PicoLE TopMAC (Top-down MAC) Mode User's Manual

v1.0

Molecular Imaging

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TopMAC Overview

In order to image samples in normal MAC Mode, the samples must be thin and small enough to be placed on a sample stage. With the drive coil beneath the sample, it is important that the sample material does not appreciably dissipate the effect of the magnetic field on the cantilever. This necessity also prevents the use of normal MAC Mode during Free-standing Operation where the microscope is placed directly onto a large bulk sample without the use of a sample stage.

For these cases, Molecular Imaging offers the TopMAC option. As the name suggests, in TopMAC Mode the drive coil is located above the cantilever, inside the special TopMAC nose. The TopMAC system works in essentially the same manner as the MAC, though some minor adjustments to the hardware and software are required.

Hardware

- TopMAC nose
- 5 Type II MAClevers

Hardware Setup

The TopMAC nose is made of a PEEK material with the drive coil mounted inside. The TopMAC nose is mounted in the tip of a standard Molecular Imaging scanner following the same procedure as for other MI noses (see the **AFM Nose Assembly** section in Chapter 3 of the **PicoLE System module**).

Figure 1 (TopMAC nose)

1. Place a multipurpose scanner in the scanner jig and insert the TopMAC nose. Be careful to align the connectors. Little force is required to insert the nose. See the **AFM Nose Assembly** section in Chapter 3 of the **PicoLE System** module for more detailed instructions.

2. Place a type II MAClever cantilever chip under the arm of the retaining spring. Alternatively, the nose can be placed directly into the mounting jig so that the cantilever chip may be mounted prior to inserting the nose into the scanner. Again, see **AFM Nose Assembly**.

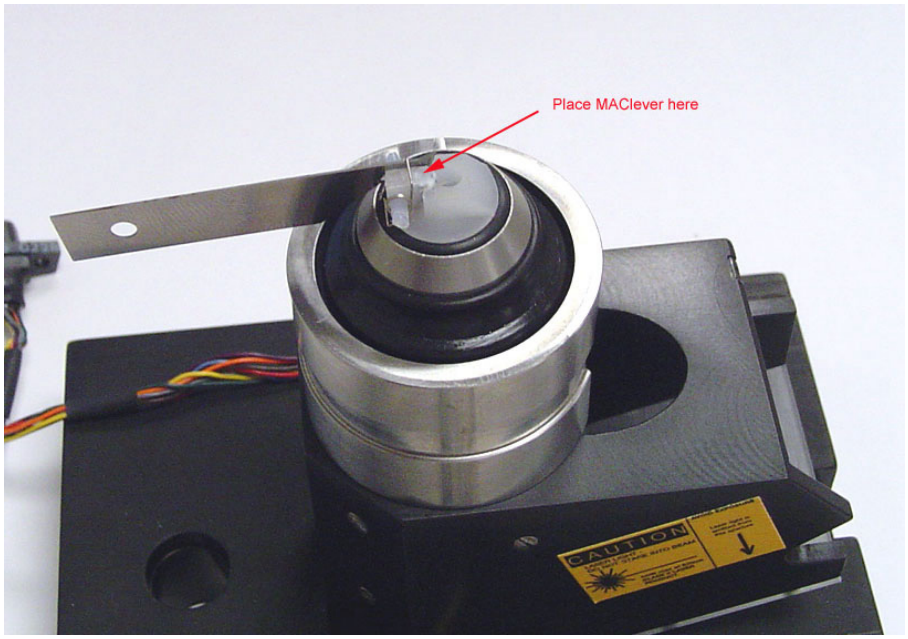

Figure 2 (Use the spring key to lift the retaining clip)

3. When placing the cantilever chip, have the cantilever as close to the edge of the viewing window as possible. See Figure 3 below. **Note:** The optical viewing window is offset from the center of the nose cone. The field is centered at the core beneath the cantilever, near the window.

