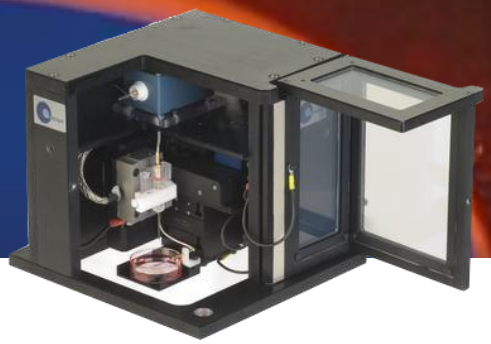
Ionscope. SICM

Scanning Ion Conductance Microscopy

Call us to discuss your applications



About Ionscope

Ionscope, headquartered in Cambridge UK, is the world-leader in Scanning Ion Conductance Microscopy (SICM), a rapidly emerging Scanning Probe Microscopy (SPM) technique which allows nanoscale topographical mapping of soft and delicate surfaces.

SICM is a versatile platform that enables new methodologies and discoveries for both life and material sciences. Neurological and cardiac scientists use Ionscope's products to understand fundamental processes associated with diseases and therapeutics, because of the unique combination of nanoscale topographical and physiological information SICM provides. Material scientists are using Ionscope's products to see nanoscale changes in electrode surface as batteries charge and discharge.

SICM's non-destructively images convoluted features that other microscopy approaches would damage. Using SICM, material can be extracted from or delivered to a surface for highly precise stimulations and single cell analysis. Moreover, without interfering with a surface, SICM can be used to position other probes to perform physical or electrochemical operations such as printing or Scanning Electrochemical Microscopy (SECM).

Based on a successful research and development programme at Imperial College London and the University of Cambridge, Ionscope was founded in 2004. Ionscope's SICM is installed in labs world widely in Asia, North America and Europe to help researchers with new discoveries.

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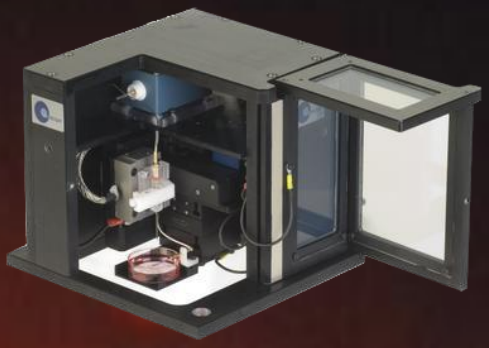
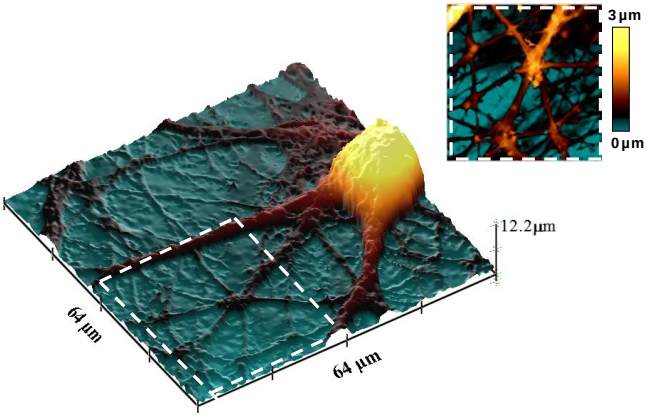


Image

Ionscope's next generation Scanning Ion Conductance Microscopes (SICMs) combine ease of sample preparation with non-destructive high resolution imaging in:

- Living cells and tissues
- Artificial structures

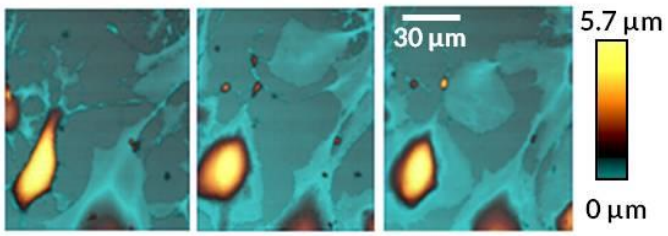


Hippocampal Neurons

Measure

SICM's unique conductance feedback captures details of soft and delicate surfaces to understand

