

## Quick Start Bruker MultiMode 8 AFM

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GLA Contacts

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- 1) Sign into the logbook. Review Figure 1 to remind yourself of the MultiMode 8 components. If you have not done so read the [Experiment Guide in the online manual](#), it has detailed descriptions of how to set up the AFM.
- 2) Check that the computer and controller are both on. If one or both are off, contact a GLA for assistance.
- 3) The MultiMode AFM and DI STM are stored on the isolation table under black covers. The STM is smaller than the AFM. Remove the cover.
- 4) The scanner is the cylindrical unit below the head (Figure 1). There are three scanners, A, E, and J, which have different x, y, and z range specifications (see Table 1, and Figure 6). Select the scanner that is appropriate for your sample. J scanner is recommended for general purposes and is the most convenient to use. To change the scanner, disconnect the cable connecting the scanner to the base and lift the scanner out of the base. For J scanner, use springs attached to it to connect to the base. For E scanner, use default springs. For A scanner, loose the two screws on the side and change to the shortest springs. Use the stabilizing screw in the front base to secure the scanner. Store it in an appropriate container located on the shelves at the back of the room.
- 5) Launch the Nanoscope 8.15 software located on the desktop. Ensure that the AFM selected is the MultiMode 8. If not, click “Change Microscope Setup” and select MultiMode 8. Select which type of experiment you want to run (ScanAsyst) and click “Load Experiment.” Click “Tools->Select Scanner” to select the scanner you are going to use.
- 6) Adjust the camera position by the knob in the back if you change the scanner. Raise the camera (Figure 1) to its maximum height by rotating the knobs on either side of the camera stand.
- 7) Move the AFM base to its position on the translation stages under the microscope. Take care to avoid bumping the AFM head during this process. The feet of the AFM base fit into depressions on the translation stage. The base should be level.

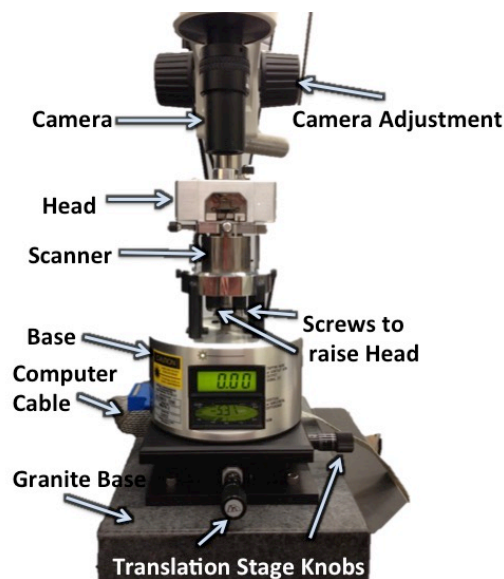


Figure 1. Diagram of the MultiMode AFM setup with camera.

- 8) Connect the cable between the MultiMode AFM and the Nanoscope V controller (Figure 1). The laser will turn on and the displays will light up. Verify the left toggle switch is set to TM AFM for tapping mode. The cable connection is temperamental and so you should avoid touching the cable while working.
- 9) In the software, select “Setup” from the menu on the left and follow the on-screen instructions.
- 10) Raising the head: Raise the camera stand.
  - a. For J scanner, pull the right toggle to “UP”.
  - b. For E or A scanner, manually raise the AFM head by adjusting the two manual screws below the scanner (Figure 1). Turn the screws counterclockwise when viewed from above (clockwise when viewed from below) to raise the head. (You are turning the screws to move them into the body of the scanner that raises the head.) The third screw is automatic and can be adjusted by pulling the right toggle switch toward “UP”.
- 11) Attempt to raise the head so it is level (you can place the small level on the head) and there is enough space for a sample to be easily placed between the scanner and the tip. This will prevent the tip from being damaged when removing and replacing the head.
- 12) Removing the head: Disconnect the cable connecting the head to the base. While holding onto the head **CAREFULLY** remove the two springs. Lift the head off the scanner and place it on the table.

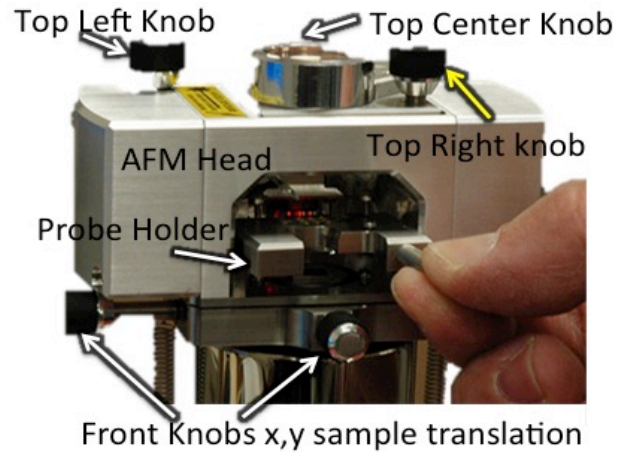


Figure 2. The front of the AFM head with the probe holder installed. The Top Center and Right Knobs adjust the position of the laser in the probe. The Top Left Knob adjusts the position of the laser on the detector and the difference signal. The Front knobs adjust the x and y position of the sample with respect to the probe.

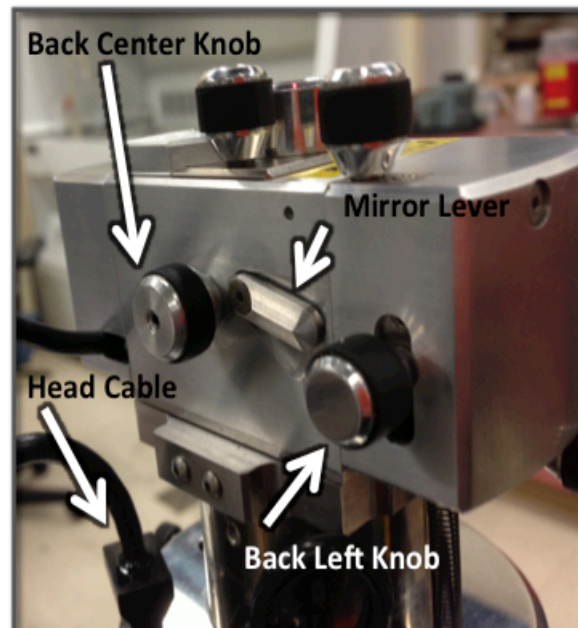


Figure 3. The back of the AFM head. The cable connects the head to the base. The back center knob is used to lock and unlock the probe holder in the head. Use the mirror lever if necessary to adjust the sum value. Use the back left knob to make fine adjustments to the difference value.

- 13) Remove the probe holder: First loosen the screw on the back center of the head (Figure 3) and remove the probe holder by pulling it out of the head with the little handle
- 14) Loading the probe (cantilever and tip) in the probe holder (Figure 2): Turn the probe holder over and press down on the side with the gold clip. Transfer your tip with tweezers so it fits in the groove and release the gold clip to secure it in place. Pick up the holder by the handle and turn it back over, so the six gold connectors are facing up. Then place the probe holder back into the head and tighten the center screw on the back of the head.
- 15) Secure your sample to a magnetic puck. If the sample is reflective, place it on the puck if not, load a reflective sample (e.g. polished silicon) on the puck. Place the puck on top of the scanner. These 12mm-diameter magnetic pucks can be bought from Bruker accessories.
- 16) Check to be sure the tip will not contact the sample surface. If it looks like it might, raise the scanner head until there is enough clearance.
- 17) Replace the head on top of the scanner and while holding onto the head **CAREFULLY** secure the head with the springs. Connect the cable to the base.
- 18) The light for the camera is located on the desk to the left of the monitor. Turn the light on and adjust the brightness so you can see it on sample.
- 19) Move the adjustment knobs on the translation stage until the camera light hits the cantilever.
- 20) Lower the camera and focus on the cantilever. Adjust the camera brightness until it is appropriate. Due to variation in probe size and its position in the probe holder, it may not be visible in the camera immediately. Move the AFM base (Figure 1) using the translation stage adjustment knobs to adjust the x and y positions until the tip is in view.
- 21) Click the mouse in the video panel on the end of the tip.
- 22) Focus the camera on the sample surface.
- 23) For J scanner, press the right toggle to “DOWN” to move the cantilever close to the sample surface. For E or A scanner, manually lower the cantilever down toward the surface by turning the screws (Figure 1) and press the right toggle switch toward “DOWN” to lower the automatic screw to keep the head level. Do this slowly until the cantilever comes into focus. You may need to move the translation stage some if the sample seems to move in the video display. You should now see both the surface of the sample and the cantilever.
- 24) Turn down the illuminator intensity so you can see the red laser spot.
- 25) If the laser is not visible in the camera, adjust the top right and center knobs (on the top of the head) (Figure 4), which move the laser in the x and y directions, respectively. Once the laser is located, position it on the tip of the probe.
- 26) Align the laser: Maximize the signal sum (dark hatches around periphery of lower display, see Figure 5) with the right and center knobs. (If the sum

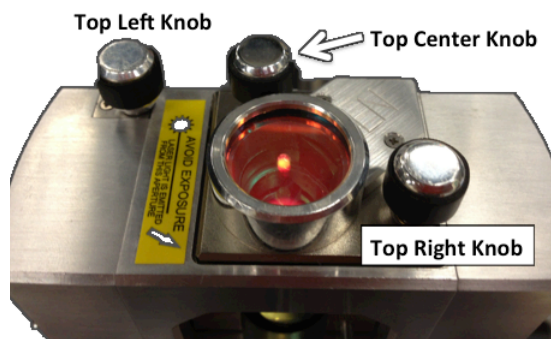


Figure 4. The top of the AFM head. The top left knob is used to adjust the difference value. The top center knob moves the laser in the y-direction and the top left knob moves the laser in the x-direction.

signal is too small use the mirror lever to maximize it, Figure 3). The sum signal should be approximately 4.0 - 9.0V for silicon nitride cantilevers. The value of this signal varies with many factors. Note that it is possible to see a large response on the bar graph without having the laser beam on the probe, so it is important to visually verify that the laser beam is on the probe and not rely on the bar graph alone. Laser beam improperly aligned will usually destroy the cantilever and may damage the sample.

