

SECM150

Compact & Powerful

Scanning Electrochemical Microscope



- Small footprint
- Fast scanning
- <10 nm scanning resolution
- fA current resolution



APPLICATIONS

- Batteries
- Corrosion/coatings
- Fuel cells and photocatalysis
- Biosensors
- Fundamental electrochemistry

SECM: When local supports global

SECM is a probe based microscope technique where the image contrast is a function of the electrochemical activity local to a surface under study.

In classical electrochemical measurements the average response of the whole sample is quantified. With SECM the electrochemical properties are resolved spatially.

The local behaviour yields complementary information to help explain the global measurements.

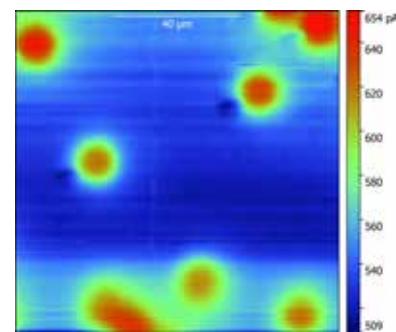


Fig. 1 : Whatman® Cyclopore™ Track Etched Membrane
12 μm pores, shiny side of membrane on Au sample
TG/SC mode in Ferricyanide solution

Applications

The SECM150 may be utilised for any application involving a material or body at which an electrochemical reaction is needed or occurs spontaneously.

Examples of applications are listed below:

Batteries

- Li-ion: spatial heterogeneity of Li^+ dissociation from a LiCoO_2 paste electrode
- Li-ion: formation and evolution of the Solid Electrolyte Interphase *in operando* conditions
- Li-ion: study of the homogeneity of the insulative properties of the separator
- Li-air: mass transport resistance of oxygen across the Gas Diffusion Electrode by collecting the oxygen at the tip
- Redox Flow: study of the passivation of the current collector

Corrosion/coatings

- determination of the electrochemical characteristics of particles and phases contained in metal alloys (inclusions, intermetallic particles, grain boundaries, grains...)
- evolution of the protective homogeneity of a specific anti-corrosion treatment

Fuel cells and photocatalysis

- spatially-resolved catalytic properties of catalysts
- screening of catalysts composition

Biosensors

- testing receptors reactivity towards specific molecules produced at the probe
- testing immobilization techniques using the probe to locally produce molecules

Fundamental electrochemistry

- study of electron transfer distribution over a conductive substrate



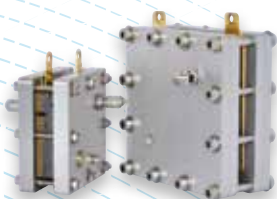
Batteries



Corrosion



Coatings



Fuel cells

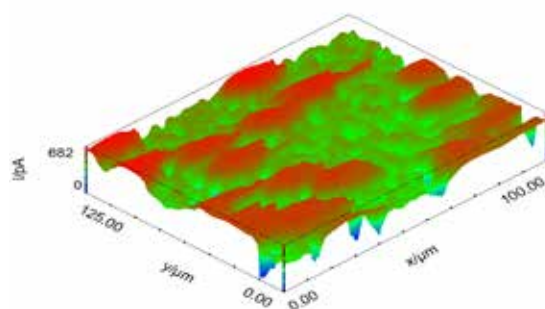


Fig. 2 : Whatman® Cyclopore™ Track Etched Membrane
12 μm pores, dull side of membrane on Au sample
TG/SC mode in Ferricyanide solution

So compact that it fits in a glove box!

Space is often limited in labs, especially when experiments require stringent atmospheric control. The SECM150 was designed to be as compact as possible, while keeping high performances. It weighs only 8 kg and its size makes it fit in an environment as crowded as a glove box. As an example, the PU51 potentiostat is only 10 cm long and weighs 61 g.



PU51 potentiostat

Ultra high resolution <10 nm scanning resolution

The position of the probe is controlled by 3 piezo scanning stages with a range of 200 μm in the X and Y axes and 100 μm in the Z axis.

The positioning resolution is lower than 10 nm for each axis.

Bio-Logic Pt disk Ultra Micro Electrodes are available in many different sizes, down to 1 μm diameter, but the SECM150 can accommodate smaller probes of any material.

The potentiostats have a high current range sensitivity of 100 pA, with 6.1 fA resolution.

