INSTRUMENTAL TECHNIQUE

SCANNING SPREADING RESISTANCE MICROSCOPY (SSRM)

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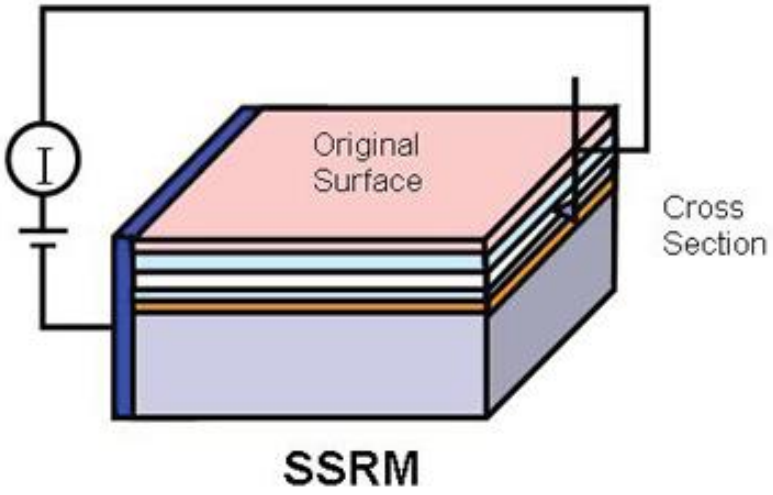
Probing the Local Electronic Structure of a Sample's Surface



SSRM is an implementation of a well-established Spreading Resistance Profiling (SRP) method used for micro and nano-scale. A generic SRP, however, is a dual probe technique, while in **SSRM** a conductive AFM tip scans a small device region with a common electrode, as shown in the Figure.

Measuring spreading resistance by SSRM

$$R = \rho/4a$$

Where,

ρ is the local resistivity of the sample and a is the tip radius.

- Additionally, resistance could also be calculated by ohms law.

- The operation of Conductive-AFM and **SSRM** is identical except that **SSRM** scans the cross-sectioned surface of a device, while in Conductive-AFM a generalized surface is scanned. The applications of **SSRM** include determination of dopant distribution in semiconductor materials as well as exact pn-junction delineation.

- At each point of the image, the force-distance curve is acquired and used to calculate the mechanical properties of the sample being measured.

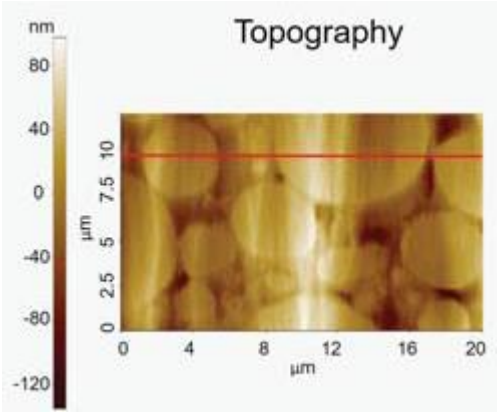
Different modes in SSRM

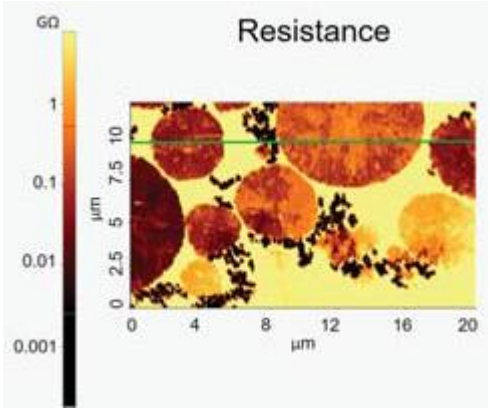
There are two **SSRM** modes according to the current amplifier being used.