- Morphological changes
- Physiological processes
- Surface chemistry

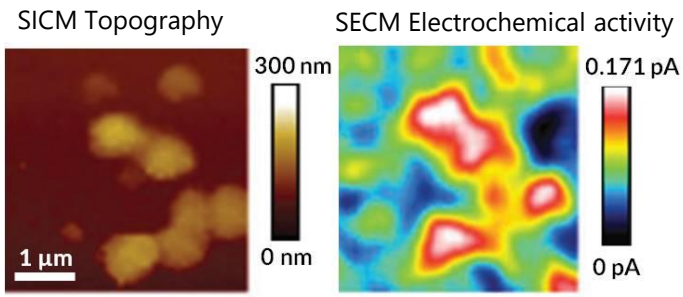


Mesenchymal Stem Cells (overnight scan)

Position

Ionscope's microscopes can place a probe over an imaged 3D surface to perform or generate a map for

- Optical observations
- Physiological processes
- Surface chemistry

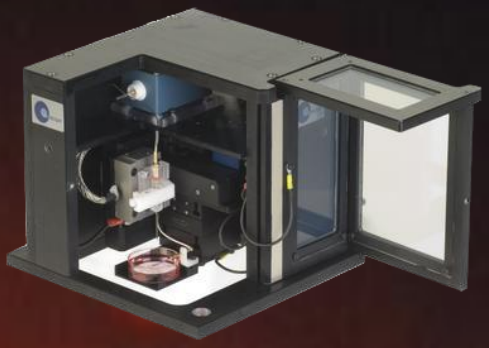


Gold nanoparticles — Hydrogen Peroxide Oxidation

Images courtesy of Prof. Korchev, Imperial College; Dr. Palona, University of Liverpool; Dr. O'Connell, National Physical Laboratory.

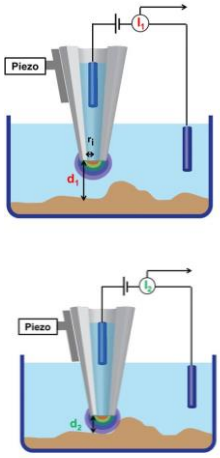
Ionscope. SICM

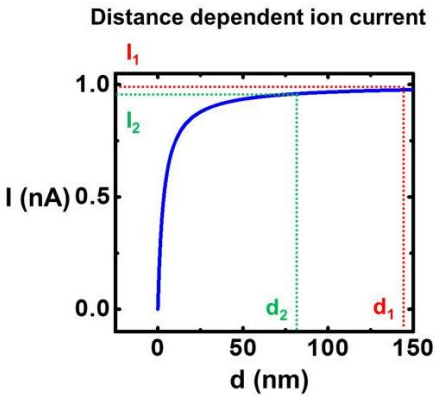
Scanning Ion Conductance Microscopy



SICM Principles

SICM acquires topographic images by scanning a glass nanopipette probe over the sample whilst measuring the ion current through the pipette. As the probe approaches the sample surface the ion current decreases; the Z position is recorded when the ion current has dropped by a predefined amount.





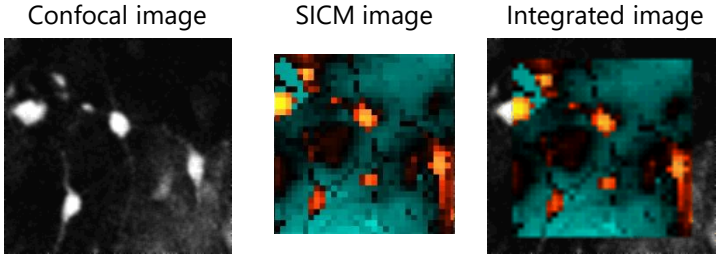
System Features

- Automated scanning with nano-positioning in XYZ.
- Multiple scan mode and pipette controls: hopping mode, approach curve, manual approach.
- Auxiliary input: allows recording of simultaneous external measurements.
- Customisable software and development support.

