

Jupiter AFM (Oxford Instruments) SOP:

Latest update 01.11.2023 Sabrina Eder

Shortest version of SOP Manual:

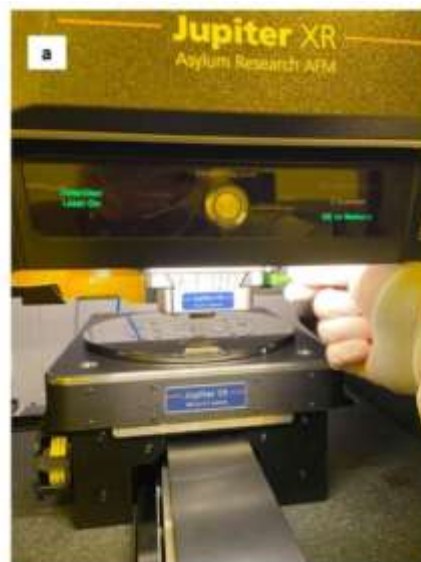
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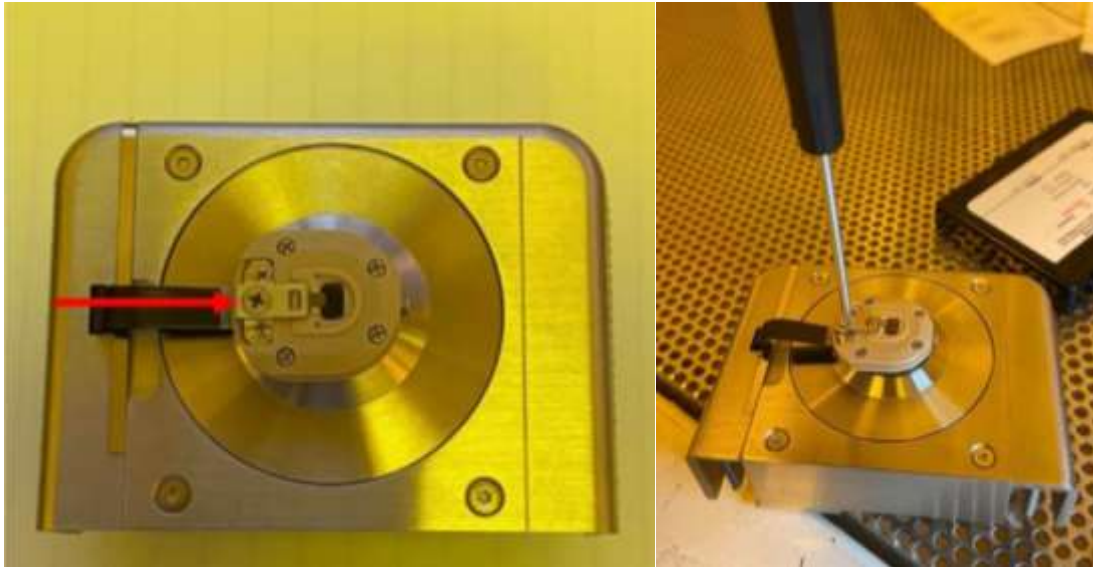
Start up the AFM

- **Check in to use the AFM in the logbook:** Fill paper logbook located at AFM.
- **Turn on the light in the AFM cabinet:** Light switch between top and bottom unit of the system.
- **Check if there is an AFM tip or sample loaded:** there should not be but maybe someone forgot to unload.
- **Launch Jupiter software:** Igor (real time) or Egon
- **Select your tip and imaging mode:** You can choose your imaging mode now.
- **Load your Tip:**
 - **Exchange cantilever:**
 - press **Change cantilever:** this moves the stage to the cantilever exchange position. (sample out of the way, Cantilever holder up, AFM laser off)
Wait until the software says ready.
 - open the AFM cabinet door
 - on the AFM head, a green light is now illuminated that says '**OK to remove**'
 - disengage the green lever that locks the z-scanner in place

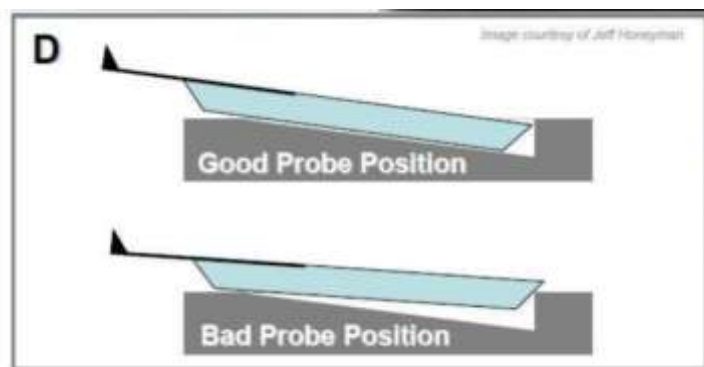


- using one thumb and a forefinger, use one hand to carefully grasp the z-scanner on either side and pull it out of the tool
- carefully place the cantilever holder on the table, with the beige disc that forms the tip holder facing upwards (see image below)