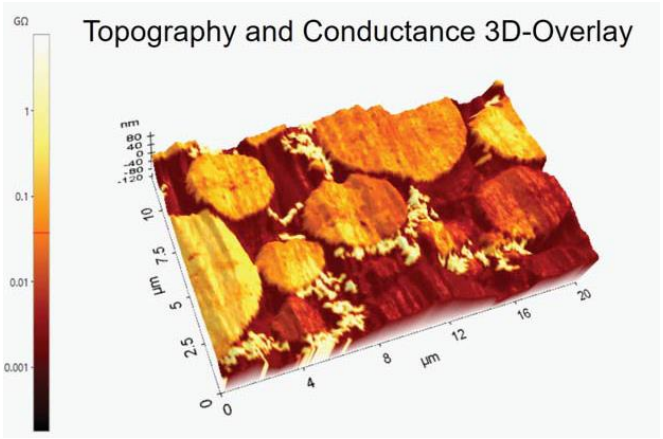
1. Internal **SSRM** and
2. External **SSRM**.

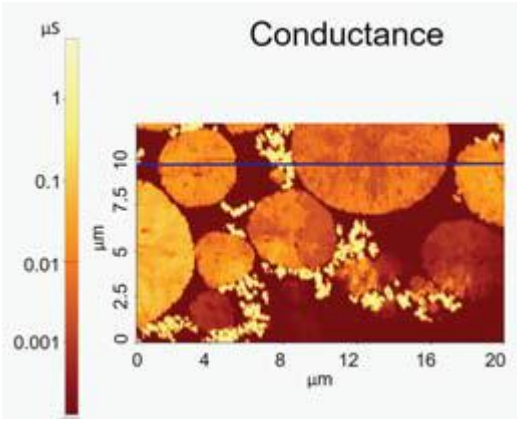
The 'Internal **SSRM**' mode refers to the **SSRM** mode that uses the current amplifier with fixed gain in the head extension module. The 'External **SSRM**' mode refers to the **SSRM** mode that uses the external low noise current amplifier with variable gain. In the external **SSRM** mode, measurable current range can be changed by varying the gain of the amplifier.

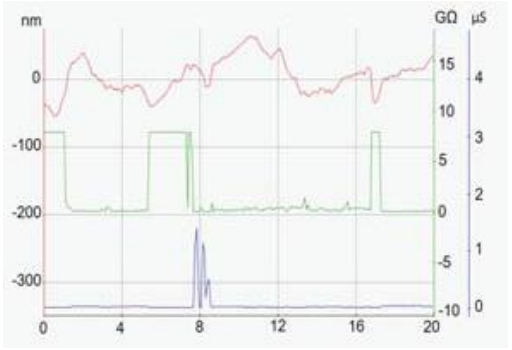
Tomography and electrical data of the sample







