STANDARD OPERATING PROCEDURE

Dimension Icon AFM

I. SCOPE

The purpose of this document is to describe requirements and basic operating instructions for the Dimension Icon Atomic Force Microscope. This tool is intended to measure thickness variations at the nanometer scale, roughness, and several other surface properties.

II. SAFETY

A. Whenever possible, keep the enclosure closed.

B. In the unlikely case of a sudden breach of pressurized gas within the system, move away from the system promptly to avoid collisions from very high velocity particles.

C. The Scanner should be handled with the at most care. It is very fragile and extremely expensive. DO NOT set it down anywhere except the slot it sits in.

D. Take care when handling probes. Probes consist of a substrate, cantilevers, and tips. The cantilevers are microns thick, and the tips are on the nanometer scale so they are extremely fragile. If a probe is dropped, it will most likely break.

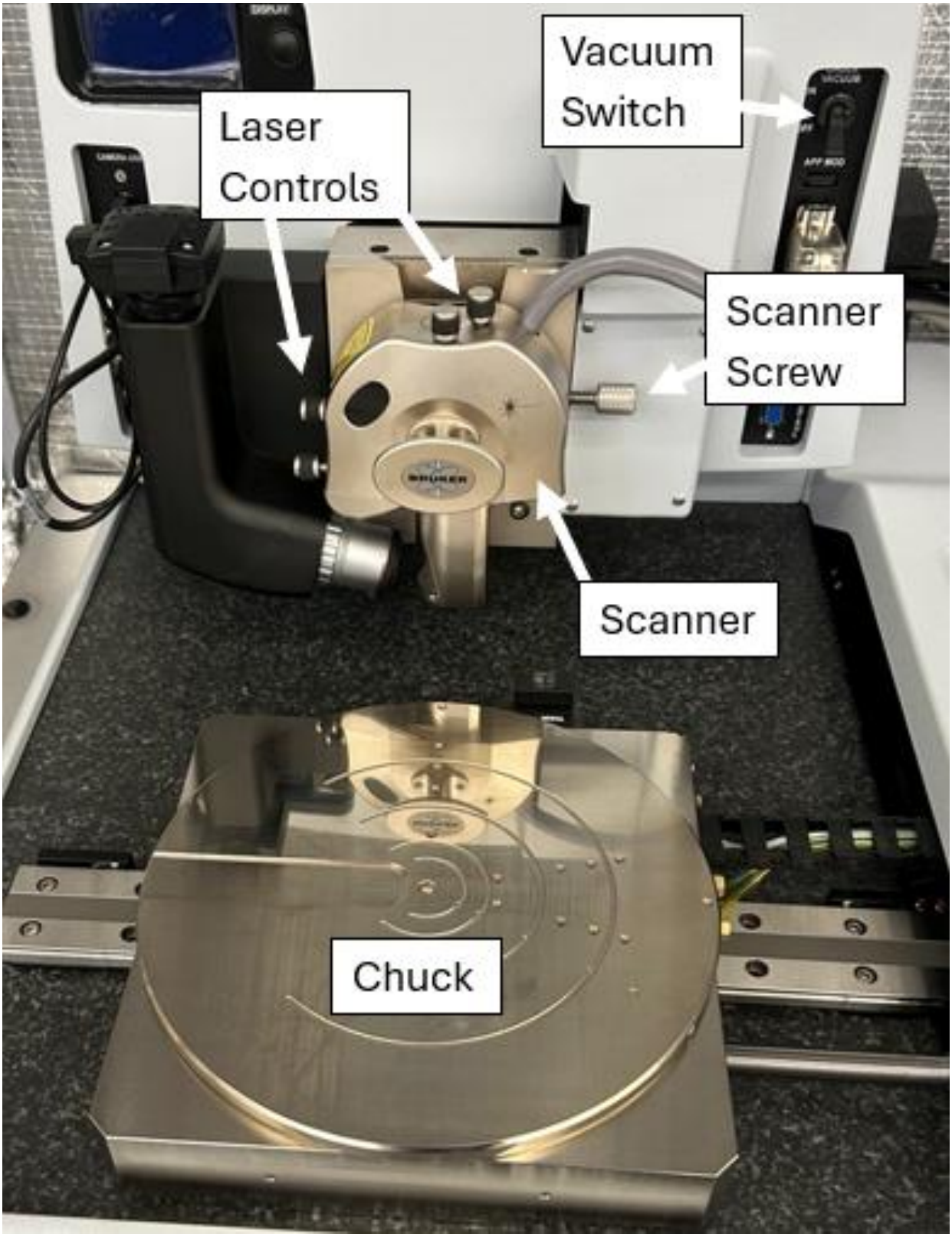
E. The Scanner has a laser that will be active while the software is opened. Do not look directly into the laser beam or point it toward others. When handling the Scanner, it is recommended to wear the safety glasses provided near the tool.