- use the small Phillips head screwdriver to loosen the central screw on the cantilever clip (see image below) by a few turns, **but don't completely remove it**, just loosen it



- Using the tweezers, grasp the old probe by the sides, and pull it out of the channel
- Take a fresh cantilever by the side edges, and carefully slide the probe into the channel of the tip holder.: Notice that on the beige probe holder, there are 2 vertical side walls and a flat back wall that forms a channel in which the cantilever should be placed. Make sure the cantilever is properly in place hitting the back all and mounted centred between the two side walls. This will mean the cantilever sticks out of the holder as you can see in the image below



- **Lightly** tighten the Phillips head screw to ensure the cantilever is secured in place. **Make sure to just tighten it finger tight!!** Double check with the tweezers that the tip is held in place.
- Return the z-scanner holding the new tip back into place and ensure that the z-scanner is moved all the way into its position. You will feel the USB connections in the back locking in place. Double check that the z-scanner is mounted the right way: *The blue label on the z-scanner is supposed to be visible.* And ensure the z-scanner is as far back as it possibly can be. *(if not*

the optical microscope system looking at the Tip and the sample can be crashed).

- Lock the z-scanner in place with the green lever.
- **Load your sample and move the X-Y stage to your sample position:** there are two methods to clamp your sample: Vacuum or magnetic. Please use the **AFM's plastic tweezers to avoid scratches on the chuck!**
 - **Magnetic:** Stick your sample onto a magnetic sample disc and clamp it to one of the stage-embedded magnet slots.
 - **Vacuum:**
 - Turn on the little vacuum pump standing besides the AFM (DIVAC 1.2L)
 - The vacuum control must be an option in the engage panel.
 - An Allen key (located at the AFM table) can be used to remove all the vacuum stage screws (on vacuum chuck) that will be below your sample surface. Remove them and place them in the little blue box with transparent lids on the AFM table. **DO NOT LOSE THOSE CREWS!**
 - Load your sample and press the vacuum button on the top of the AFM head. The vacuum will now clamp down your sample.



- **Lower the AFM head to approx. 2-3mm above the sample surface:** by carefully using the joystick
- **Focus on the tip:** use the up and down arrows in the 'Engage panel' to find the focus on the tip. Once the tip is in focus, press SET for the focus on tip button.
- **Set detector laser:** set the spot for the detector laser on the front of the AFM tip and right click and press auto spot on.
- **Zero-PD:** once the detector laser is in the right position press 'Zero-PD' to 0 the detection laser.
- **Set the blue drive laser:** the location for the blue drive should be at the bottom of the cantilever (left side where it is attached to the cantilever Chip)

- **Focus on sample:** use the down arrow in the 'Engage panel' to focus on the sample surface (Note: don't press 'focus on sample' yet since this will potentially lower the z-scanner and crash the tip/scanner into the sample). You will be focused on the sample surface once you can see the outer black ring of the optical camera setup being sharp. You can double check this by slightly moving the sample with the X/Y stage and see if particles on the sample surface move. Once the sample is in focus press *SET*.
- **Double check the TIP and Sample focus:** press 'focus on tip' and 'focus on sample' respectively and double check that the focus is set correct.
- **Move to Pre-engage height:** go back to focus on tip and press '*move to pre-engage*'. This will move the tip closer to the sample surface into a predefined distance away from the sample.
- **Thermal tune the tip:** press the 'Thermal' button in the *Master panel*. Choose the correct cantilever model and press '*get started*'.
- **Auto tune the cantilever (tip):** press 'Tune' in the master panel and choose the wanted amplitude for the auto-tune. (1V can be a good starting point). This will be your *Free-Amplitude*. Rule of thumb, bigger value for bigger features, smaller value for small features.
- **Set your Setpoint:** set your setpoint in the Master Panel (ca. $\frac{3}{4}$ of the Auto Tune amplitude, so 800mV for 1V free Amplitude). If in doubt use a value closer to the Auto tune value you used.
- **Tip approach:** press 'start tip Approach' in the Engage panel. This moves your tip to slowly engage with your sample. The software will give you an audio signal once the tip has reached the surface. After the automatic tip approach the tip will stop a little bit above the sample surface. To ensure the tip has found the surface it is possible to press 'engage' in the Engage panel and see if the Z-voltage is <150. Then the tip has found the sample.
- **Set the storage directory for the image files:** Choose your storage directory (set path) for the image files and set a file name.
- **Set the imaging parameters:** 'Scan Size', 'Scan rate', 'Integral gain' (a good starting point for the integral gain is 10)
- **Click 'Frame up/ Frame down' to start imaging:** this will start the tip rastering over your sample to record the image. Optimize image parameters:
 - **Lower setpoint:** until the trace and retrace line of the height map overlap each other (look similar)
 - **Increase 'Integral gain':** until trace and retrace line in the height map are as similar as possible but no ringing occurs yet. (ringing can be seen in the Phase image)
- **Collect optimized image:** to make sure you save an optimized image press 'Frame up/ Frame down' once you found good imaging parameters and wait until a full image is recorded.
- **Done?**
 - **Stop imaging:** press 'Stop'
 - **Remove sample:** press 'remove sample'
 - **Open AFM door and remove sample**
 - **Remove your tip:** if you are not the next person to image right away, remove your tip. (see 'exchange cantilever' description above)
 - **Close AFM software**
 - **Turn off the light in the AFM**
 - **Finish your entry in the AFM-logbook**
 - **Log out of Windows**

