

# AFM Microscopy

## Electrical Characterization ResiScope

The World's Greatest Performance  
for AFM Electrical Characterization

**CURRENT & RESISTANCE  
OVER 10 DECADES**

- » Current/ Resistance from  $10^2$  to  $10^{12}$  ohms
- » High sensitivity over the full range  
(automatic adjustable gain)
- » Current control & auto range driven by fast processor



# ResiScope

## Resistance & Current mapping

### The BEST tool for AFM Electrical Characterization

The ResiScope II is a unique system able to measure AFM resistance over 10 decades with a high sensitivity and resolution. It can be combined with several dynamic modes as MFM/EFM or KFM single-pass providing several sample characterization on the same scan area.

## Applications



- Photovoltaic
- Oxyde characterization
- Semiconductors
- Organic Electronic

## AWARDS

### 2014 : « Yves Rocard 2014 » Prize (Société Française de physique)

This prize has awarded the ResiScope for its instrumental innovation and the successful of technology transfer between an academic laboratory and a private company.

### FIEEC Prize for Applied Research at « Rendez-Vous Carnot 2013 »

These prizes reward research works which, through a partnership with an SME, which helped to generate growth and employment. CSInstruments received second prize.



# What you can do with ResiScope

**The World's Greatest Performance for AFM Electrical Characterization !  
ResiScope combined with the Nano-Observer AFM will deliver  
the best AFM electrical characterization result.**

## ResiScope

- AFM conductivity & resistance
- High sensitivity & resolution over the full range (automatic adjustable gain)
- True quantitative resistance/current mapping

## Soft ResiScope

- ResiScope on fragile & soft conductive samples
- No friction, Not AC modulation
- Constant force control