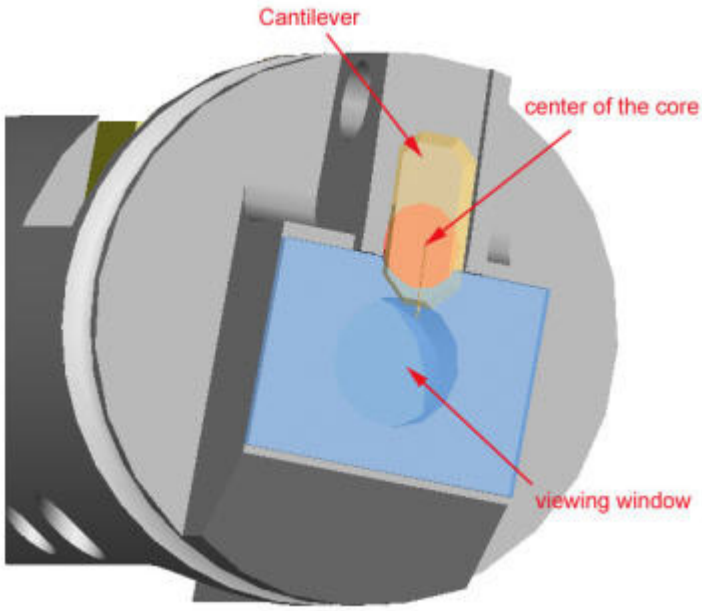

Figure 3 (Place the cantilever as close to the edge of the window as possible)

4. Place the scanner into the microscope and connect the two scanner leads to the microscope base.

5. On the front of the PicoLE **Head Electronics Box**, turn the middle selector to "AC MODE." Make sure the AFM/STM selector is in the AFM position. See Figure 4 below.

Figure 4 (Front of the PicoLE Head Electronics Box)

6. Using the BNC cable, connect the BNC connector labeled MAC on the back of the **MAC Mode Controller** to the BNC connector on the back of the PicoLE **Head Electronics Box** that is labeled AAC.

Figure 5 (left: PicoLE Head Elec. Box, right: MAC Mode Controller)

7. Be sure to use either a MAC sample stage or TopMAC sample stage for imaging in TopMAC mode. The magnetic core of the standard sample stage interferes with the TopMAC core's magnetic field.

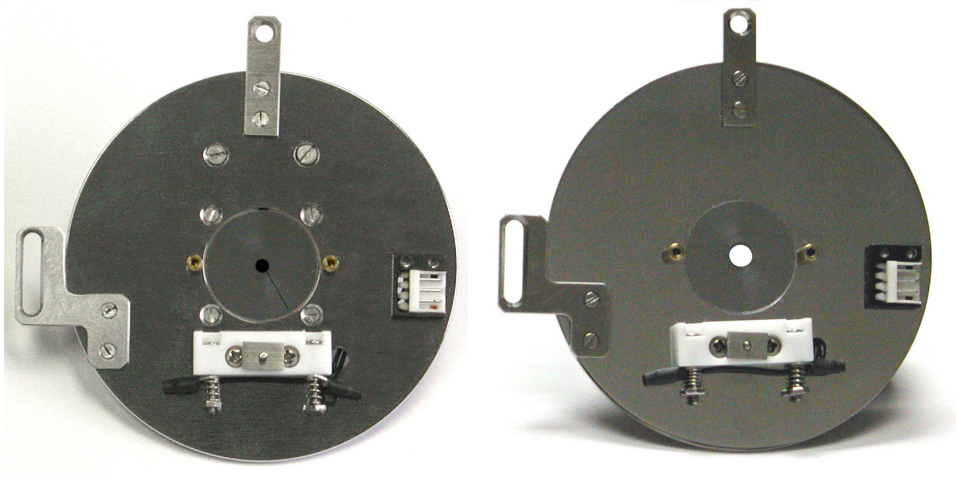

Figure 6 (Left: MAC and right: TopMAC sample stages)

