

SCANNING TUNNELING MICROSCOPE

Operating Instructions On How To Get Atomic Resolution Images

Do NOT turn on the electronics or the computer until you have followed the STM Set-Up procedures listed below:

STM Set-Up: Use either a scanning tip from the tip wire box (skip to the “While holding the tip wire...” step.) or create your own in the following manner:

- Cut about 7 mm (1/4 inch) of tungsten tip wire using the needle nose pliers to hold the wire and the wire cutters to cut the wire.
- Obtain at least a 45-degree cut on one end of the tip wire, which becomes the scanning tip. Hold the tip wire with the tweezers in one hand and do an angle cut with the cutting pliers with the other hand. When making this cut, pull upward in order to create the sharpest tip possible.
- While holding the tip wire with the tweezers, bend the blunt end of the tip wire about 20-degrees and insert it into the metal casing within the white tip holder of the scanning head. The bending will help to create some friction so the wire will stay in the tip holder. If you use a pre-cut tip, make sure the blunt end is inserted into the tip holder. (Note—use the magnifying glass to see the tip.)
- IMPORTANT—Make sure that the wire tip does not come into contact with the sample being scanned to assure a good image during the following steps. Use the macroscope or magnifying glass to watch the location of the tip.
- Turn on the fiber optic light source to see the scanning tip
- Set the scanning tip unit on the scanning base. Plug the small black serial input into the serial port on the backside of the scanning base.

- Set the back leg of the scanning tip unit onto the magnetic base ring closest to the serial port. Align the other two holes/slots with the protruding legs arising from the scanning base.
- Turn the brown rubber screws below the scanning base to level up the top of the scanning tip unit. By turning the screw to the right, the leg will extend upward, thus raising that side of scanning tip unit. Turning the screw to the left, the leg will withdraw downward, thus lowering that side of the scanning tip unit.
- After the scanning tip unit is level, lower it closer to the sample by turning the screws simultaneously to the left to keep the two sides even. During this process the backside of the scanner will stay at the original height.
- Get the scanning tip as close as you can to the sample without touching it.
- Turn off the fiber optic light when operating the STM to avoid electrical interference.

Power Up:

- Flip the toggle switch up on the backside of the electronic unit located above the power input.
- Push in the button on the right front/bottom of monitors #1 and #2.
- Flip the rocker switch located at the rear of the right side of the computer.

Operating the STM from the keyboard:

- On the start-up menu on monitor #2, it defaults to Choice #1, press enter.
- To run the STM program, press z and enter.
- See Command at the bottom of the screen. It defaults to Engage. Press enter to start the scanning process.

- At the bottom of the screen, tip travel will be measured in nanometers (um) up to a maximum of 250. If the tip is too far from the sample, it will beep when it reaches 250 and state that tip failed to engage.
- If this happens, enter the Withdraw command three times to stop the scanner and slightly raise the tip from the sample. Look at the tip with the magnifying glass inserted lens and turn the brown screws to the left simultaneously. Check after each turn to see if tip is just barely above the sample. Enter Engage again.
- After atomic image appears on monitor #1, it may take a few minutes for the image to stabilize. Be patient.
- To move to other Command options, use the right or left arrow key. Hit Enter to execute the command.
- To move to the upper part of the screen, hit Escape. Press Escape again if you want to move to the bottom of the screen.
- Some basic STM Menu items that can be adjusted higher or lower are the Scan Size, X offset, Y offset, Integral gain, Proportional Gain, Bias Voltage, and Tunneling current in order to achieve a better atomic image.

Scan size: for atomic resolution images should be set to 200 Å or less

X offset and Y offset: only change these if you want to move the position of the tip to a new location on the sample; normally this is not necessary in order to achieve atomic resolution images

Integral gain: current setting is 6.97 which works for atomic resolution

Proportional gain: current setting is 11.23 which works for atomic resolution

Bias Voltage: normally 30 mV but could be up to 200 mV

Tunneling current: normally about 1 nA

Note about Current and Height image modes:

A note on page X-43 of the manual explains that the current mode displays the tunneling current measured by the pre-amplifier as the image. In height mode, the z-piezo voltage which corresponds to the tip height is displayed. These two modes do NOT by themselves correspond to constant current and constant height.

If constant current (the usual mode) is desired, then the gain settings should be relatively high (see typical values above) and the mode used should be height mode. The high gain settings make it so that the tip height tracks the surface features, keeping the current almost constant.

If constant height mode is desired, the gain settings should be made very low, and the mode used should be Current so that variation in current are seen. The low gain settings make it so the tip height stays almost constant.

STM SCANNER DIAGRAM

Front view:

