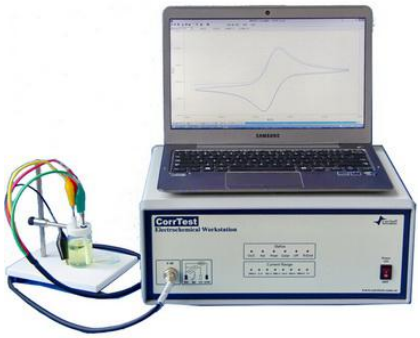
CS350 single -channel potentiostat/galvanostat

CS350 Electrochemical workstation /Potentiostat / Galvanostat 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.

Applications



(1) Reaction mechanism of Electrosynthesis, electrodeposition (electroplating), anodic oxidation, etc.
(2) Electrochemical analysis and sensor;
(3) New energy materials (Li-ion battery, solar cell, fuel cell, supercapacitors), advanced functional materials, photoelectronic materials;
(4)Corrosion study of metals in water, concrete and soil etc;
(5) Fast evaluation of corrosion inhibitor, water stabilizer, coating and cathodic protection efficiency.

HARDWARE FEATURES

Dual-channel high-speed 16bit/high-accuracy 24bit AD converter;
Built-in frequency response analyzer(FRA), frequency range: 10μHz~1MHz;
High-bandwidth high input impedance amplifier unit
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.

