

Standard Operating Procedure of Atomic Force Microscope (Anasys afm+)

The Anasys Instruments afm+ system incorporates an Atomic Force Microscope which can scan the sample in the contact mode and generate topography images of the sample.



Product specifications

Motorized XY Stage Range: ~8 x 8 mm

Spatial Resolution (XY stage): <1 micron

Z Stage Range: >4 mm

Optical field of view: ~900 x 600 microns low zoom, ~300 x 200 microns high zoom

Spatial Resolution (optics): ~1.5 μm

Sample Size: 40 mm dia.

AFM Mode

XY Scan Range: 100 x 100 microns, closed loop control

Z Scan Range: >7 microns

I Sample Preparation

I-1 Sample Placement

- Samples need to be placed or prepared on a metal disk which can be supplied by Anasys. The metal disks are magnetic stainless steel and they are held in place in the afm+ by a magnet in the sample mount.
- The measurable area of the disk is 8 mm by 8 mm, so all areas of interest on the sample must be within this region.
- Samples need to be held down well to the metal disk either with epoxy or double sided tape.

I-2 Sample Preparation Methods

Most samples can be imaged directly as long as they are flat, dry and rigidly held in place. For some samples, such as polymer blends or multilayer films you may need to section them to access the material of interest. This can be

done by using a microtome (or cryo-microtome) to make a flat surface. If you have a sample in solution you can spin coat onto a piece of silicon wafer or glass slide or simply deposit a droplet of material to dry (it is hard to control the thickness with this method)

I-3 Sample thickness

The thickness of the sample is limited by the Z travel of the stage which moves the AFM probe down to the sample surface. Typically this is greater than 4 mm.

I-4 Sample roughness

The smoother a sample is, the easier it will be to get good results. Generally it is best to keep the roughness below 100 nm RMS.

