**Corrtest Single-channel potentiostat /galvanostat / electrochemical workstation** consists of DDS arbitrary function generator, high power potentiostat/galvanostat, dual-channel correlation analyzer, dual-channel high-speed 16bit/high-precision 24bit AD converter and extension interfaces. Max. current is ±2A, potential range is ±10V. EIS frequency range is 10uHz~1MHz. It can be used for various electrochemical fields such as corrosion, energy, material and electroanalysis. The current can be boosted up to 20A/40A/100A with a current booster CS2020B/ CS2040B/CS2100B.


**Applications**

-Energy materials (Li-ion battery, solar cell, fuel cell, supercapacitors, electrocatalysis;
-Reactive mechanisms of electrosynthesis, electrodeposition (electroplating), anodic oxidation, electrolysis;
-Metallic corrosion; corrosion inhibitor, coating and cathodic protection efficiency;
-Electrocatalysis (HER, OER, ORR, $CO_2$RR, NRR).

| **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:$10^{12}$Ω\|\|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 10/11 | 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:<br>minimum:10ms or the longest time of a cycle | Maximum:$10^6$ cycles or $10^5$s |

| Measurement delay: 0~$10^5$s | |
|---|---|
| **DC offset compensation** | |
| Potential automatic compensation range: -10V~+10V | Current compensation range: -1A~+1A |
| Bandwidth: 8-decade frequency range, automatic and manual setting | |

# Techniques- models comparison

| Techniques | | CS300M | CS310M | CS350M |
|---|---|---|---|---|
| **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)(i-v) | √ | √ | √ |
| | Staircase Voltammetry (SCV) # | √ | | √ |
| | Square wave voltammetry (SWV) # | √ | | √ |
| | Differential Pulse Voltammetry (DPV)# | √ | | √ |
| | Normal Pulse Voltammetry (NPV)# | √ | | √ |
| | Differential Normal Pulse Voltammetry (DNPV)# | √ | | √ |
| | AC voltammetry (ACV) # | √ | | √ |
| **EIS** | 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 measurement** | 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) | √ | √ | √ |
| **Amperometry** | Differential Pulse Amperometry (DPA) | √ | | √ |
| | Double Differential Pulse Amperometry (DDPA) | √ | | √ |
| | Triple Pulse Amperometry (TPA) | √ | | √ |
| | Integrated Pulse Amperometric Detection (IPAD) | √ | | √ |

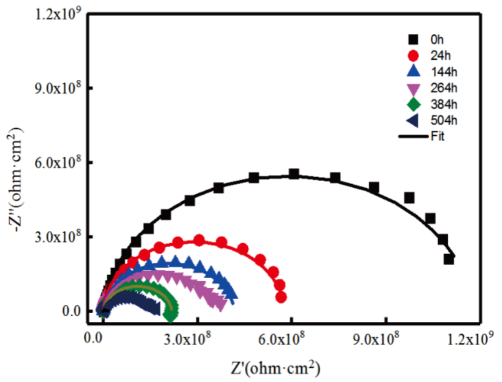
# corresponding stripping methods can be performed.

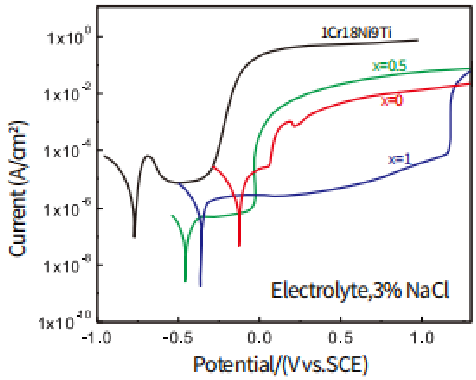
# Applications

## 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.

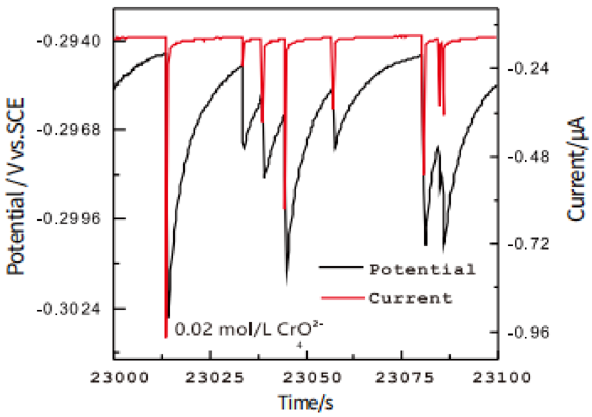
Due to their high input impedance($10^{13}\Omega$), they are especially suitable for EIS measurement of high-impedance systems like coating, concrete, and pure water.