- 27) Minimize the signal difference (Figure 5) by adjusting the left knob on the top of the head. Once the difference is within  $\pm 2V$ , use the fine adjustment knob on the back left of the head (Figure 3) to reduce the difference to within  $\pm 0.5 V$ . If this method doesn't bring the difference close to zero, you can adjust the mirror lever (Figure 3) on the back of the AFM head to try to minimize the difference. Usually, there is no need to touch the mirror lever on the back and the mirror lever should be in the middle.
- 28) If you used a reflective sample to align the laser and you now need to load your own sample. Remove the AFM head by adjusting the three screws to raise the head away from the sample, removing the springs and cable connecting it to the base. Place the head aside and add your sample to the stage. Replace the head, reattach the cable and springs.
- 29) Find the surface: Focus the camera on the surface of the sample. The cantilever is out of focus. Carefully lower the head till the cantilever is in focus.
- 30) Find a region of your sample you want to image. You can move the probe by adjusting the knobs on the front and left sides of the head (Figure 2). The left knob moves the probe in the x direction and the front knob moves the probe in the y-direction.
- 31) In the software, click on the tip of the probe to move the crosshair to mark the position of the tip. Check that the switch on the AFM base is set to the appropriate type of imaging.
- 32) Select "Check Parameters" from the menu on the left. Enter the parameters appropriate for the sample you are scanning. If you are using the ScanAsyst Mode, change the Peak Force Setpoint to 0.05V. Also click "Microscope->Engage Settings", change the Peak Force Engage Setpoint here to 0.05V. If you don't use the ScanAsyst mode, you need to tune the cantilever. In tapping mode this can be done simply by pressing "Auto Tune," or you can manually tune the cantilever. The full User Guide is available by pressing F1 and includes information about what each parameter does.
- 33) Select Engage from the menu on the left. The automatic screw will lower the probe to the sample surface. The software will automatically proceed to "Scan" and you will begin to see the image as it collects on the screen. You will hear a continuous sound made by the instrument. It comes from the driving frequency which can be heard by human ears.
- 34) Modify the parameters to optimize the data quality and choose one of the image capture options. Select the directory for saving your files by clicking on the "Select Capture Directory" button. Name your file. When you are ready to save your image, select one of the capture options ("Capture," "Capture Continuous," or "Capture Now"). The image should



Figure 5. The sum and difference values on the lower display. The sum is shown by the hash marks around the edge and must be maximized. The difference should be minimized

save in your directory with the file name you gave it. When the image is finished collecting, you may wish to adjust additional parameters, or you can in the software (menu or the left of the screen) “Withdraw” the tip and move the head to a new location to scan.

- 35) When you finish collecting data, “Withdraw” the tip, and raise the scanner head. For J scanner, press the right toggle to “UP”. For E or A scanner, raise the two front screws by turning the counterclockwise direction (when viewed from above), and press the right toggle switch toward “UP” to raise the back screw until it is level with the front.
- 36) You can run additional samples by repeating steps 26-33.
- 37) When done, “Withdraw” the tip, remove the head (step 10-11), remove your cantilever (step 12), and remove your sample.
- 38) Replace the probe holder in the head and tighten the back center screw of the head.
- 39) Place the head back on the top of the scanner, reattach the springs and connect the cable.
- 40) Disconnect the cable from the MultiMode base. Move the multimode to its original location on the isolation table and cover with the black cover.
- 41) TURN OFF the microscope illumination. CLOSE the software and clean the area around the microscope and computer when you are finished.

Table 1. Scan size and vertical range for the A, E, and J scanners.

| Scanner | Scan Size<br>$\mu\text{m}$ | Vertical Range<br>$\mu\text{m}$ |
|---------|----------------------------|---------------------------------|
| A       | 0.4 x 0.4                  | 0.4                             |
| E       | 10 x 10                    | 2.5                             |
| J       | 125 x 125                  | 5                               |

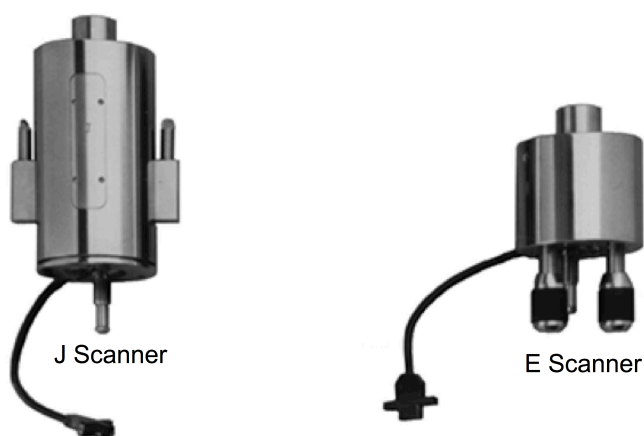


Figure 6. The left is J scanner. The right is E scanner (longer) or A scanner (shorter).