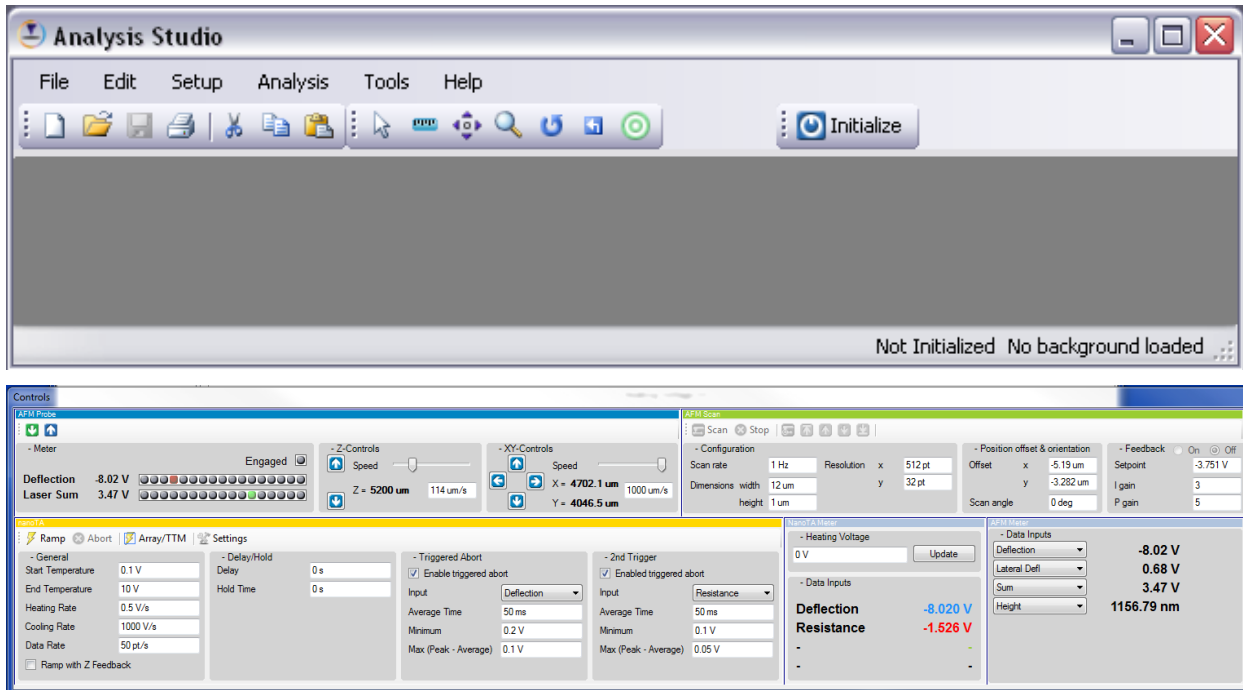
I-5 Handling/Storage

The sample must be kept clean – free of dust, fingerprints, or other contaminants as well as defects such as scratches.

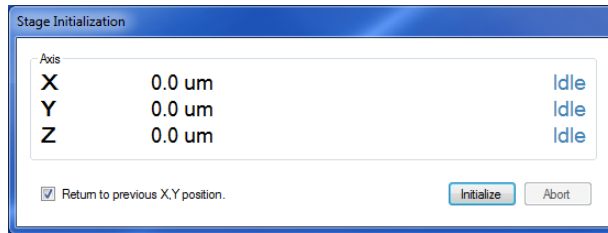
II System Preparation

II-1 Turn on the afm+ electronics via the rocker switch on the back of the Power Supply box. The power indicator lights on the fronts of the Controller and Power Supply boxes should illuminate.

II-2 Open the Analysis Studio software by double-clicking its icon on the computer screen . The software interface should look similar to the screen below.



II-3 Initialize the system by selecting the Initialize icon on the top toolbar of the software. This operation verifies communication between all the components and readies the hardware and software for use. The bottom status bar will change from “Not Initialized” to “Idle” when initialization is complete.



III Sample Installation

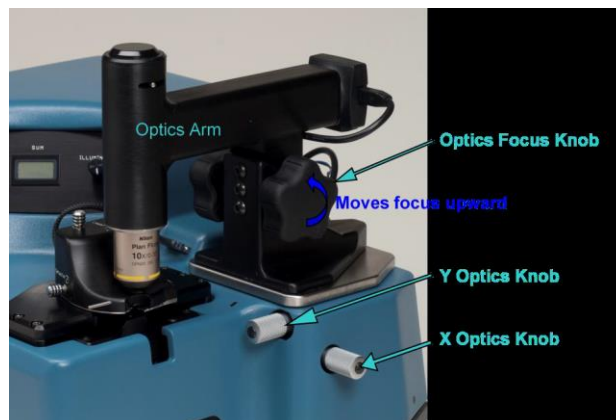
The sample is prepared on a metal disk. The disk is then placed on a sample mount before it is placed into the afm+ system. **Be very careful not to touch the top surface of the sample. The top surface of the sample should be relatively flat.**




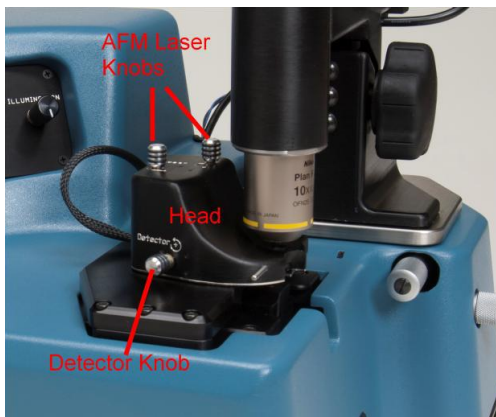
There needs to be enough clearance between the probe and sample so that they do not touch when the head is lowered back down. **The safest route is to raise the head to the top of its range before lowering the head. Go to the Setup menu and select Initialize Stage.**

IV AFM Laser Alignment

Once a probe and sample are mounted, the next step is to align the AFM laser onto the probe.



Start by adjusting the optics so that the cantilever is centered and focused in the optical view. To open the optical view in the software, select the left optics icon on the top toolbar of the Microscope Window. This view can be made full screen by selecting the right optics icon.  Use the X and Y optics knobs to center the cantilever in the optical view. Use the optics focus knob to bring the cantilever into focus.