Daily Use Shutdown

If the AFM system is used on the daily basis, there is no need to fully shut down the instrument. The following procedure is recommended for shutting down the system:

- **Finish the last scan.**
- **Click 'Change Sample' on the Engage Panel.** The Z scanner/ cantilever holder will move up and the XY stage will move to the front and center of the granite.
- **Remove the sample from the sample chuck.**
- **To remove the probe from the cantilever holder, click 'Change Cantilever' on the Engage Panel.** The XY stage will move to the back, and the Z scanner will be moved up. The objective will be moved up as well, allowing for removal of the Z scanner from the AFM.
- **Once the cantilever is removed from the cantilever holder, put the Z scanner back in the instrument until the next use.**
- **Turn off the light (switch on the front of the enclosure).**
- **Turn off the software.**

Prolonged Shut Down

The following procedure should be performed if the Jupiter system will not be used for an extended period (one week or longer):

- **Finish the last scan.**
- **Click 'Change Sample' on the Engage Panel.** The Z scanner/ cantilever holder will move up and the XY stage will move to the front and center of the granite.
- **Remove the sample from the sample chuck.**
- **To remove the probe from the cantilever holder, click 'Change Cantilever' on the Engage Panel.** The XY stage will move to the back, and the Z scanner will be moved up. The objective will be moved up as well, allowing for removal of the Z scanner from the AFM.
- **Once the cantilever is removed from the cantilever holder, put the Z scanner back in the instrument until the next use.**
- **Turn off the light (switch on the front of the enclosure).**
- **Once you are done imaging, save your data to a desired directory. Close Igor and shut down the computer.**
- **Turn off the software.**
- **Turn off the laser key on the controller.**
- **Turn off the controller (ARC 3).**
- **Turn off the pneumatics controller.**

Power up the AFM

If the AFM system was completely turned off (powered down) the following procedure is used to power the system up:

- **Power up the computer.**
- **Turn on the ARC 3 controller.**
 - Press the power button as shown.
 - Turn the laser key to the ON position.
- **Turn on the stage (pneumatics) controller:** *The switch is located at the rear, upper left-hand corner, as seen from the front.*
- **Vibration isolation using active vibration isolation (AVI).**
 - AVI is placed under the granite and connected to the AVI controller by the installer.
 - **Note:** Even when AVI is used as vibration isolation, house air is still necessary for XY stage movements.
 - Make sure house air is connected to the back of the AFM enclosure in the “Input” port.
 - The air flows through a filter out from the back of the enclosure “Output” port and into the stage controller which directs it to the XY stage.
 - The installer should make sure that no air is flowing into the air isolators.
 - The AVI controller should be turned ON for operation.
- **Sample vacuum connection:** *Vacuum pump (or house vacuum) should be connected to the Stage controller and turned on.*
- **Double-check the laser key:** *Confirm that the laser key is in the ‘On’ position.*
- **Start the ‘Igor Real time’ software:**
 - *During initialization, the software will not be responsive. Look at the bottom status bar for the initializing message.*
 - *When the software is done, the status bar will say it is Ready.*
- **System status check:**
 - *At the bottom of the software, you will find the Status Bar.*
 - *Location 1 and 2 should read Ready, and green light checkmarks should appear.*
 - *If some components are reported missing, check their connections. Once you have the cables secured and powered, click the ‘Rescan’ button (4). If that does not solve the problem, please contact support.*