SICM system

Advanced Applications

- Smart patch-clamp
- SICM-SECM
- Confocal integration
- Localised delivery and sampling
- Mechanical stimulation

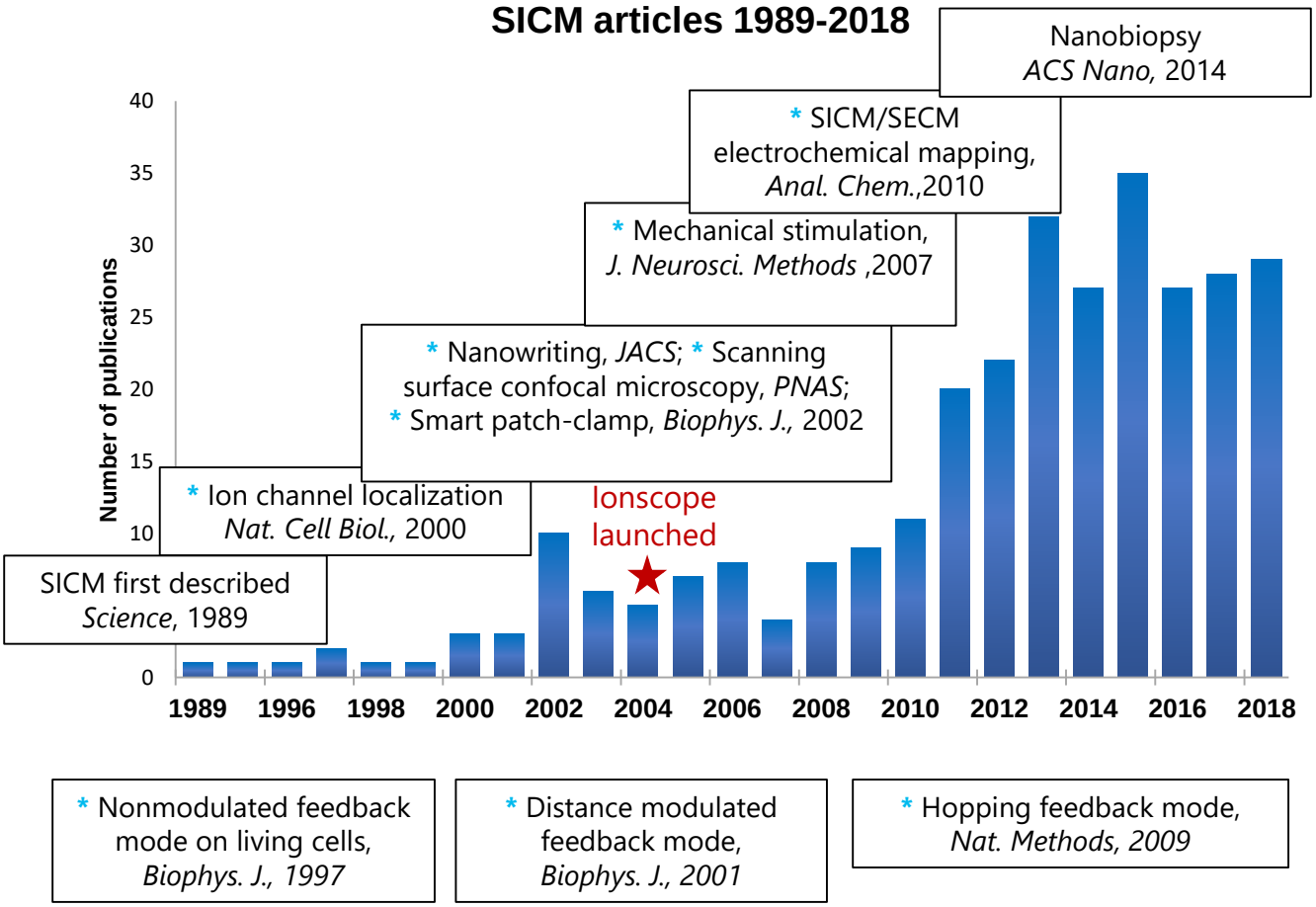


Integration performed with SCInt™ software from Ionscope

(Image courtesy of Prof. Fang, Zhejiang University, China)

SICM and Ionscope

Scanning Ion Conductance Microscopy



70% of SICM publications used Ionscope product or technology.

