SECM150

Scanning ElectroChemical Microscope

- Compact
- <10 nm scanning resolution
- Up to 20 data points/s scan speed
- 7.8 fA measured current best resolution

Small & Mighty

BioLogic
Science Instruments

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.

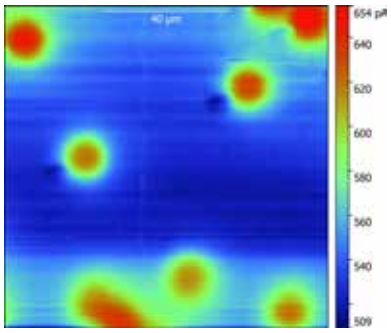


Fig. 1 : Whatman® Cyclopore™ Track Etched Membrane
12 µm pores, shiny side of membrane on Au sample
TG/SC mode in Ferricyanide solution

Applications

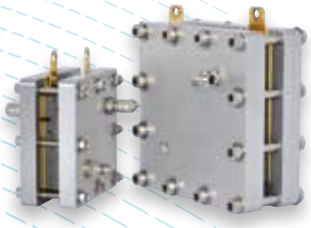
The SECM150 may be utilised for any application involving a material or body at which an electrochemical reaction is needed or occurs spontaneously.
Examples of applications are listed below:

Batteries

- **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

- **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



Fuel cells

- **Fundamental electrochemistry**
  - study of electron transfer distribution over a conductive substrate

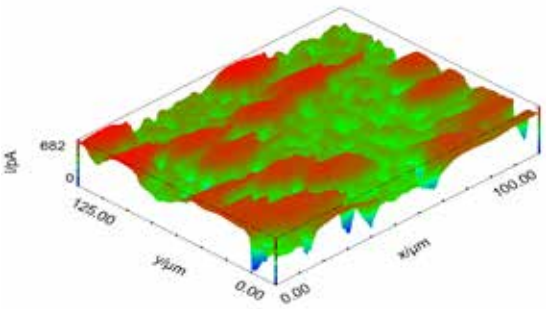


Fig. 2 : Whatman® Cyclopore™ Track Etched Membrane
12 µm pores, dull side of membrane on Au sample
TG/SC mode in Ferricyanide solution

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 60 g.

PU51 potentiostat

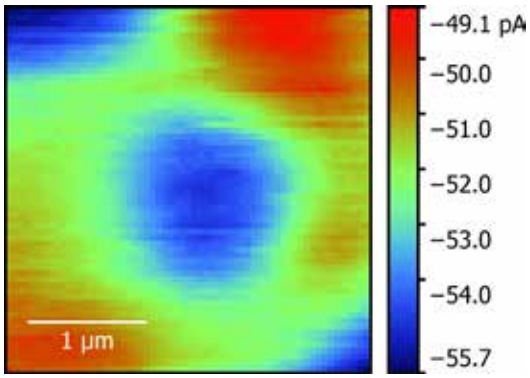


Fig. 3 : Whatman® Nucleopore™ Track Etched Membrane on Au sample
TG/SC mode in Ferricyanide solution

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.

Fast scanning up to 20 points/s

A fast scanning device to study time-variant systems.
The maximum speed scan is 200 µm/s.
As an example, the data shown in Fig. 4 contain 10 000 points acquired in 18 min.

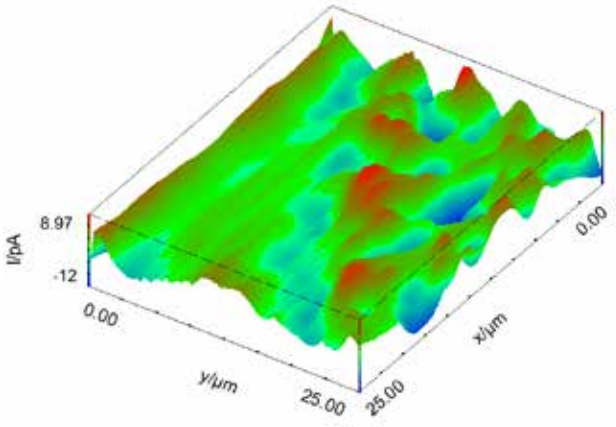
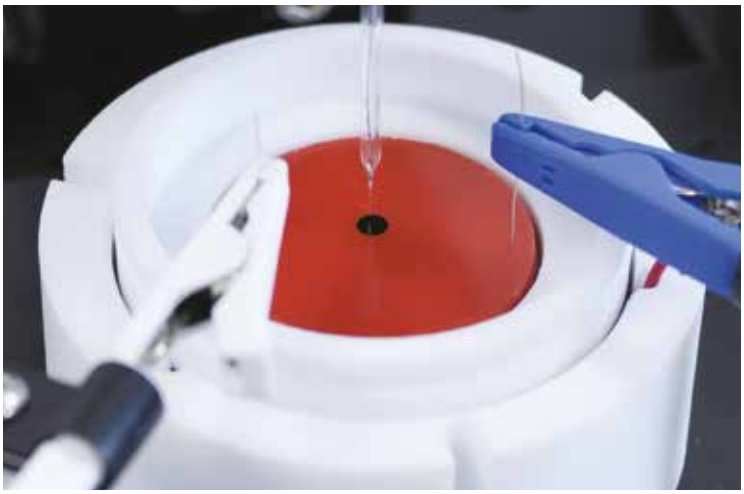


Fig. 4 : Whatman® Nucleopore™ Track Etched Membrane on Au sample
TG/SC mode in Ferricyanide solution
10 000 data points map acquired in 18 mn

Specifications



Positioning

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

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	±2.048 V for applied voltage with 0.5% accuracy and 62 µV resolution ±2.56 V for measured voltage with 0.5% accuracy and 78 µV resolution
Electrometer	<10 pA input bias current and 10^{11} Ω II 5 pF input impedance (R/C)
Time base	typically 100 µs
Sampling rate	1 mHz to 10 kHz
Maximum data samples	100,000
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 µm

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 °C ±5 °C
Operating humidity range	75% ±10%
Power	100 to 240 V 50/60 Hz 60 W (Universal external certified power pack)

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