III. APPLICABLE DOCUMENTS, MATERIALS AND REQUIREMENTS

A. Please speak with the Staff for more information regarding this tool.

B. Tips are available for purchase. Please speak with the Staff to purchase a tip.

IV. TOOL OVERVIEW



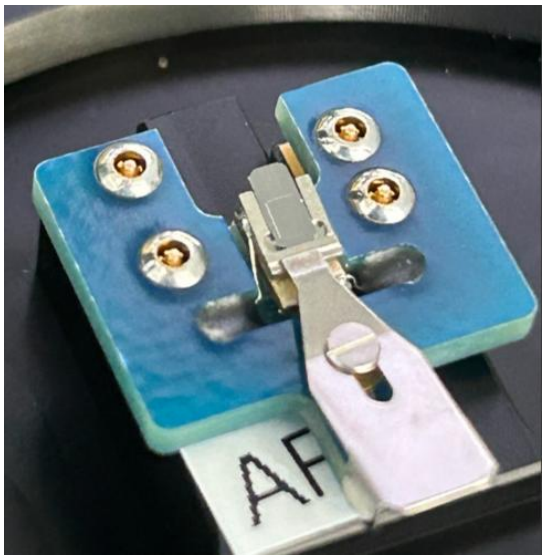
V. OPERATION

1. Load the probe onto the probe holder

a) Find a probe holder and put it in the probe holder stand

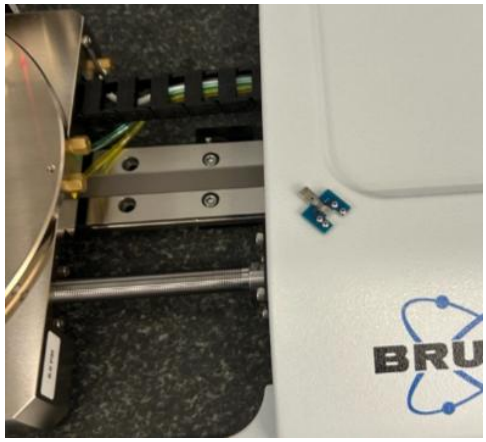
b) Pull the clamp on the holder back

c) Carefully load your probe onto the holder using tweezers so that it sits flat in the indentation in front of the clamp



d) Push the clamp down and then forward so that it holds the probe in place

e) Once finished, remove the holder from the loading tool and place it next to the chuck inside the enclosure with the probe pointing away from the scanner



2. Load the probe holder onto the scanner

a) Loosen the screw holding the scanner

b) Carefully lift the scanner straight up (remember the scanner costs $60,000!)

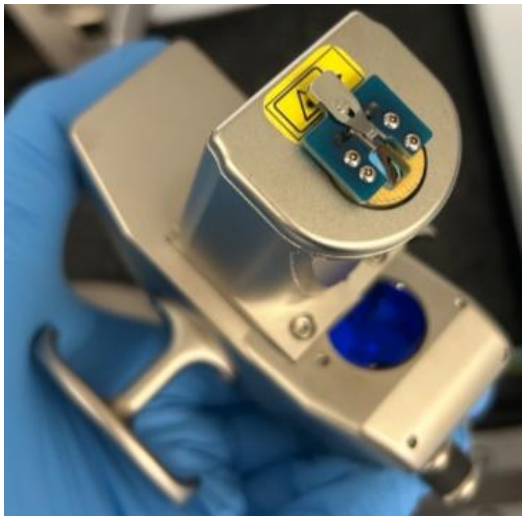
i. With your right hand, grab the handle on the front of the scanner

ii. Place your left hand on the top of the scanner to stabilize it as you lift

c) Once the scanner is out of the slot, flip it over and hold it in your left hand

