Scanning Electrochemical Potential Microscopy

Figure 1. An LFMLN platform configured for SECPM. The Digital Instruments MultiMode SPM platform configuration looks nearly identical.

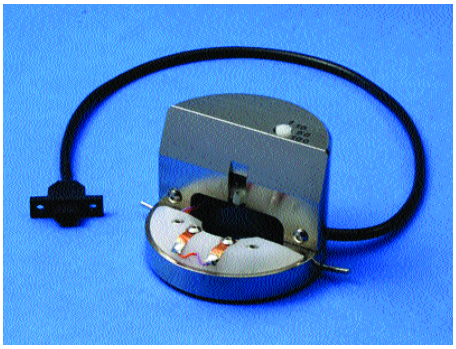

Figure 2. Intergrated SECPM–STM head works in either STM mode or SECPM mode through software control.

Veeco Instruments Inc. offers three different options for electrochemical Scanning Probe Microscopy (SPM), powered by Digital Instruments NanoScope® SPM controllers. The newest of these options is Scanning Electrochemical Potential Microscopy (SECPM). The other two options, Electrochemical Scanning Tunneling Microscopy (ECSTM) and Electrochemical Atomic Force Microscopy (ECAFM) are described in a separate datasheet (Electrochemical Scanning Probe Microscopy) from Veeco.

The SECPM or Scanning Electrochemical Potential Microscope, the latest electrochemical SPM, is a patented technique exclusively available from Veeco Instruments. SECPM offers *in-situ* imaging or potential mapping of the electrode surface with nanometer-scale resolution. The electrochemical potential, Φ, changes with distance across the electrical double layer at solid/liquid interfaces. SECPM measures the potential difference between its potentiometric probe and the sample, immersed in an electrolyte solution or a polar liquid. Moreover, STM is integrated with SECPM, offering combined power, flexibility and comparison of images and data captured with the two techniques. SECPM includes a Bipotentiostat/ galvanostat, liquid cell, and attachments and is available on two Digital Instruments SPM platforms: the MultiMode SPM and LFMLN (Figure 1).

SECPM has three modes of operation:

Constant Potential Mode: In this mode, SECPM uses SPM feedback to adjust the position (height) of the probe relative to the sample surface to maintain a constant value of Φ. When the probe raster-scans the sample surface (in X and Y), SECPM captures topograhic images of the sample surface (Figures 3,4).

Constant Height Mode: In this mode, SECPM's feedback is turned off, and when the probe is raster-scanned, SECPM maps the electrochemical potential distribution across the sample surface.

Spectroscopic Mode (or Potential Profiling): SECPM's raster-scanning (in X,Y) is disabled in this mode. Instead, the probe is scanned (in Z) across the electrical double layer, and the SECPM records a plot of the measured potential vs. distance traveled (Figure 5).

With nanometer-scale in-plane resolution in these three modes, SECPM can provide new insights into electrochemical fundamentals, with applications in numerous areas that include electroplating, corrosion, and battery research and development.

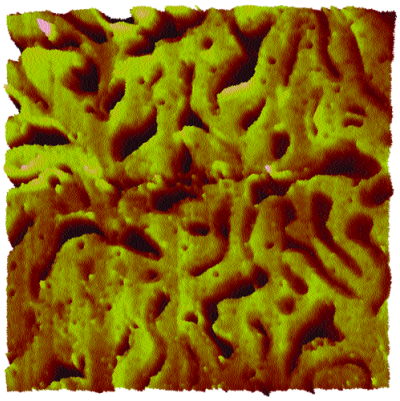

Figure 3. SECPM constant potential mode image of Sn60Pb40 alloy in Glycerol at open circuit potential using uncoated Pt-Ir tip at potential setpoint of 100mV. The open circuit potential is -520mV vs. Pt quasi reference electrode. Scan rate: 0.5Hz, 5µm scan.

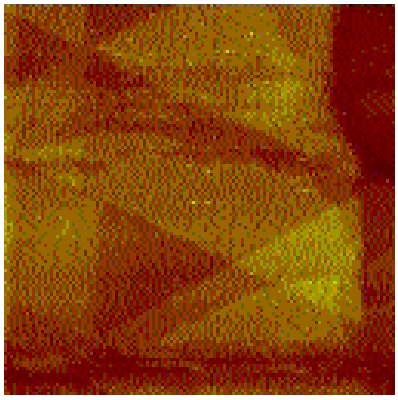

Figure 4. SECPM constant potential mode image of Au/Quartz in 0.115M KClO4, captured at electrochemical potential (Φ) setpoint of 100mV 250nm scan.

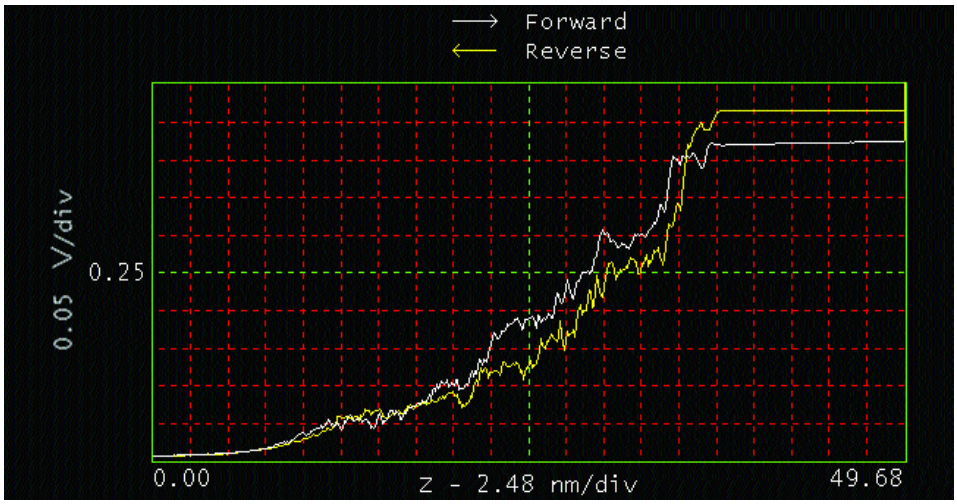

Figure 5. An example of SECPM electrochemical potential spectroscopy. These plots of potential (Φ) vs. Probe-sample distance were recorded above a HOPG sample in Glycerol as the probe approached (white plot) and retracted (yellow plot) from the sample. SECPM's unique, patented technology allows profiling the electrochemical potential across the electrical double layer, offering new insights into fundamentals of electrochemical processes at solid/liquid interfaces.

SECPM Specifications

Potentiostat Amplifier Gain	Sensitivity (mV/V)	Electrochemical Potential Measurement Resolution (mV)	Maximum Measured Electrochemical Potential (V)
1	1000	0.5	10.0
10	100	<0.1	1.0
50	20	<0.1	0.2
100	10	<0.1	0.1

Input Impedance: $>10_{13}$ Ω
Offset: <5mV

Veeco Instruments, Inc.
112 Robin Hill Road
Santa Barbara, CA 93117
Find out more at www.veeco.com
805-967-1400 • 1-888-24-VEECO

DS57, Rev A0