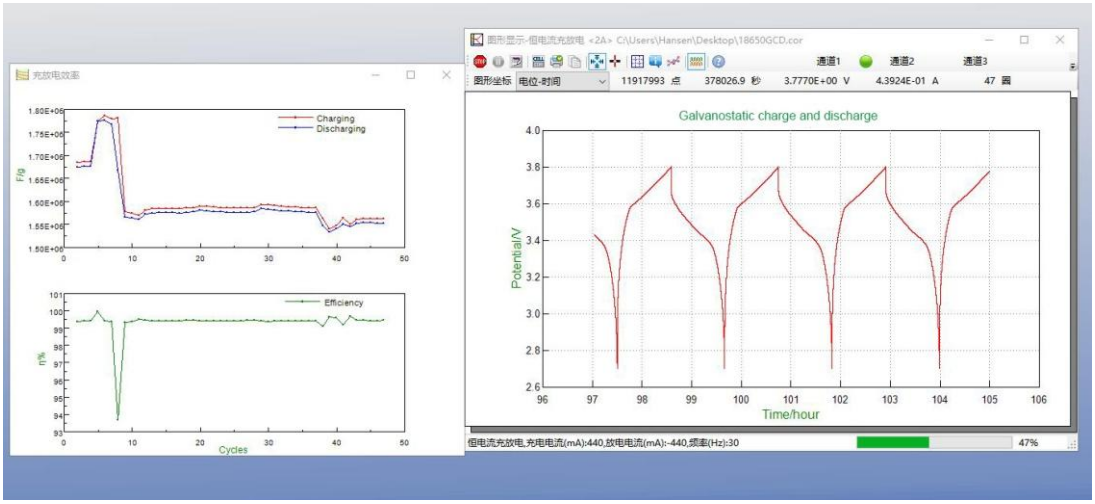
Cyclic voltammetry: CS studio software provides users a versatile smoothing/differential/ integration kit, which can complete the calculation of peak height, peak area and peak potential of CV curves. In CV technique, during the data analysis, there is function of selecting exact cycle(s) to show.

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.