MSTAT

Multi-Station Multi-Electrode Potentiostat/Galvanostat System

MSTAT is a series of independent multi-channel, multi-electrode potentiostat/ galvanostat system. It has the capability to perform various electrochemical analyses independently on each electrode in a multi-working-electrode cell. The fields of use are numerous such as in electrosynthesis, electrochromics, electro-plating, and energy storage devices. The unique structure of this system allows it to carry experiments on a large number of working and reference electrodes, sharing a common electrode in one bath. This is especially useful for combinatorial electrochemistry where electrode study must be done in exactly similar conditions.

- Multiple potentiostat/ galvanostat stations fine-tuned for electro-chemical research
- Three current ranges on each potentiostat/ galvanostat channel
- Multiple electrodes functionality
- Windows based testing software
- Standard serial port communication, no extra card is required
- Online calibration

Arbin INSTRUMENTS

Unique Features

In contrast to the electronic design of the traditional multi-electrodes potentiostat/galvanostat, MSTAT utilizes a unique circuit design and advanced software that provides the following features:

- Each channel can function as an independent potentiostat/galvanostat. Each channel can be referred to its own reference electrode (RE).
- In multi-electrode applications, each channel accommodates an individual RE, or several channels can share one RE (such as in a combinatorial cell). This results in accurate control and measurement and enables individual IR drop compensation. Channels share ground as the counter electrode.
- Advanced software package, ***MITS Pro*** (Multiple Integrated Testing Software, professional version) provides flexible scheduling, user-friendly interface, distributed system control and DAQ and easy automatic or manual maintenance and calibration.
- Each channel can be used as a standard battery, supercapacitor, or fuel cell tester.

Applications

MSTAT can conduct all electrochemical experiments that have been previously conducted using single-station potentiostat/galvanostat. However, given the multi-electrode arrangement, users may experiment either with individual counter/reference electrode, such as for comparative testing (Figure 1) or with a working electrode array and a common counter electrode, as for combinatorial experiments (Figure 2 & 3).

Figure 4 shows a result of a multi-electrode chronoamperometric test using an MSTAT system. The combinatorial working electrode contains 7 elements. This complex working electrode with one reference electrode and one counter electrode sit in the same electrolyte bath. Each element of the working electrode connects to a channel of the MSTAT. A constant potential of -0.15V is applied to each element of the working electrodes for 120 seconds. Results indicate that the composition of the element connecting to Channel 3 offers the most active material.

Figure 5 is a result of Cyclic Voltammetry test carried out on a lithium battery spinel, at a scan rate of 50 micro-volt per second, between 3.2 and 5.2 volts.

MSTAT can be used in general and specific R&D in various electrochemistry fields. Examples are:

- General Electrochemistry R&D techniques—cyclic voltammetry, chronopotentiometry, linear sweep voltammetry, chronocoulometry, potentiodynamic polarization, potentiostatic polarization purve, cyclic polarization, galvanodynamic polarization, and galvanostatic polarization.
- Industrial R&D—battery anode or cathode development, electrochemical research of corrosion materials, electro-catalyst evaluation of fuel cells, evaluation of electro-synthesis materials, electro-chromic material investigation, electrochemical plating technology, biosensor/immuno-sensor research, photovoltaic applications and double-layer super capacitor technology.

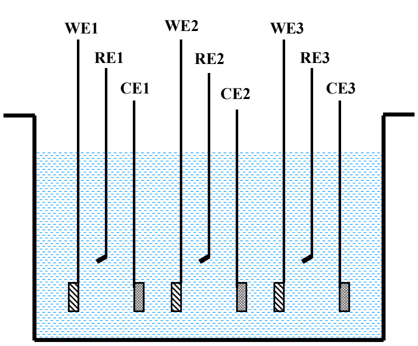

Figure 1. Multi-electrode cell with individual reference electrodes (RE), counter electrodes (CE) and working electrodes (WE).

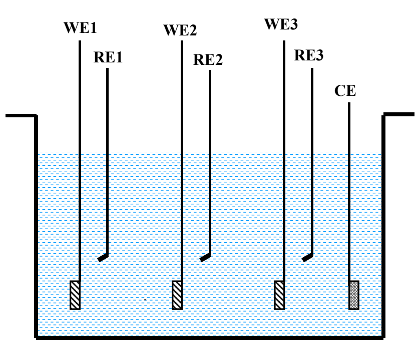

Figure 2. Multi-electrode cell with individual reference electrodes (RE) and working electrodes (WE) sharing one common counter electrode (CE).

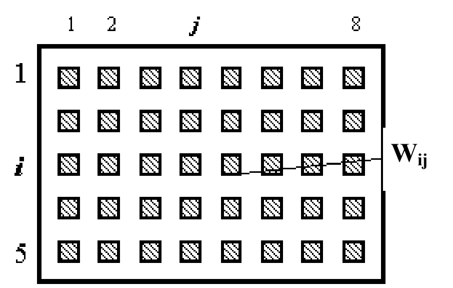

Figure 3. 40-electrode array used as combinatorial working electrode, configurable as a cell with one common counter electrode and one reference electrode (W_{ij} — element of working electrode at row *i* and column *j*).