Software Setup

Select AC AFM and set the controls

1. Select AC Mode Control from the **View** menu to open the **AC Mode Controls** dialog.

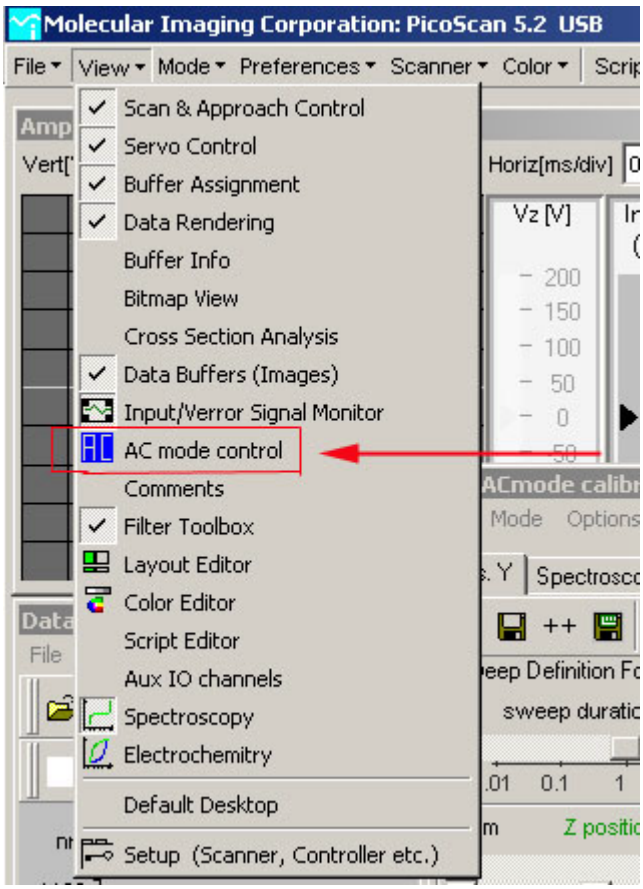

Figure 7 (Open the AC Mode Control dialog)

2. Select the **Drive On** checkbox and enter the drive percentage of ~ 0.5% for imaging in air and ~ 5.0% for imaging in water. See Figure 8 below.

3. In the **AC Mode Controls** dialog, select **MAC, AC Mode** and **Gain x1** in the three drop-down menus. See Figure 8 below.

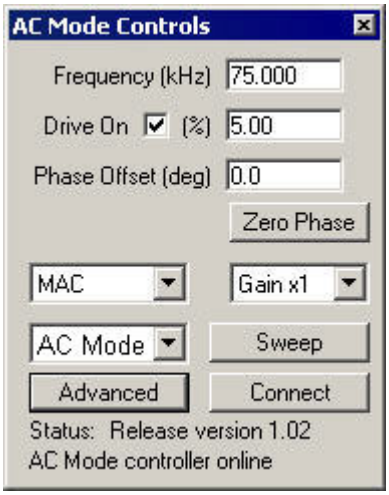

Figure 8 (The Main page of the AC Mode Controls dialog)

4. Click **Sweep** to bring up the Spectroscopy window.

Find the resonance peak

5. In the **Amplitude vs. Frequency** plot, set the frequency range according to the specifications of the MAClever being used and click **Start** (Note: the **Start** button is in the panel to the left of the **Amplitude vs. Frequency** plot, and is not shown in Figure 9 below).

