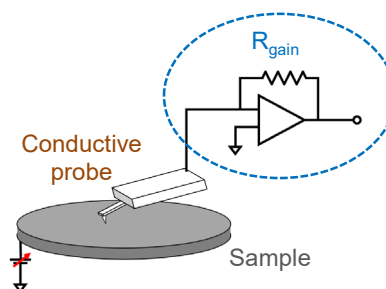


# Conductive AFM Imaging on Jupiter XR

Conductive AFM measures current to determine local variations in sample conductivity. Images of sample topography and conductivity are acquired simultaneously with nanoscale spatial resolution allowing for local electrical properties to be correlated to sample morphology. Electric current measurements ranging from picoamperes to microamperes can be performed on a wide array of samples including thin dielectric films, ferroelectric films, nanotubes, conductive polymers, and others.

## How It Works

ORCA™ (Optimized Resistance Conductance Amplifier) is a conductive AFM imaging mode on Asylum Research AFMs and consists of a specially designed probe holder. Bias is applied to the sample while a conductive probe scans the surface in contact mode. As the tip is scanning the sample surface, any current flow detected between the tip and the sample is recorded and a conductivity image is constructed.



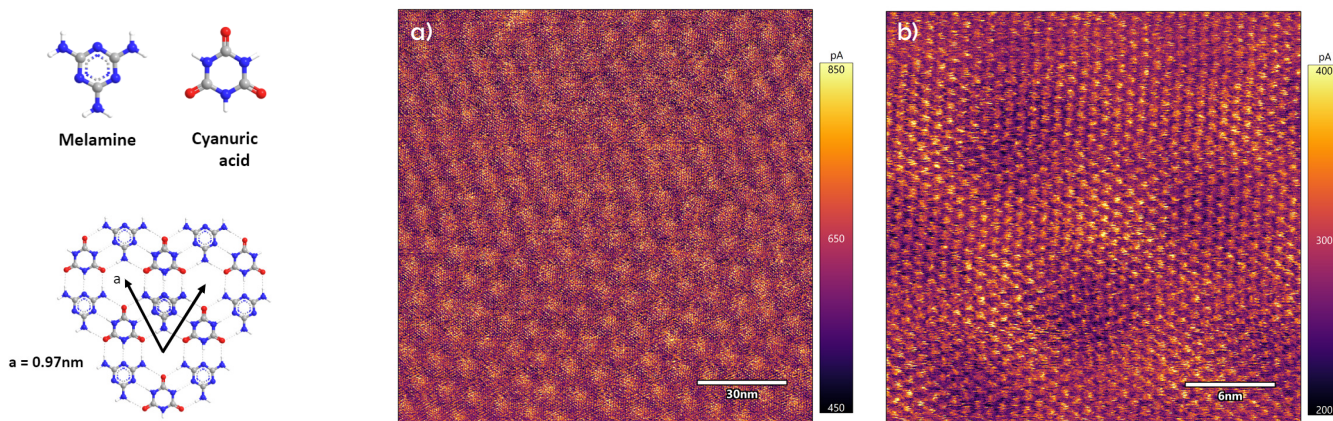
Schematic representation of an ORCA conductive imaging setup.

## Hardware

ORCA holder includes a transimpedance amplifier with standard values of the amplifier gain (resistance) ranging from  $5 \times 10^7$  to  $5 \times 10^9$  volts/amp. The standard single gain ORCA holder has a sensitivity of 2 nA/V which allows for current measurements from ~1 pA to 20 nA. The Dual Gain ORCA holder has two separate amplifiers with sensitivities of 1 nA/V and 1  $\mu$ A/V and can measure a wider current range of ~6 pA to 10  $\mu$ A.

## Results

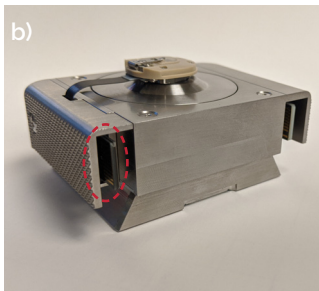
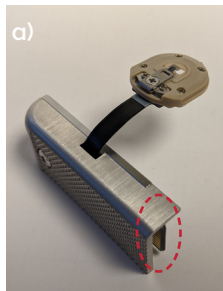
The high sensitivity and low noise of the ORCA conductive imaging allows for exceptional resolution and high quality images. An example of such results is shown below, where melamine and cyanuric acid molecules assembled on a graphite surface show both the Moiré pattern as well as the molecular lattice arrangement.



When deposited on a graphite surface, melamine and cyanuric acid form an extended hexagonal network that exhibit Moiré pattern of 12 nm and molecular lattice of 0.97 nm. Images were acquired using single gain ORCA holder at a) 6.5 Hz and b) 10 Hz scan rate.

## ORCA cantilever holder

The ORCA cantilever holder is designed with the user in mind and can be easily exchanged with the standard gas cantilever holder within a minute. Once the ORCA cantilever holder is secured onto the Z scanner, the scanner connects to the AFM and the holder is automatically recognized by the software through the electronic "plug and play" connector.

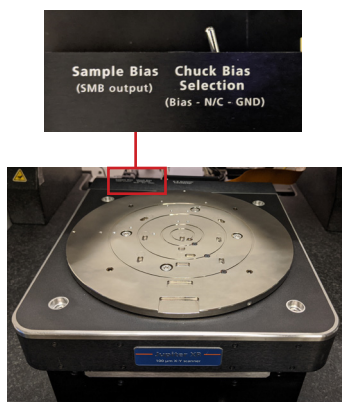


a) ORCA cantilever holder with a dedicated ID module

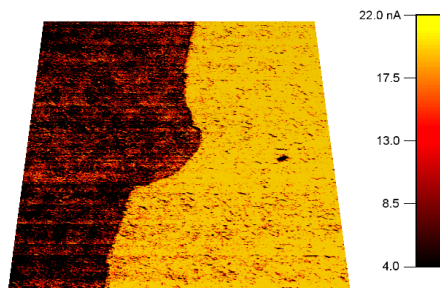
b) ORCA cantilever holder mounted on the Z scanner

## Sample Bias

The 200 mm sample chuck is electrically connected to the XY scanner and the electrical state of the chuck is controlled directly from a toggle switch on the XY scanner. The sample chuck can be set to one of three states: bias, floating, or ground. The magnitude of the bias applied is set from the software interface.



Sample chuck mounted on the XY scanner with the inset showing the electrical settings of the sample chuck.



Indium tin oxide (ITO) covered glass with a discontinuous 60 nm thin layer of platinum (Pt) on top of it. The region covered with Pt shows higher conductivity than bare ITO

## Specifications

ORCA conductive AFM mode enables conductive AFM imaging and I-V (current-voltage) measurement capabilities. The standard module is capable of measuring currents from ~1 pA to 20 nA. Other current ranges and dual gain versions are available.

### Sample compatibility

- Samples up to 200 mm in diameter and up to 35 mm in thickness can be measured

### Cleaning

- Wipe with alcohol
- Do not immerse in fluid

### System compatibility

Jupiter XR

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