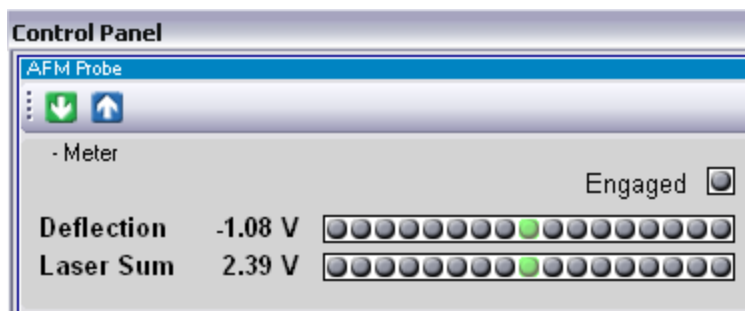


The AFM laser is moved onto the cantilever by adjusting the two AFM laser alignment knobs on the top of the head. The knob on the left moves the AFM laser spot perpendicular to the cantilever. The knob on the right moves the AFM laser spot parallel to the cantilever. The laser spot needs to be positioned on the end of the cantilever. If the red spot is difficult to see try decreasing the white illumination using the Illumination knob on the afm+ cover. Once the laser spot looks correctly positioned on the cantilever, fine tune the position by watching the Laser Sum value in the AFM Probe Meter panel. **This value should be maximized while still keeping the laser spot close to the end of the cantilever in the optical view.**



V Detector Alignment

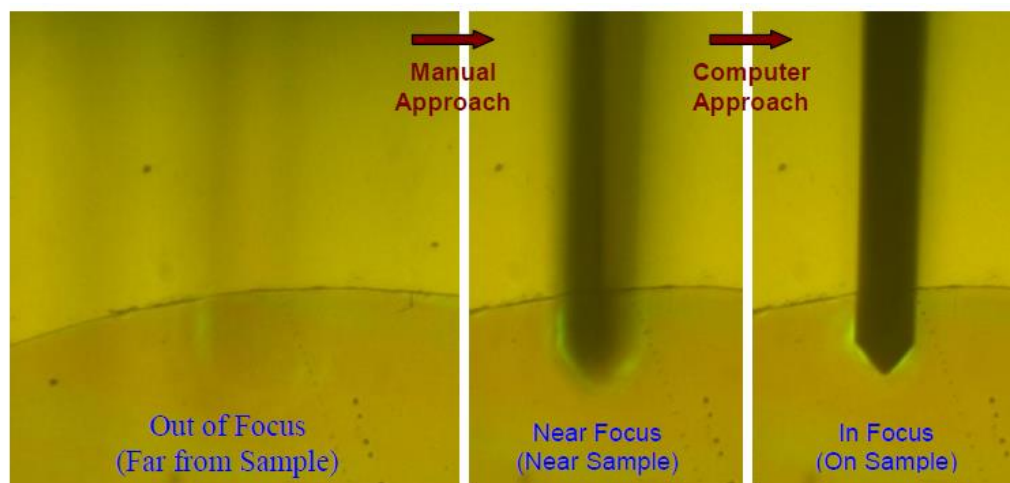
After aligning the AFM laser on the cantilever, the next step is to center the reflected light from the cantilever onto the detector. While looking at the AFM Meter display, adjust the detector knob on the front of the head to achieve a green indicator on the Deflection light bar.




Once the green light in the light bar is illuminated, the user should **confirm that the Laser Sum value is greater than 1 V**. The exact value will depend on the type of cantilever loaded and the position of the laser spot on the cantilever.

VI Probe-Sample Approach

The last step of the AFM preparation is to bring the probe into controlled contact with the sample. There are two parts to this process: an initial, manual approach of the probe toward the sample and a final computer-controlled approach. The initial approach is accomplished by watching the probe come into near-focus above the sample while manually controlling the Z position of the probe. First make sure that the cantilever is near the center of the optical view. Then rotate the focus knob until the surface of the sample surface is in focus. Use the X and Y sample knobs to move the sample around in the optical view to find the area of interest on the sample. Center the approximate location of the sample you want to analyze in the optical view.