High-impedance coating ageing test in salt spray tests

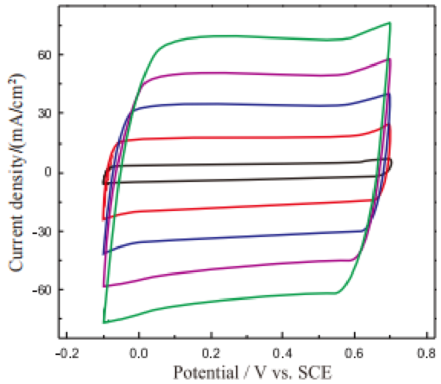
Polarization curves of Ti-alloy& stainless steel in 3%NaCl solution




ECN of low-carbon steel in 0.05mol/L Cl+0.1mol/L $NaHCO_3$

## Energy & Battery Testing

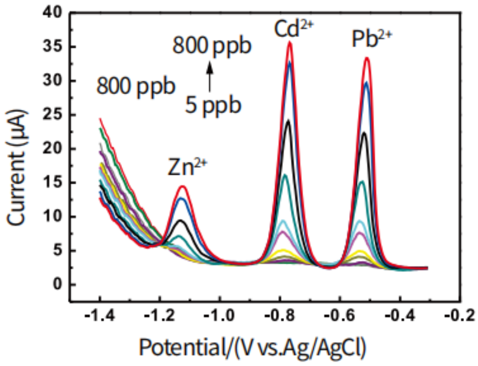
With versatile functions like linear sweep voltammetry (LSV), cyclic voltammetry (CV), galvanostatic charge/discharge (GCD), EIS (including potentiostatic and galvanostatic modes) with precise IR compensation, CS potentiostats are widely used in supercapacitor, Li-ion batteries, Li-S batteries, fuel cell, solar cell, solid-state batteries, flow batteries, and metal-air batteries, *etc*.




CV of PPy supercapacitor in 0.5 mol/L $H_2SO_4$ solution

## 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.

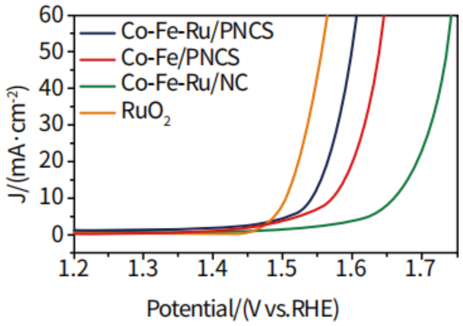



Stripping voltammetric curves in the solution dissolved with $Pb^{2+}$, $Cd^{2+}$, and $Zn^{2+}$ ions

## 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. In addition, the CS2350M bi-potentiostat and multichannel potentiostat specialize in Faradaic efficiency synchronous measurement.

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




LSV curves of various catalysts in alkaline solution

## 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

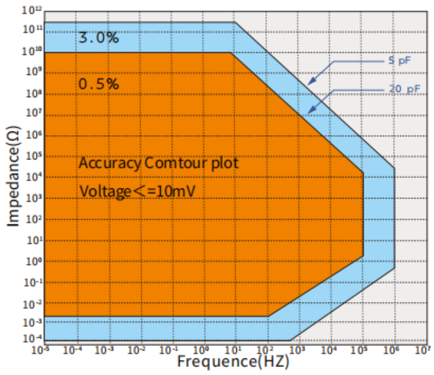
## Switchable floating and earthing mode

All CS potentiostats/galvanostats can switch between the floating and earthing modes, and this strategy is beneficial for studying electrochemical systems in which the working electrodes are intrinsically ground, such as autoclaves, in-site concrete structures and multi-working electrodes requiring isolation, etc.

## High-bandwidth EIS

With the help of 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 different charge/discharge states 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.