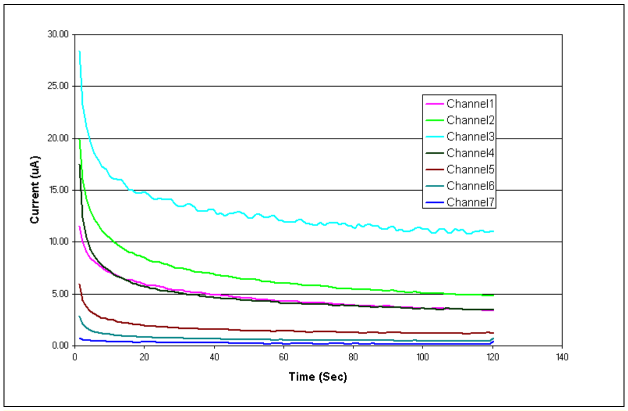

Figure 4. Multi-electrode chronoamperogram from a combinatorial test.

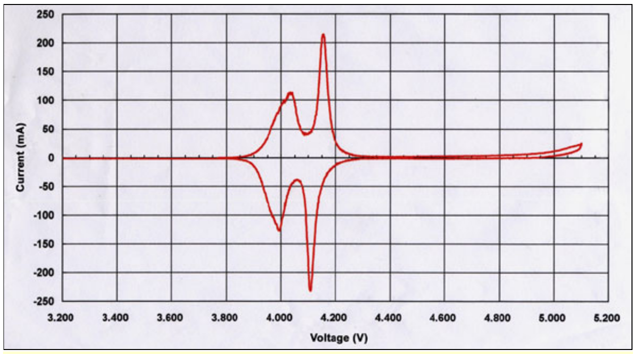

Figure 5. Cyclic Voltammetry carried out on a lithium battery spinel, at a scan rate of 50 micro-Volt per second, between 3.2 and 5.2 volts.

Typical System Order

MSTAT Model	MSTAT-10V-1A-4Ch-4Tm-4AV-4pH (MSTAT4+)	MSTAT-5V-3A-40Ch-8Tm-8AV	MSTAT-5V-50A-2Ch-8Tm-8AV	MSTAT-10V-5A-12Ch-16AV-8pH
Voltage Clamp	Shared for all channels	Shared for all channels	Shared for all channels	Shared for all channels
I/V Output Voltage	-10 ~ 10 V	-5 ~ 5 V	-5 ~ 5 V	-10 ~ 10 V
Accuracy of V Control & Reading	± 10 mV	± 5 mV	± 5 mV	± 10 mV
Resolution of V	~ 0.31 mV	~ 0.15 mV	~ 0.15 mV	~ 0.31 mV
Voltage Input Impedance	~ 10 GΩ	~ 10 GΩ	~ 10 GΩ	~ 10 GΩ
High Range of Current	± 1 A	± 3 A	± 50 A	± 5 A
Medium Range of Current	± 10 mA	± 500 mA	± 5 A	± 500 mA
Low Range of Current	± 100 μA	± 50 mA	± 1 A	± 50 mA
Accuracy of I Control & Reading	± 2 mA(H) ± 20 μA(M) ± 0.2 μA(L)	± 6 mA(H) ± 1 A(M) ± 100 μA(L)	± 100 mA(H) ± 10 mA(M) ± 2 mA(L)	± 10 mA(H) ± 1 mA(M) ± 100 μA(L)
Resolution of I	± 0.12 mA(H) ± 1.2 μA(M) ± 12 nA(L)	± 92 μA(H) ± 15 μA(M) ± 1.5 μA(L)	± 1.5 mA (H) ± 0.15 μA (M) ± 31 μA (L)	± 0.15 mA (H) ±15 μA (M) ± 1.5 μA (L)
Current Rise Time	50 μs ~ 1 ms	50 μs ~ 1 ms	500 μs ~ 2 ms	50 μs ~ 1 ms
Auxiliary	4 aux. thermister (10kΩ), 4 aux. voltage, 4 aux. pH	8 aux. thermister (10kΩ), 8 aux. voltage	8 aux. thermister (10kΩ), 8 aux. voltage	16 aux. voltage, 8 aux. pH

Please consult with our sales engineers for your custom-designed system requirements.

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Control Software Specifications

Arbin Software Version	MITS Pro 3.0 or later
Independent Standard Types of Control	Current, Voltage, Power, Load at Constant, Ramp, Staircase, or Formula
Independent Standard Limit Condition	Time, Voltage, Current, Capacity, Energy, Voltage difference, First/second derivative of current/voltage, Formula and Meta-variables
Data Logging Rate during the Standard Step	More than 100 points/second per control PC
Internal Resistance (IR) Measurement	Standard feature, Pulse method with time-domain analysis; average over 10 pulses. Refer to Technical Notes.
Mathematic Filter in Micro-controller	Iterative filtering of first order. Range of F-factor: 0.01 ~1.00. 1 for no filtering.
Data Format	Automatically convert to standard Excel file
Data File Content	Channel data: Testing time, Step time, Voltage, Current, Capacity, Energy, First/ second derivative of I or V, Auxiliary input data (optional) Statistical data: Cycle #, Cycle Capacity/Energy, Max. voltage, etc.

System Specifications

Power Requirement	AC 1Φ, 110V/220V, ± 10%
Work Environment	10°C to 35°C, 10% - 90% RH non-condensing
Control Computer	> 500MHz, 256 Mb
Operating System	Win2k_Pro, Office 2k_Pro/XP
Communication Interface	RS232 or RS485

Scheduling Cyclic Voltammetry Test with MITS Pro Testing Software