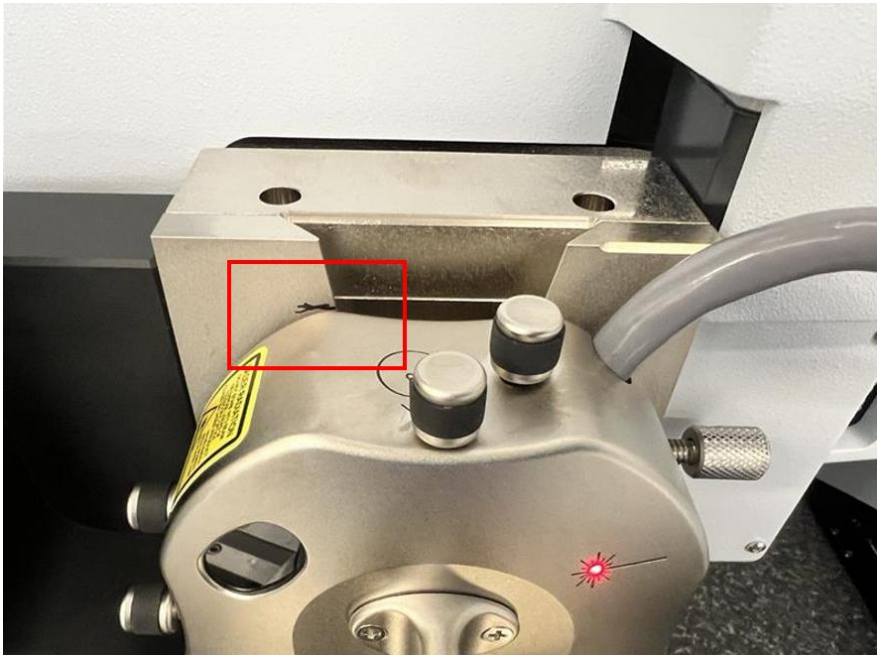
i. DO NOT set the scanner down. It should be held carefully until you load the holder and can put it back in the slot

d) Use your right hand to pick up the probe holder and connect it to the scanner. Make sure it is sitting at the bottom of the pins as shown:



e) Carefully flip the scanner back over and return it to the slot. Lower it slowly until reach the bottom— the top of the scanner should align with the black reference line on the mounting post — then tighten the screw back.

Note: During lowering, if resistance is encountered, it usually indicates that the scanner is slightly tilted and not perfectly vertical. Adjust its angle gently and resume lowering.



3. Open NanoScope 10.30 software on the computer and select experiment

a) Tapping Mode > Tapping Mode In Air > Tapping Mode Standard > Load Experiment

b) Wait for the software to load in the experiment

4. Setup

a) Select Probe

i. If using a Bruker probe, select the Probe Model from the list

ii. If using uMasch or another brand of probe, select “unknown”

iii. Click Return and Save Changes when finished

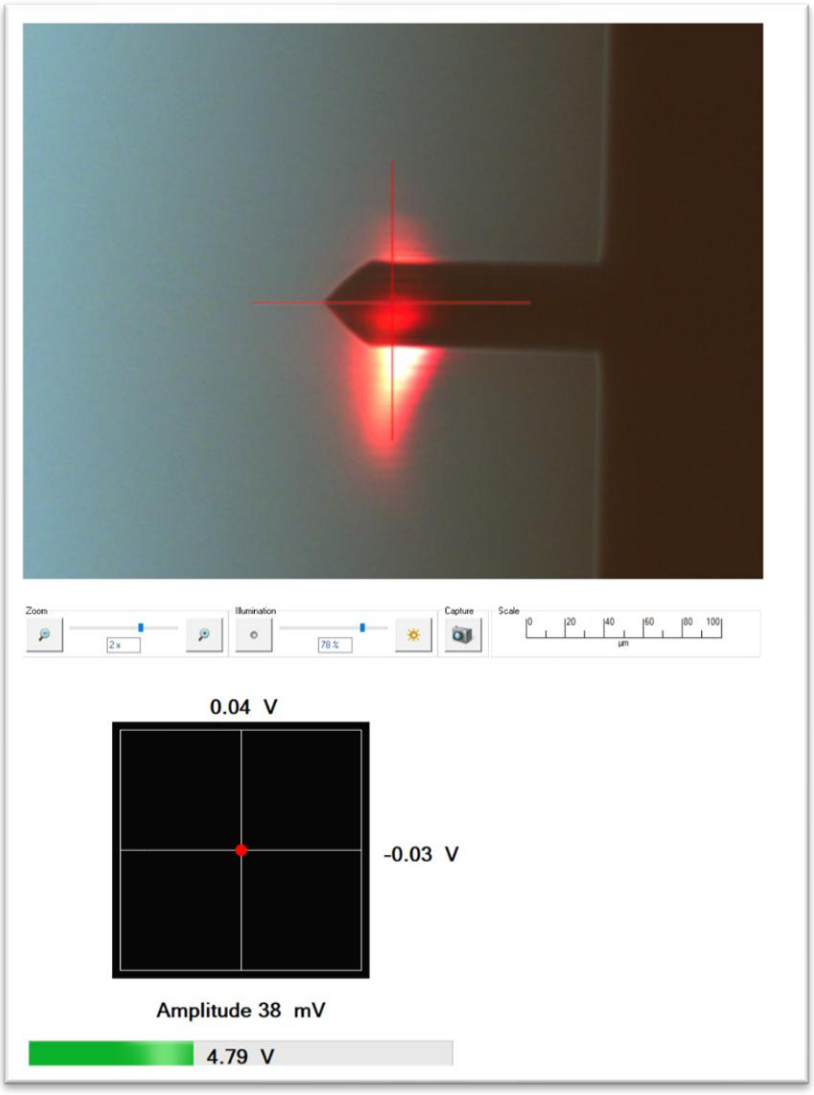
b) Click move to the alignment station

i. Focus on the cantilever’s shadow using the up/down arrows (zoom in/out and change the brightness if needed)