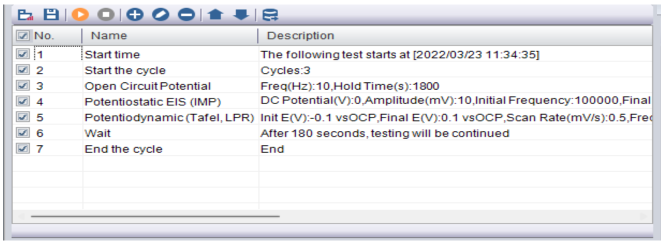
## Independent multiple channels

For CS 310X multi-channel potentiostat, each channel is completely independent. It can be used for the electrochemistry measurements of multiple cells or multiple working electrodes in a cell.

CS2350M Bipotentiostat/multi-channel potentiostat can be used for the RRDE test, dual-cell hydrogen diffusion test.

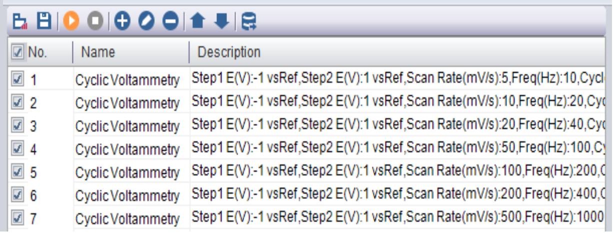
## User-defined sequence test

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,Freq |
| 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,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 |

Sequence Test: Pseudocapacitor tests

## Power booster

Through CS2020B/CS2040B/CS2100B booster, the CS potentiostats can extend their output current up to ±20A/40A/100A, meeting the growing requirements in fuel cells, power batteries, electroplating and

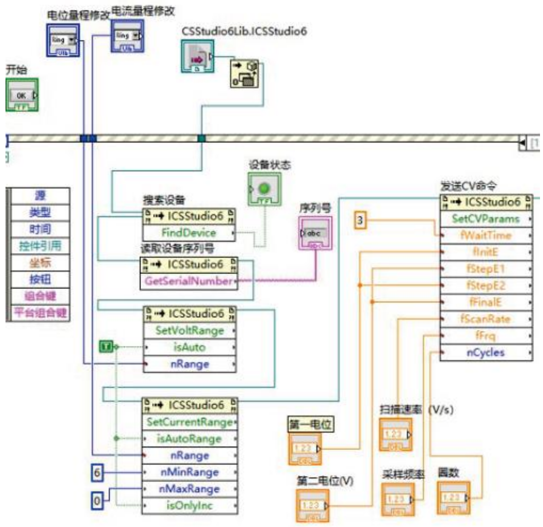
The compliance voltage of single-channel potentiostat can be customized(±30V),suitable for carbon/nitrogen electrochemical reduction.

With a multiplexer, the CS single-channel potentiostats can be extended to 16~32 channels for high throughput testing.

CS potentiostats can work with a CST520 arrayed electrode mapper to study the non-uniform corrosion of metal samples under deposits, coatings and anti-rust oils.