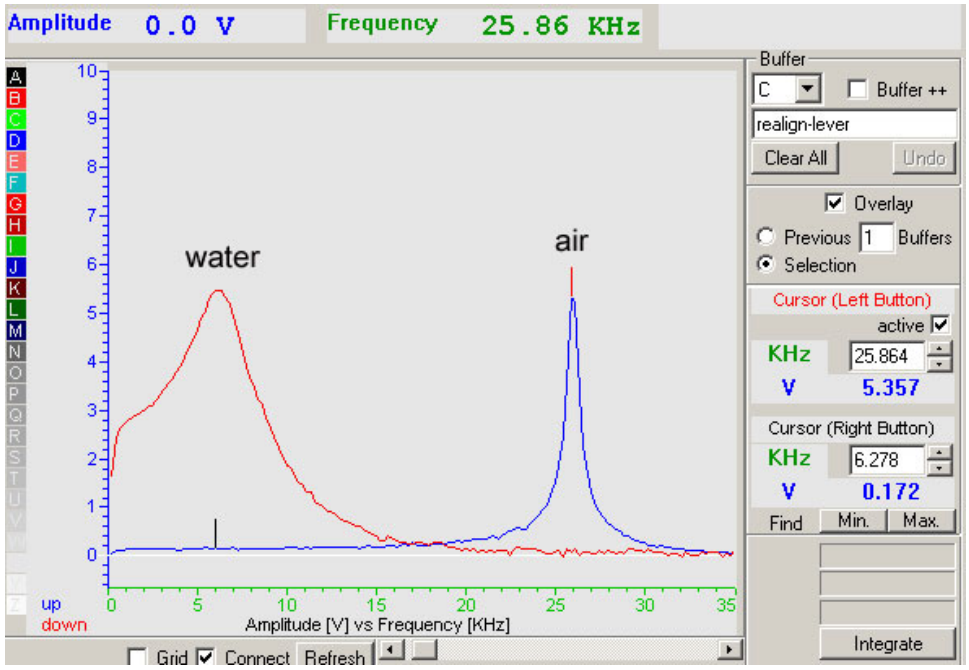

Figure 9 (A typical Amplitude vs. Frequency curve for a Type III MAClever. The blue curve, peaked on the right, was taken in ambient conditions by running a Sweep with a 0.8% drive. The red curve was taken by running a Sweep in water with a 10% drive.)

6. Make sure that the **active** box under **Cursor (Left Button)** is checked. Position the cursor at the peak of the curve and click the left mouse button to set the drive frequency. See Figure 9 above.

Approach and scan the sample

7. On the **Approach** tab of the **Scan and Approach Control** dialog, set the **Stop At:** value between 0.7 and 0.9. This value represents the ratio of operating (servo) amplitude over free amplitude. NOTE: With a setting of 0.9 the system will stop the approach of the sample to the tip when the amplitude of the cantilever's oscillation is reduced to 90% of the free amplitude.

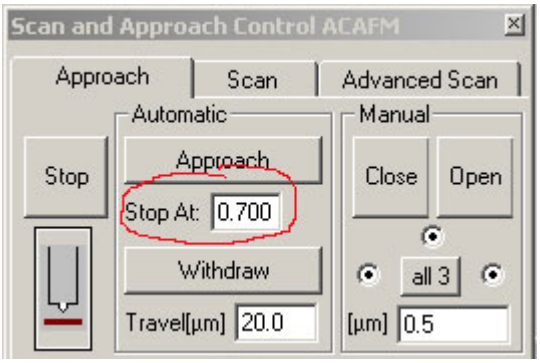

Figure 10 (The top portion of the Approach tab of the Scan and Approach Control dialog)

8. Click the **Approach** button. This will close the sample-tip distance.

9. When the approach is completed, click the **Start** button in the **Scan** tab of the **Scan and Approach Control** dialog to begin imaging.

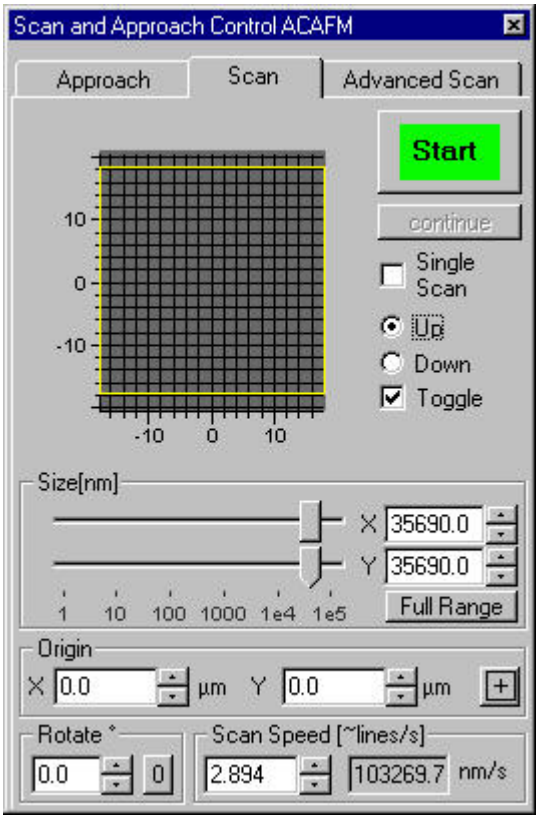

Figure 11 (The Start button only appears once the sample is engaged)