- 2004, Ionscope limited was launched with techniques developed by scientists from Imperial College and Cambridge University, dated back to 1997.
- Ionscope holds 16 patents in Europe, US and Asia for SICM scan modes and specific applications, which cover 7 patent families with 2 newly added in 2014.
- More than 10 years of experience in SICM technique developments and customer support.

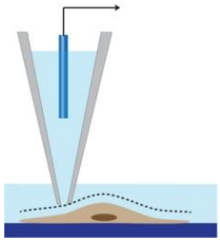
* – *asterisk marks papers using Ionscope technology/product*

Applications

Scanning Ion Conductance Microscopy

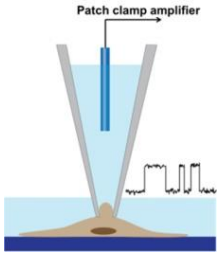
High Resolution Topography

- Live cell / delicate materials morphology characterization in solution
- Non-contact, non-destructive, high resolution



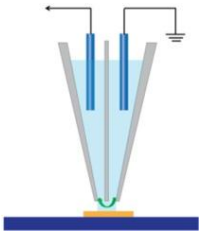
Smart Patch-clamp

- Precise positioning of pipette over features of interest
- Non-transparent samples, higher patch success, target small features



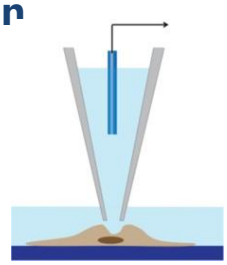
Scanning Electrochemical Cell Microscopy (SECCM)

- Scan with the meniscus at pipette tip
- Electrochemical mapping, creation of multidimensional nanostructures



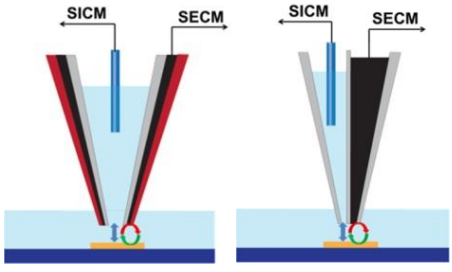
Mechanical Stimulation

- Apply positive pressure on pipette during scan
- Study mechanical sensitivity of cells



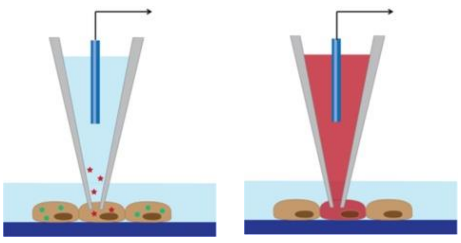
SICM-Scanning Electrochemical Microscopy (SECM)

- Robust feedback with SICM to control probe-sample distance
- Ring shape or double barrel design of SECM electrode measure local electrochemical property
- Correlation of local topography and electrochemical property in both life and material sciences



Localized Sampling and Delivery

- Delivery materials (e.g. fluorescent probes) to a single cell/small region
- Fast delivery with minimum damage (to cells)
- Obtain material for further analysis from a single cell
- Nanobiopsy, nanowriting



Specifications

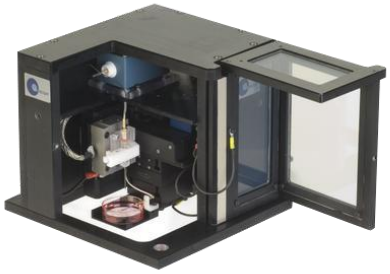
Scanning Ion Conductance Microscopy

System Summary

The Ionscope Scanning Ion Conductance Microscope (SICM) is a state-of-the-art nanometer imaging system. It comprises a scan head, a controller, and data-acquisition systems. The robust mechanical design of the Ionscope SICM ensures high precision measurements. It can be used as a standalone system or integrated with an inverted light (or confocal) microscope. The Ionscope image software offers a variety of supported modes and in-built system functions such as automated immersion, surface detection, real-time ion current display, real-time 2D and 3D display of images as they are formed.