### Resistance measurements

Over 10 decades,  
from  $10^2$  ohms to  
 $10^{12}$  ohms



### Current measurements

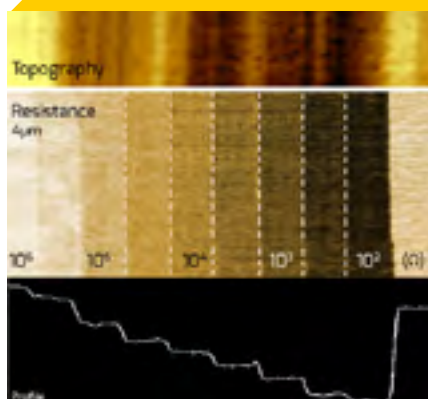
R, Log R, Current &  
I/V Spectroscopy



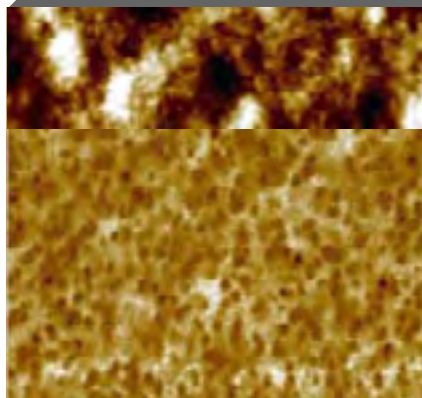
### High sensitivity

Over the full range

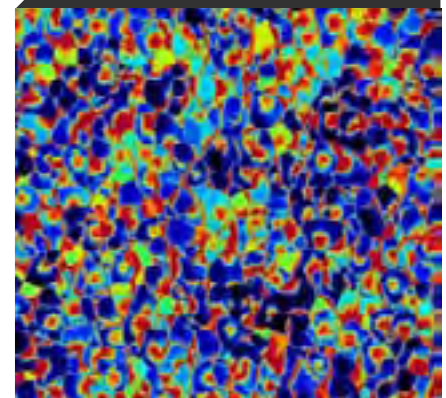
### Semiconductors



### Molecular electronic, Organic Photovoltaic...



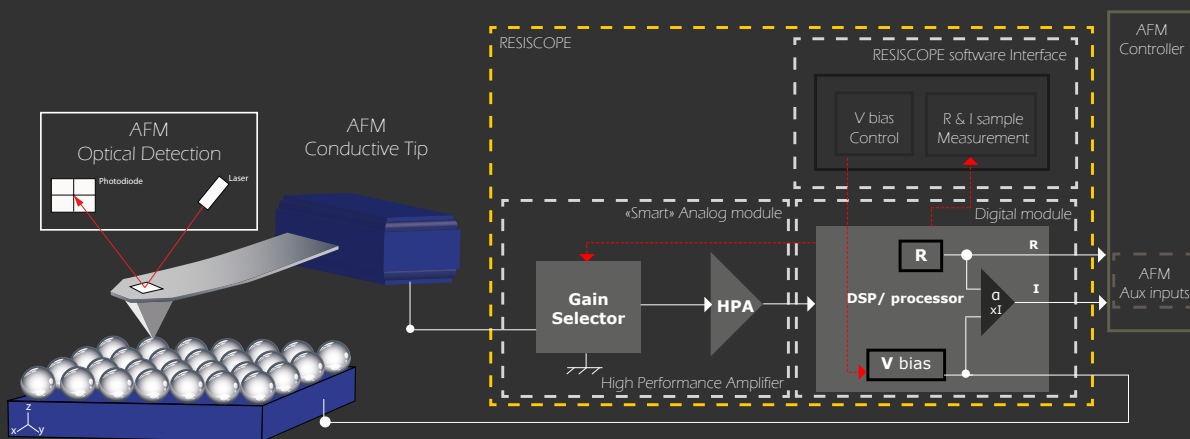
### Materials, metals, alloys, oxides



## Intuitive software

- Easy to use
- Automatic or advanced modes
- Configurable outputs
- Selectable output scale : R | Log R | Current
- Real time current & resistance measurements

## Principle



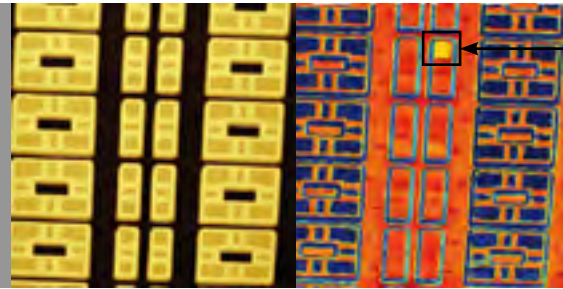
During the measurement, the DSP chooses in real time the best gain to optimize the measurement made by the amplifier module (HPA). This operating condition allows a very high sensitivity on all the range of resistivity at a regular scan speed (AFM). Contrary to other techniques, the current between the probe and the sample is controlled (current control). This has the result of limiting the local effect of oxidation or electrochemistry and protecting the conductive probe from high current damage.

ResiScope is a smart real-time control of the appropriate ranges to obtain the best measurement (sensitivity and range). It limits the current through tip and sample is limited to prevent any damage. It is more than a simple linear or Log amplifier used for a basic conductive measurement

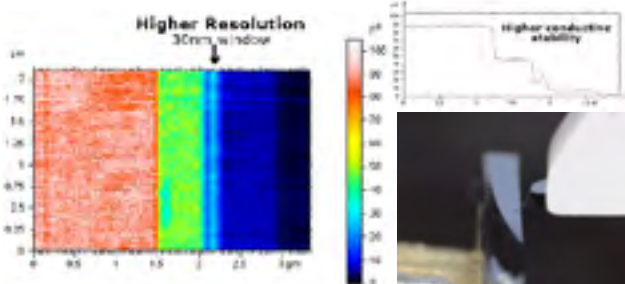
# Results

## SRAM

ResiScope measurements,  
Left : topography ; Right : resistance  
Scan size : 50 $\mu$ m  
On the resistance image we can see  
a resistance defect not visible on the  
topography



Resistance defect

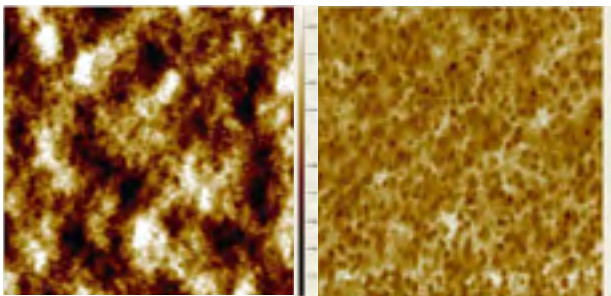
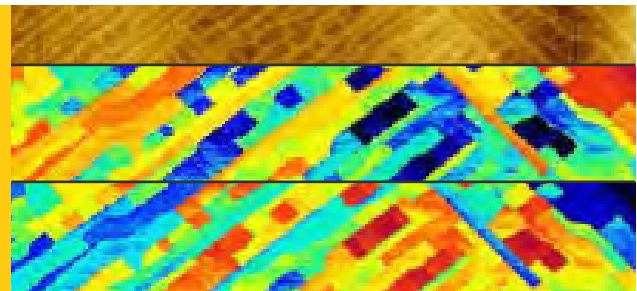