ii. Use the top control knobs to move the laser behind the cantilever. When moving the laser, maximize the voltage value at the bottom of the screen

iii. Use the left control knobs to focus the laser. Try to get the dot to the middle of the graph (between -0.1V and 0.1V on both the X and Y)

iv. An aligned laser should be similar to the following:



v. Return from the alignment station

c) Center the red crosshair on the cantilever by clicking on it in the camera screen

d) Focus on the cantilever again using the up/down arrows

e) Tune the probe

i. If using a Bruker probe, click on Autotune

ii. If using a uMasch probe (or another brand):

a. Click Manual Tune

b. Adjust the frequency range (top right) so that the nominal frequency of the probe is well within the range

c. Click Autotune at the bottom and ensure the frequency is somewhat similar to the nominal value

d. Click Exit once finished

5. Navigate

a) Load your sample onto the chuck

b) Be sure your sample completely covers the vacuum hole, then flip the vacuum switch to on

c) Use the XY Controls to move the stage so the sample is under the scanner

d) Use the up/down arrows to move the scan head and focus on the sample.

i. Be careful not to crash the scan head into your sample. Lower the speed as you get closer to your sample

ii. The scan head should be about 1mm above the sample to get good focus

e) Verify the scan head is 1mm above the sample

i. Find the number after “Optics” at the bottom of the screen while in the Navigate tab

ii. Switch to the Setup tab and make sure the number is ~1000um higher than in the Navigate tab

iii. Return to the Navigate tab once finished

f) Use the XY Controls to move to the point of interest on your sample

6. Check Parameters

a) Ensure the Scan Size is small (1um or less) to prevent tip breakage

b) Close the enclosure, make sure the latch catches and seals properly

7. Engage

a) The tip will approach the surface and begin scanning

8. Scan

a) Once the tip reaches the surface, slowly increase the scan size if needed

b) If the trace and retrace lines are not aligned, adjust the proportional and integral gain

c) If the probe is scanning in the wrong direction, adjust the Scan Angle

d) Adjust the scan rate as needed

i. Lower scan rate for more accurate but slower measurements

ii. Higher scan rate for faster but less accurate measurements

e) Capture the scan

i. Open the file explorer and navigate to This PC > (E:) Data > AFM user data

ii. Create a folder for your scans here

iii. Back on the NanoScope software, click Capture at the top left of the screen then Capture Filename

iv. Under Directory click the 3 dots and find the folder you just made

v. Change the filename as desired and click OK

vi. The right side of the screen shows the capture information. Use the 3 dots next to Directory to find your folder and show previously captured scans

vii. At the top right corner, click the camera on the left  to start a capture. Once the current scan is complete, the software will take the capture

viii. Verify the capture is “On” at the bottom right of the screen. If it is “Off” or “Done” the capture will not be taken and you will need to wait until the next scan finishes

ix. You can also click the Capture Now  option to capture what has been scanned so far

f) Zoom in on the scan

i. Under the scan screens there is a Zoom button, clicking this creates an adjustable box on the screen and an Execute button

ii. Adjust the box to the desired area and then click Execute button

9. Withdraw – Moves the tip away from the sample

10. Unload the sample

a) Go to the navigate tab and click Sample Load Position

b) Turn off the vacuum switch and remove the sample

c) If you are measuring another sample, return to Step 5 above

11. Unload the probe
    a) Close the NanoScope software
    b) Loosen the scanner, carefully pull it up, and flip it over (remember the scanner costs $60,000!) so that you can access the probe holder
    c) Remove the probe holder and set it to the side
    d) Replace the scanner very carefully (remember the scanner costs $60,000!)
    e) Place the holder on the probe holder stand
    f) Carefully remove the probe from the holder using tweezers and place it in your probe container
12. Use a USB stick to get your captures off of the AFM PC
13. Close the enclosure, return the probe holder and any tweezers to the respective cases, and end your session

VI. SIGNATURES AND REVISION HISTORY

a. Author of this document: John Slentz

i. Author Title or Role: Laboratory Coordinator

ii. Date: 11/05/2025

iii. Revision: Original Issue

iv. Revision notes: Added standard procedure

b. Approvals:

Technical Manager Signature: Sandra G Malhotra, 11/12/2025

Revision History:

Revision	**Author**	**Date**
Original Issue Rev A	John Slentz	11/05/2025