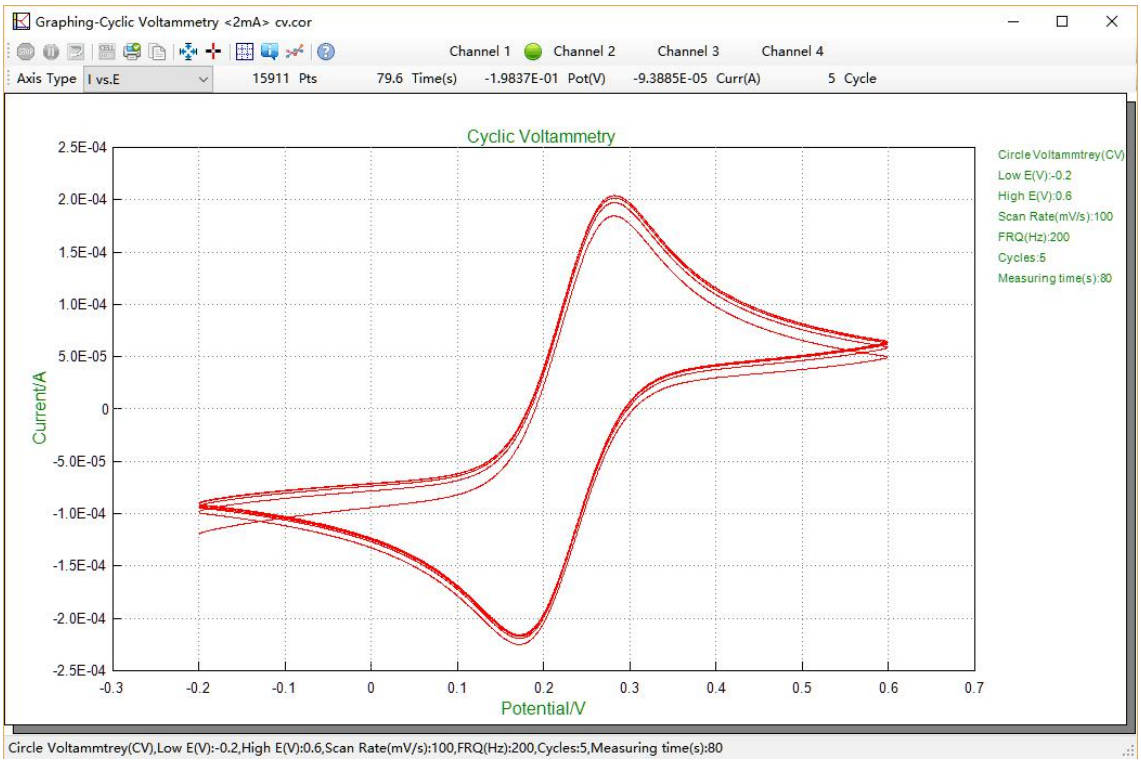
SOFTWARE FEATURES

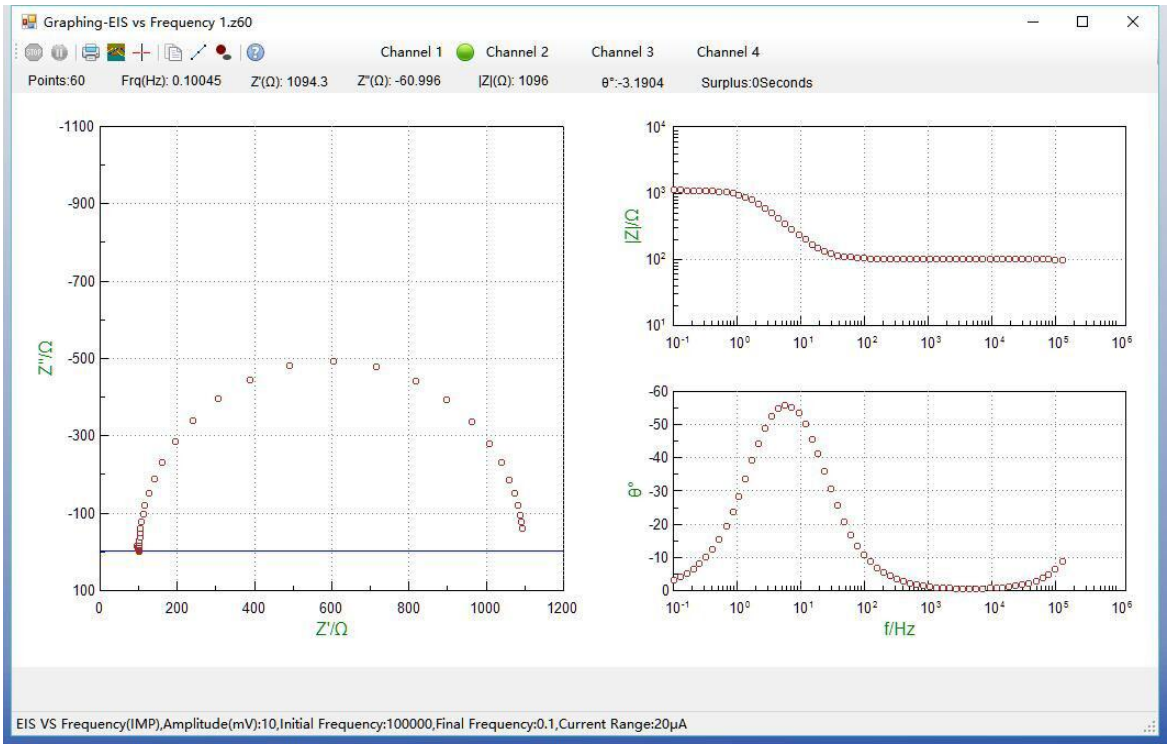
CS studio software provides users a versatile smoothing/differential/ integration kit, which can complete the calculation of peak height, peak area and peak potential of CV curves.

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.

CS Studio software can achieve real time saving of the measuring data. The data can be automatically saved even in case of sudden power off.

CS studio kit has a built-in versatile timing policy for combined measurements, which can facilitate the automation of experiments and save time.