## Semiconductor solar cell sample (Back Surface Field)

Measurement made with the ResiScope and a Sharp Crystal Diamond 10N / m. The measurement highlights a clear 30 nm band of different resistance

V02, ResiScope mode, 20x6  $\mu$ m

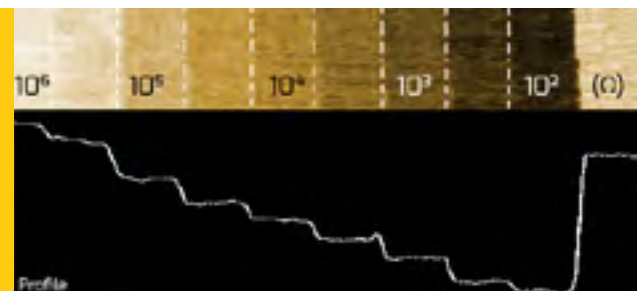
- Topography
- Current at 30°C from 0 to 500pA
- Resistance at 30°C from 0 to 5 GOhm



## SOLAR CELLS

Organic Solar Cell sample  
Some organic layers can not be  
measured by conductive AFM ( current  
burns the organic layer )  
Scan size : 5 $\mu$ m

« Stair case » sample showing clear  
different doping concentration (each  
step is about 400nm). No cross talk  
with topography and very clean and  
define electrical measurement.



More information  
<https://CSIinstruments.eu/ResiScope>



# The 3<sup>rd</sup> AFM Mode

## Soft IC + ResiScope

### Soft Intermittent Contact : Soft IC

Soft IC mode combines the advantages of contact AFM and resonant AFM modes without the drawbacks. Indeed, it is perfectly adapted for soft or abrasive samples and allows local electrical and mechanical measurements.

- Adapted for soft sample
- Mechanical properties : Adhesion, Stiffness, Young's Modulus
- Constant force = quantitative measurement
- Compatible with : ResiScope, SThM, PFM, C-AFM...

### Soft ResiScope

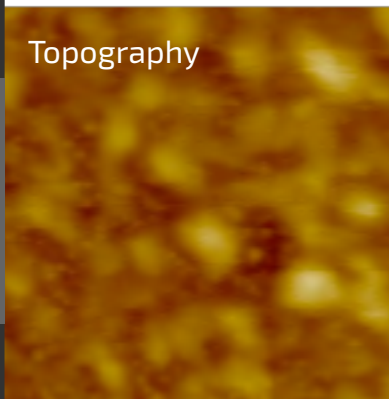
The soft resiscope allows to measure resistance and current on fragile conductive samples. The specific vertical movement applied to the tip in Soft Resiscope mode optimizes the electrical measurement at the time of contact and preserves the tip and the sample. Unlike other oscillating techniques available on the market, the Soft Resiscope measures current / resistance by keeping static tip and maintaining a renewable electrical measurements. The electrical measurements are then comparable to those made in AFM contact mode but with the advantage of being able to measure fragile samples.

#### Applications

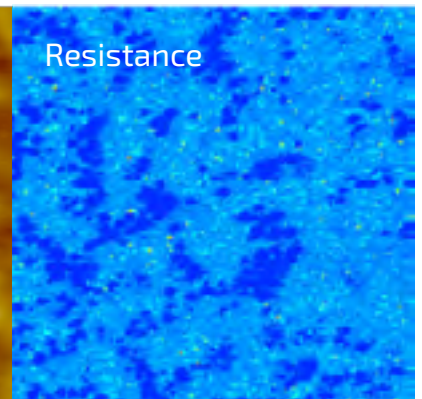
- Semiconductor
- Polymer
- Nanotubes
- Organic materials
- Nanostructure

#### P3HT 3 $\mu$ m scan

Topography

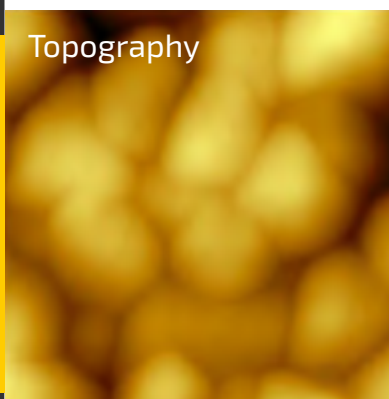


Resistance

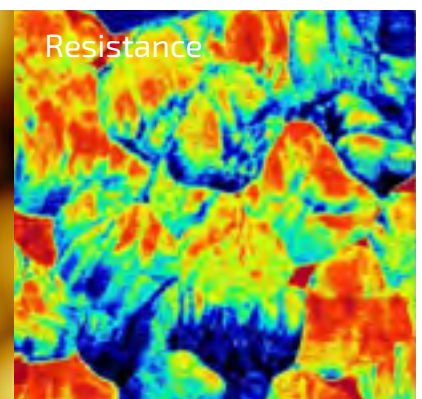


#### Conductive composite materials in powder form 2.5 $\mu$ m scan

Topography



Resistance



# Principle & benefits

**Soft ResiScope is a unique mode to measure resistance and current on all kind of samples including soft samples.**

- Resistance & current on fragile conductive samples
- No friction and constant force
- Quantitative electrical measurements