Scan Head

- Large scan range and sample stage travel range.
- Accurate positioning with nanometre resolution.
- Low noise level in the system.
- Easy access to pipette and sample area.
- Fit a wide range of inverted microscopes.

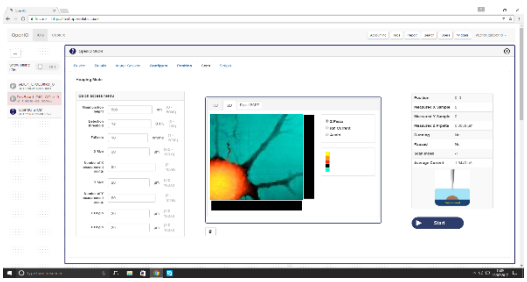


Controller

- New platform with more flexibility
- Interface control and feedback signals.
- FPGA provides advanced signal processing for pipette positioning and current detection.
- Auxiliary input allow signals from external device to be displayed in synchronisation with detection of threshold ion current and pipette position.

Software

- User friendly Web-based User Interface allows easy configuration, control, measurement and display of system and data remotely.
- Database with search functions on local or cloud server
- Dynamic 2D and 3D images.
- Controls hopping mode and also supports Approach Curve and Manual Approach operations.



Ionscope. Specifications

Scanning Ion Conductance Microscopy

Scan Head

Coarse Positioning - Sample
- XYZ position of sample using precise DC motors
- Control through Web-based User Interface
- XYZ travel range 25 mm
- XYZ resolution 95 nm

Precision Nano Positioning Piezo - Sample
- XY range 100 µm
- XY resolution 1 nm

Precision Nano Positioning Piezo - Pipette
- Z range 25 µm
- Z resolution 0.02 nm

Controller

Controller Electronics
- CPU: 32 bit, 1GHz and 1GB RAM
- ADC: 8 channels, 16 bit, ±10 V
- DAC: 8 channels, 16 bit, ±10 V
- Aux input for additional probes
- Sampling frequency 50 KHz

Controller Software
- Fully integrated embedded software including FPGA module and real-time module
- Digital filtering for noise reduction

Software

General configuration parameters
- Ion current bias voltage
- Immersion threshold and depth
- Approach/withdraw speed
- Scan area (in µm and pixels),
- Scan origin

Hopping configuration
- Ion current: detection threshold, measurement time (ms)
- Min hop height (nm), fall rate/rise rate (nm/ms)

Status
- Immersion status, real-time ion current display

Topography Display
- 3D full colour display, user controlled display
- 2D full colour display, XY cross section of Z-axis

Topography Data
- Stored data for X,Y,Z, Imean, Aux input

Supported Modes &Features

Hopping mode
- 100 x 100 µm scan area

Manual approach
- Control of X,Y and Z start location in µm
- Control of step size
- Keyboard control of Z movement

Approach curve
- Selectable points from scan or user defined XY
- Multiple measurements for each XY location
- Full control of approach and retraction for each XY

Application Modes
- SICM
- SECM
- Manual approach for electrophysiology and delivery

Databases
- All parameters and data are stored on a local or cloud server

Viewing Software
- SPIP Compatible exported data (Image Metrology)

Supported Microscopes
- Compatible with most models and makes
- Olympus IX73/53
- Nikon Ti2/Ti-E

Accessories
- Laser puller
- Vibration isolation or acoustic isolation enclosure if required
- Patch-clamp amplifier for selected applications