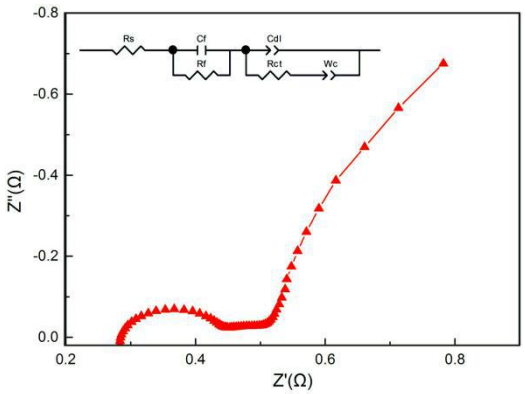

Graphing-Cyclic Voltammetry <2mA> cv.cor
Channel 1
Channel 2
Channel 3
Channel 4
Axis Type I vs.E
15911 Pts
79.6 Time(s)
-1.9837E-01 Pot(V)
-9.3885E-05 Curr(A)
5 Cycle
Cyclic Voltammetry
Current/A
Potential/V
Circle Voltammtrey(CV)
Low E(V):-0.2
High E(V):0.6
Scan Rate(mV/s):100
FRQ(Hz):200
Cycles:5
Measuring time(s):80
Circle Voltammtrey(CV),Low E(V):-0.2,High E(V):0.6,Scan Rate(mV/s):100,FRQ(Hz):200,Cycles:5,Measuring time(s):80


Graphing-EIS vs Frequency 1.z60
Channel 1
Channel 2
Channel 3
Channel 4
Points:60
Frq(Hz): 0.10045
Z'(Ω): 1094.3
Z''(Ω): -60.996
|Z|(Ω): 1096
θ°:-3.1904
Surplus:0Seconds
Z''/Ω
Z'/Ω
|Z|/Ω
θ°
f/Hz
EIS VS Frequency(IMP),Amplitude(mV):10,Initial Frequency:100000,Final Frequency:0.1,Current Range:20μA

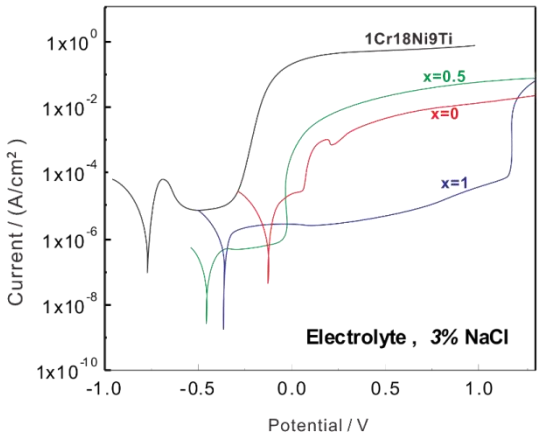
TECHNICAL ADVANTAGES

1. Impedance (EIS)

CS350 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.). It can also be used to obtain Mott-Schottky curve and differential capacitance curve. During test, the software can display real-time open circuit potential(OCP) without entering..



EIS plot of Li battery, frequency range: 10mHz~1MHz



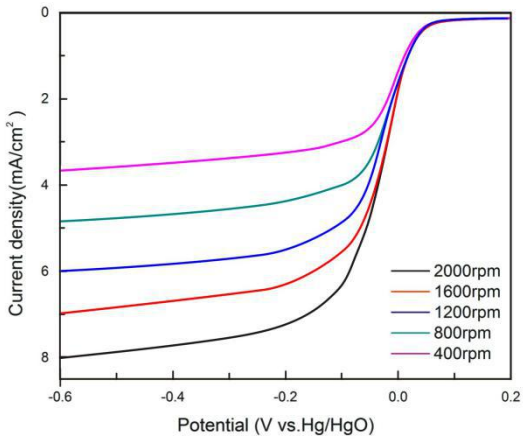
Polarization curve of Ti-based amorphous alloy & stainless steel in 3%NaCl solution