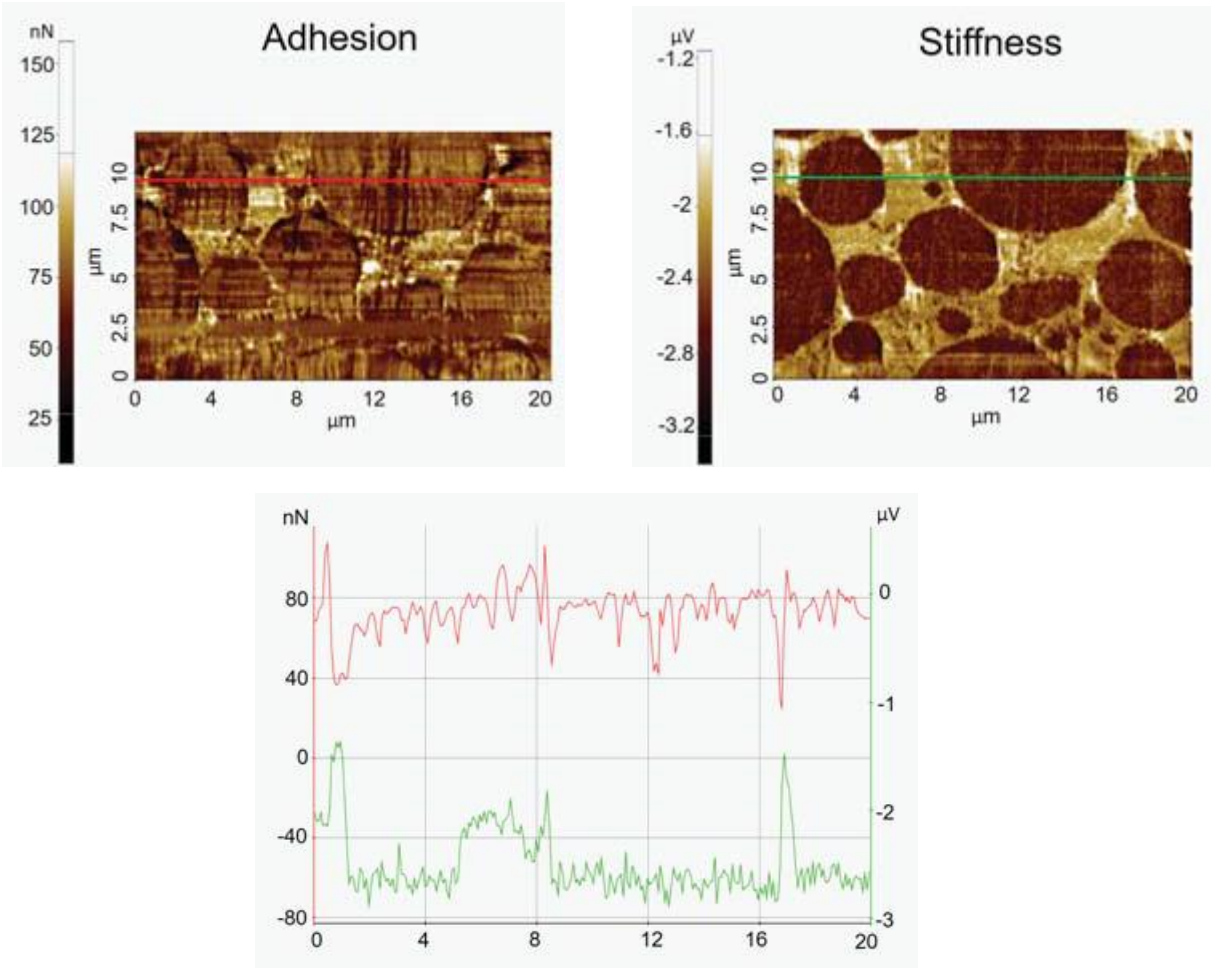




Topography (top-left) resistance (top-right) and conductance (middle-left) images acquired from an Lithium ion battery electrode sample. Line profile (middle-right): Topography line profile (red line, y-axis on left),resistance line profile (green, y-axis on right), and conductance line profile (blue line, y-axis on right).3D-overlay image of topography and conductance (Extreme right).

Source: Park systems

Mechanical data of the sample



Adhesion (top-left) and stiffness images (top-right) acquired from an LIB electrode sample. Line profile (bottom): Adhesion line profile (red line, y-axis on left) and stiffness line profile (green, y-axis on right).

Source: Park systems

THANK YOU ☺

Specifications

Common

- Carrier concentration: 10^{15} ~ 10^{20} carries/cm^3
- Lateral Resolution: 10 nm

External

- Transimpedance: 10^3 ~ 10^{11} V/A
- 4.3 fA / √Hz Input Noise
- Bandwidth: up to 500 KHz
- Bias voltage range: -10 ~ +10 V
- Current range: 1 pA ~ 10 mA

Internal

- Current range: 10 pA ~ 100 mA
- DC bias range: -10 V ~ +10 V
- (in 0.001 V increments)
- Noise level: 10 pA