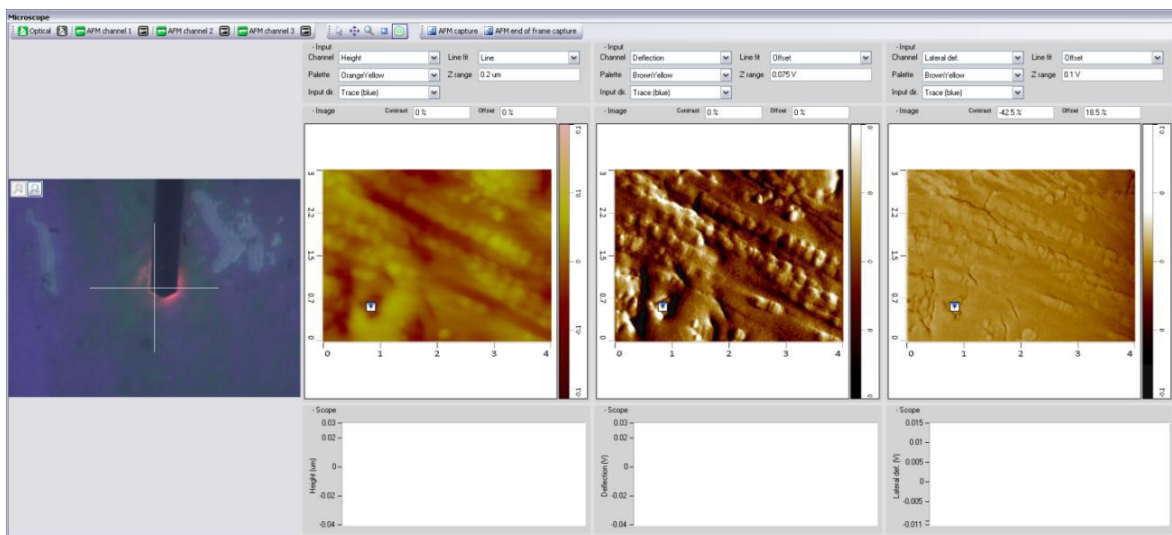




Next the probe will be moved down very close to, but not touching, the sample surface. Make sure that the Z speed in the AFM Probe panel is set quite low; **a good value is 50 $\mu\text{m/s}$** . **If the speed is too high it is easy to crash the probe into the sample surface**. While watching the optical view, use the “Down” Z Control button to move the probe down towards the sample surface until the cantilever is almost in focus. With the probe nearly in focus above the sample, finish the approach by selecting the Engage icon on the AFM Probe toolbar . This will start the computer-controlled approach to slowly bring the probe into contact with the sample surface. Once the probe successfully contacts the surface the Engaged status button in the AFM Probe panel will flash green.


VII AFM Image Acquisition

Once the probe is engaged on the sample surface, the imaging parameters in the AFM Scan panel can be optimized. The first parameter to set is the Setpoint value. This parameter controls the force between the tip and sample. The lower the Setpoint, the smaller the force is. Set the Scan Dimensions for the desired image size. Resolution is the number of data points collected in x and y. The number of scan lines (y resolution) and the scan rate directly affect the amount of time it takes to collect an image. A typical scan rate is 1 Hz for regular AFM imaging.

To begin scanning, click the Scan button on the AFM Scan panel toolbar. To collect a height image, set Channel 1 to Height in the Input panel above the left image in the Microscope Window. Up to three channels can be collected simultaneously.



Centering the image at a specific location can be done by putting the cursor in Target mode (select the target button  on the upper toolbar), then clicking on the AFM image at the desired location. This will stop the scanning and move the probe to this location on the sample. To begin scanning centered about this location, click the Target Scan button  in the toolbar of the AFM Scan panel.

AFM data is written to the document and will appear in the Document Window when the „AFM Capture“ button in the Microscope Window toolbar is clicked. If the „AFM end of frame capture“ button is selected, the data will be moved into the document once the AFM scan reaches the top or bottom of its current frame. The document itself must still be saved (File/Save) to save the data beyond this session. When the scanning session is over, press the withdraw button  to pull the probe away from the surface.