2. Polarization curve

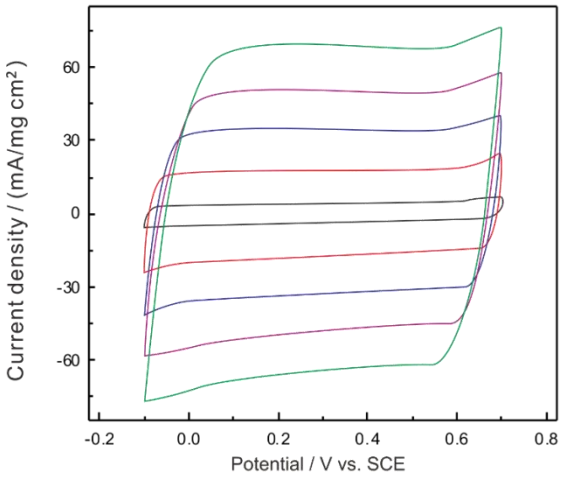
It can complete linear polarization curve and Tafel plot measurements. The user can set the anodic reversal current (passivation film breakdown current) of the cyclic polarization curve to determine material's pitting potential and protection potential and evaluate the its susceptibility to intergranular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

3. Voltammetry

It can do the following electroanalysis methods: Linear Sweep Voltammetry(LSV), Cyclic Voltammetry(CV), Staircase Cyclic Voltammetry(SCV), Square wave voltammetry(SWV), Differential Pulse Voltammetry(DPV), Normal Pulse Voltammetry(NPV), AC voltammetry(ACV), Stripping voltammetry etc. It can complete calculation of the integrated peak area, peak current and standard curve analysis.



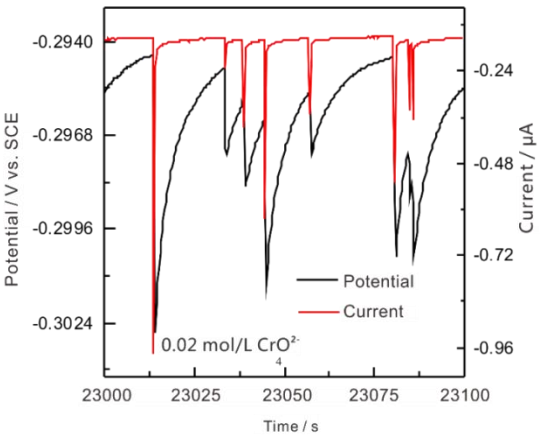
LSV curve: mesoporous carbon material in 0.1M KOH



CV curves 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. Through noise spectrum, we can evaluate the inducement, growth and death of metastable pitting and crack. Based on calculation of noise resistance and pitting index, it can complete localized corrosion monitoring.



Electrochemical noise of low-carbon steel in 0.05mol/L Cl^-+0.1mol/L $NaHCO_3$

5. Full floating measurement

CS workstation uses full-floating working electrode. It can be used for autoclave electrochemical measurements, on-line corrosion monitoring of metallic components under the ground (rebar in concrete, etc.)

6. User-defined methods

CS workstation supports user-defined combination measurements. The user can set cyclic timing measurements of an electrochemical method or several methods.

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

Specifications

Support 2-, 3- or 4-electrode system
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: 2.0A
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

Electrochemical Impedance Spectroscopy (EIS)

Signal generator:

Frequency range: 10μHz~1MHz
Frequency accuracy: 0.005%
AC signal amplitude: 1mV~2500mV
Signal resolution: 0.1 mV RMS
DC Bias: -10~+10V
Output impedance: 50Ω
Waveform: Sine wave, triangular wave and square wave
Wave distortion: <1%
Scan 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

OS Requirement

Communications Interface: isolated Universal Serial Bus (USB 2.0)
Operating System: Windows 2000/XP/ Win7/Win8/Win10

Techniques of CS350 potentiostat/galvanostat

Stable polarization

Open Circuit Potential (OCP), Potentiostatic (I-T measurement), Galvanostatic, Potentiodynamic (Tafel plot), Galvanodynamic