### 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 fitting

Electrochemical noise spectrum analysis

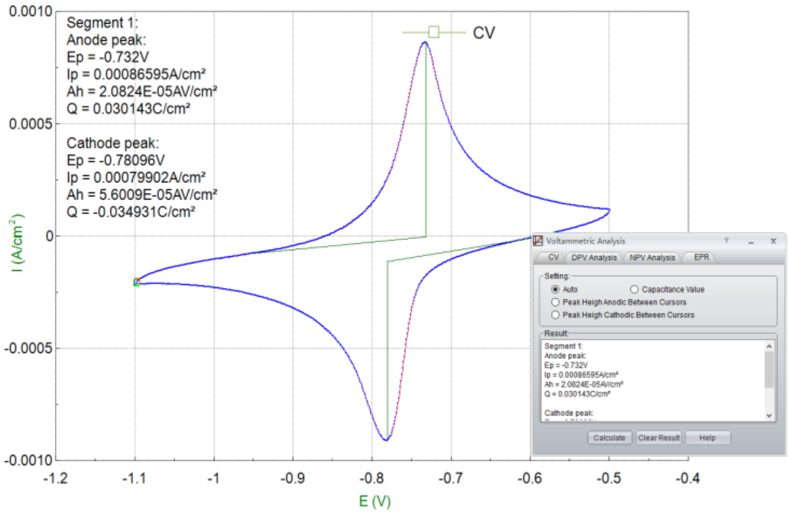
Pseudo-capacitance calculation

GCD-specific capacitance, efficiency calculation

Mott-Schottky analysis

CV curve analysis

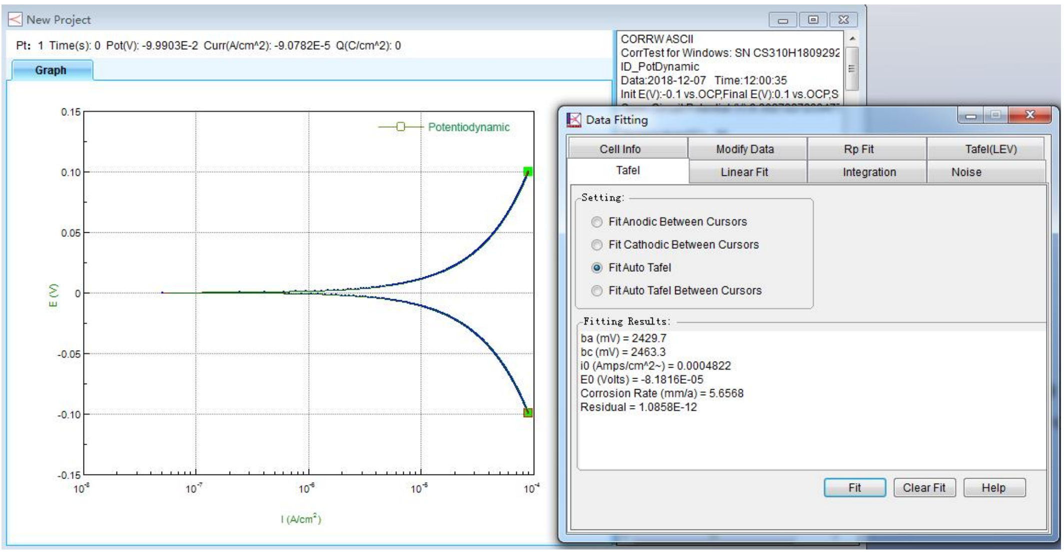
Activation/re-passivation curve analysis




# Software Features

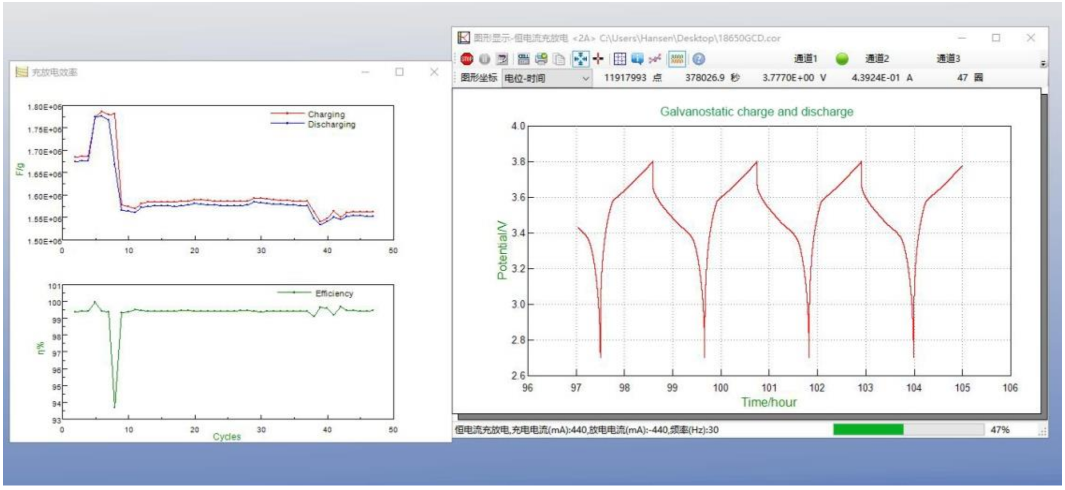
**Cyclic voltammetry:** CS studio software provides users a versatile smoothing/differential/ integration kit, which can complete the calculation of peak height, peak area and peak potential of CV curves. In CV technique, during the data analysis, there is function of selecting exact cycle(s) to show.

**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.