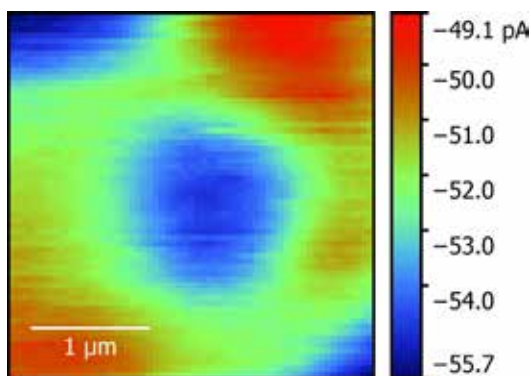


Fig. 3 : Whatman® Nucleopore™ Track Etched Membrane on Au sample
TG/SC mode in Ferricyanide solution

Fast scanning

Up to 20 discrete measurement points per second. A fast scanning device to study time-variant systems. The maximum speed scan is 200 $\mu\text{m/s}$. As an example, the data shown in Fig. 4 contain 10 000 points acquired in 18 min.

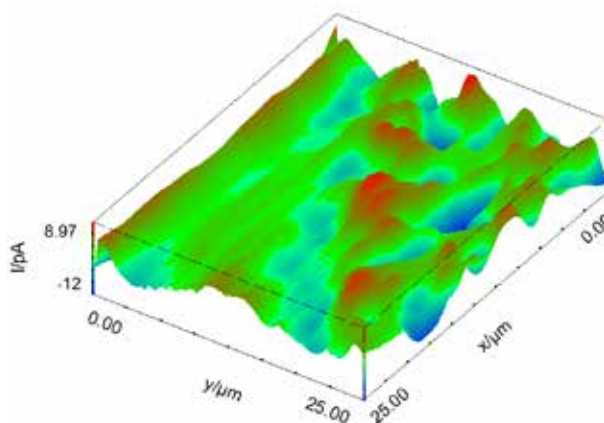


Fig. 4 : Whatman® Nucleopore™ Track Etched Membrane on Au sample
TG/SC mode in Ferricyanide solution
10 000 data points map acquired in 18 min

Specifications



Positioning

Scan range	X&Y = 200 μ m; Z = 100 μ m
Practical minimum step size	50 nm with <10 nm resolution
Max scan speed	200 μ m/s
Max discrete data acquisition for line or area scan	20 points/s
Micrometer macro positioning	13 mm range The smallest graduation is 10 μ m
Max area scan point density	>4,000,000

Potentiostat

Current measurement	2.56 x 1 mA to 100 pA with 0.5% accuracy (2% for 100 pA) and resolution (2 x range @ 16 bit, 7.8 fA @ 100 pA)
Potential	\pm 2.048 V for applied voltage with 0.5% accuracy and 62 μ V resolution \pm 2.56 V for measured voltage with 0.5% accuracy and 78 μ V resolution
Electrometer	<10 pA input bias current and 10^{11} Ω II 5 pF input impedance (R/C)
Time base	typically 100 μ s
Sampling rate	1 mHz to 10 kHz
Maximum data samples	>100,000 (technique dependent)
Electrical Isolation	yes
Power	via USB
PC connection	USB
Cell connections	with 2 mm banana plugs (WE=Red, RE=White, CE=Blue)

Software

dc-SECM	Approach Curve Line Scan Area Scan
General electrochemistry	Cyclic Voltammetry Chronoamperometry Linear Voltammetry Chrono OCP
Operating system	Windows 7/8/10 64 bit
Minimum PC requirements	CPU: i3 (Dual core) RAM: 1 GB Hard disk: 300 GB Graphics: 1200 x 800

Probes

Available in the following sizes	25, 15, 10, 5, 2, 1 μ m
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General

Control box dimensions	90 x 235 x 180 mm (H x W x D)
Scanning stage dimensions	190 x 225 x 230 mm (H x W x D)
Potentiostat dimensions	97 x 15 x 54 mm (H x W x D)
Potentiostat weight	61 g
Total weight	8 kg
Operating temperature range	25 $^{\circ}$ C \pm 5 $^{\circ}$ C
Operating humidity range	75% \pm 10%
Power	100 to 240 V 50/60 Hz 60 W (Universal external certified power pack)



Headquarters

Bio-Logic SAS
4, rue de Vaucanson
38170 Seyssinet-Pariset - France
Phone: +33 476 98 68 31
Fax: +33 476 98 69 09

www.bio-logic.net

Affiliate offices

Bio-Logic USA, LLC
P.O.Box 30009 - Knoxville, TN37930 - USA
Phone: +1 865 769 3800 - Fax: +1 865 769 3801

Bio-Logic Science Instruments Pvt Ltd
Unit No.204, Odyssey IT Park, Road No. 9, MIDC
Wagle Estate, Thane, West, Mumbai-400604 MH, India
Phone: +91 2225842128