Transient polarization

Multi-Potential Steps, Multi-Current Steps, Potential Stair-Step (VSTEP), Galvanic Stair-Step (ISTEP)

Chrono Methods

Chronopotentiometry (CP), Chronoamperometry (CA), Chronocoulometry (CC)

Voltammetry

Cyclic Voltammetry (CV), Linear Sweep Voltammetry (LSV), Staircase Voltammetry (SCV), Differential Pulse Voltammetry (DPV), Normal Pulse Voltammetry (NPV), Square wave voltammetry (SWV), AC voltammetry (ACV), Differential Normal Pulse Voltammetry (DNPV), 2nd Harmonic A. C. Voltammetry (SHACV), Fourier Transform AC Voltammetry(FTACV)

Stripping Voltammetry

Potentiostatic stripping, Linear stripping, Staircase stripping, Square wave stripping, Differential Pulse Voltammetry Stripping, Normal Pulse Voltammetry Stripping, Differential Normal Pulse Voltammetry Stripping.

Amprometric

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

Impedance

EIS vs Frequency (IMP), EIS vs Time (IMPT), EIS vs Potential (IMPE)

Corrosion testing

Electrochemical Noise (EN), Zero Resistance Ammeter (ZRA), Electrochemical Potentiokinetic Reactivation(EPR)

Battery testing

Battery charge and discharge, Galvanostatic charge and discharge

Extensions

Data Logger, Electrochemical stripping/deposition, Bulk electrolysis with Coulometry

Attachment: models' comparison

Attachment

Techniques		CS120	CS150	CS300	CS310	CS350
Stable polarization	Open Circuit Potential (OCP)	√	√	√	√	√
	Potentiostatic (I-T curve)	√	√	√	√	√
	Galvanostatic		√	√	√	√
	Potentiodynamic(Tafel plot)	√	√	√	√	√
	Galvanodynamic		√	√	√	√
Transient polarization	Multi-Potential Steps	√	√	√	√	√
	Multi-Current Steps		√	√	√	√
	Potential Stair-Step (VSTEP)	√	√	√	√	√
	Galvanic Stair-Step (ISTEP)		√	√	√	√
Chrono methods	Chronopotentiometry (CP)			√	√	√
	Chronoamperometry (CA)			√	√	√
	Chronocoulometry (CC)			√	√	√
Voltammetry	Cyclic Voltammetry (CV)	√	√	√	√	√
	Linear Sweep Voltammetry (LSV)#	√	√	√	√	√
	Staircase Voltammetry (SCV) #			√		√
	Square wave voltammetry (SWV) #			√		√
	Differential Pulse Voltammetry (DPV)#			√		√
	Normal Pulse Voltammetry (NPV)#			√		√
	Differential Normal Pulse Voltammetry（DNPV)#			√		√
	ACvoltammetry (ACV) #			√		√
	2nd Harmonic A.C.Voltammetry (SHACV)			√		√
Amperometry	Differential Pulse Amperometry (DPA)					√
	Double Differential Pulse Amperometry (DDPA)					√
	Triple Pulse Amperometry (TPA)					√
	Integrated Pulse Amperometric Detection (IPAD)					√
EIS	EIS vs Frequency (IMP)				√	√
	EIS vs Time (IMPT)				√	√
	EIS vs Potential (IMPE)(Mott-Schottky)				√	√
Corrosion testing	Electrochemical Potentiokinetic Reactivation (EPR)		√	√	√	√
	Electrochemical Noise(EN)		√	√	√	√
	Zero resistance Ammeter (ZRA)		√	√	√	√
Battery test	Battery charge and discharge		√	√	√	√
	Galvanostatic charge and discharge(GCD)		√	√	√	√
Extensions	Data Logger		√	√	√	√
	Electrochemical stripping/deposition		√	√		√
	Bulk electrolysis with Coulometry(BE)		√	√	√	√

There is the corresponding stripping method.