## Principle

1. Stiffness
2. Topography & Constant Force = Quantitative Measurements
- Soft ResiScope** measurements
3. Adhesion
4. Next point

## Quantitative measurements

The comparison of quantitative electrical measurement between the ResiScope and the Soft ResiScope shows that we obtain the same values. So, Soft ResiScope keeps the quantitative measurement

## Non-Destructive method

The sample is imaged without friction effects and damaging. This image proves that we can image soft samples with the Soft ResiScope.

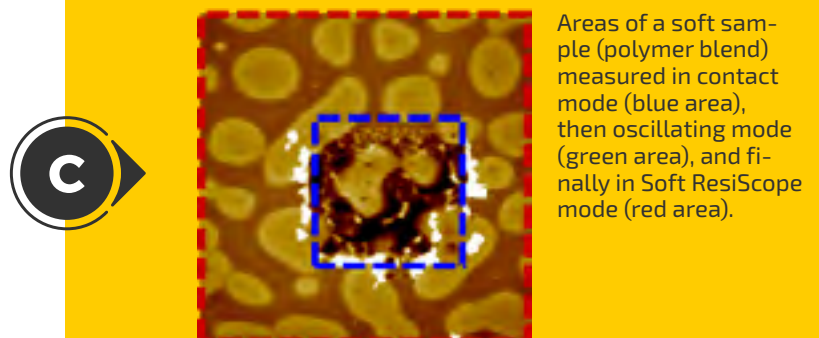
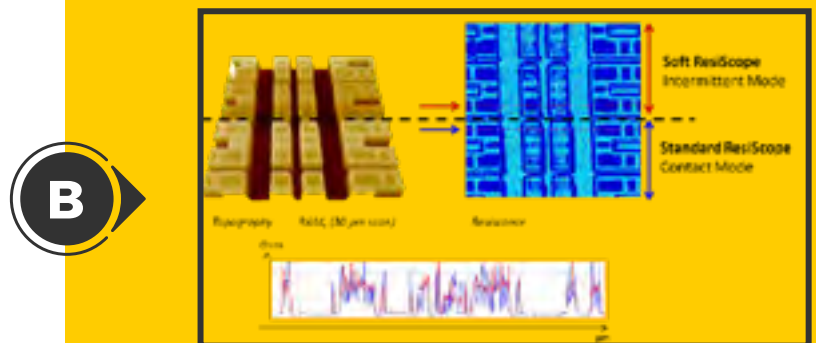
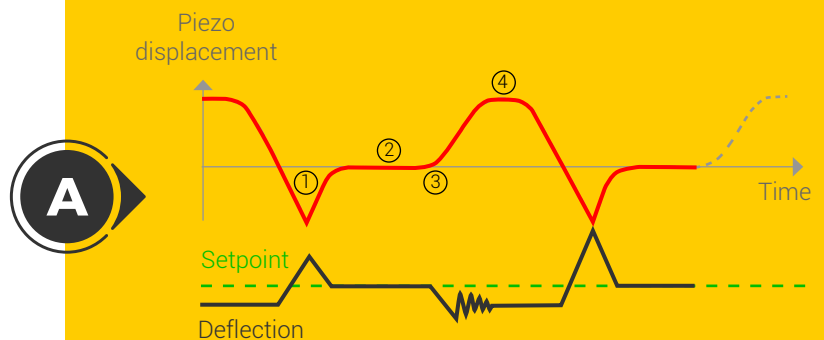
More information  
<https://CSInstruments.eu/Soft-IC>



More information  
<https://CSInstruments.eu/Soft-ResiScope>



## Soft IC + ResiScope = Soft ResiScope





CSInstruments is a French scientific equipment manufacturer specialized in the conception of Atomic Force Microscope and options designed for existing AFM

CSInstruments company was founded by a team of experts working in the AFM field for more than 30 years, starting as pioneers for some historic manufacturers. Taking the best of this experience to create the Nano-Observer, a high quality research AFM giving life to an affordable solution for any research laboratory or industry...



More information : [www.CSInstruments.eu](http://www.CSInstruments.eu)



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