AIST-NT

Advanced Integrated Scanning Tools for Nano-Technology

OmegaScope Reflection

User's manual

www.aist-nt.com

COPYRIGHT

NOTICE TO THE USER

This manual should not be construed as any representation or warranty with respect to the unit named herein. Occasionally, changes or variations exist in the units that are not reflected in the manual. Generally, should such changes or variations exist and affect the product significantly, a release note would accompany the manual. In such a case, be sure to read the release note before using the product.

Contents

1. OmegaScope-Reflection Configuration. 4

2. OmegaScope Overall dimensions. 5

3. Unpacking. 6

3.1 Inspection for damage. 7

4. Setup Top Channel. 8

4.1 Prepare an objective scanner for Top channel. 8

4.2 Setup Top objective scanner. 10

5. Setup SmartSPM into the system. 11

6. Remove cantilever from SmartSPM. 13

7. Place cantilever into SmartSPM. 14

7.1 Prepare the probe. 15

8. Align cantilever with AIST-NT program. 18

8.1 Additional means of checking the correct thickness setting cantilever. 20

9. Adjustment of system 21

10. Set 100x objective 24

11. Work with sample 25

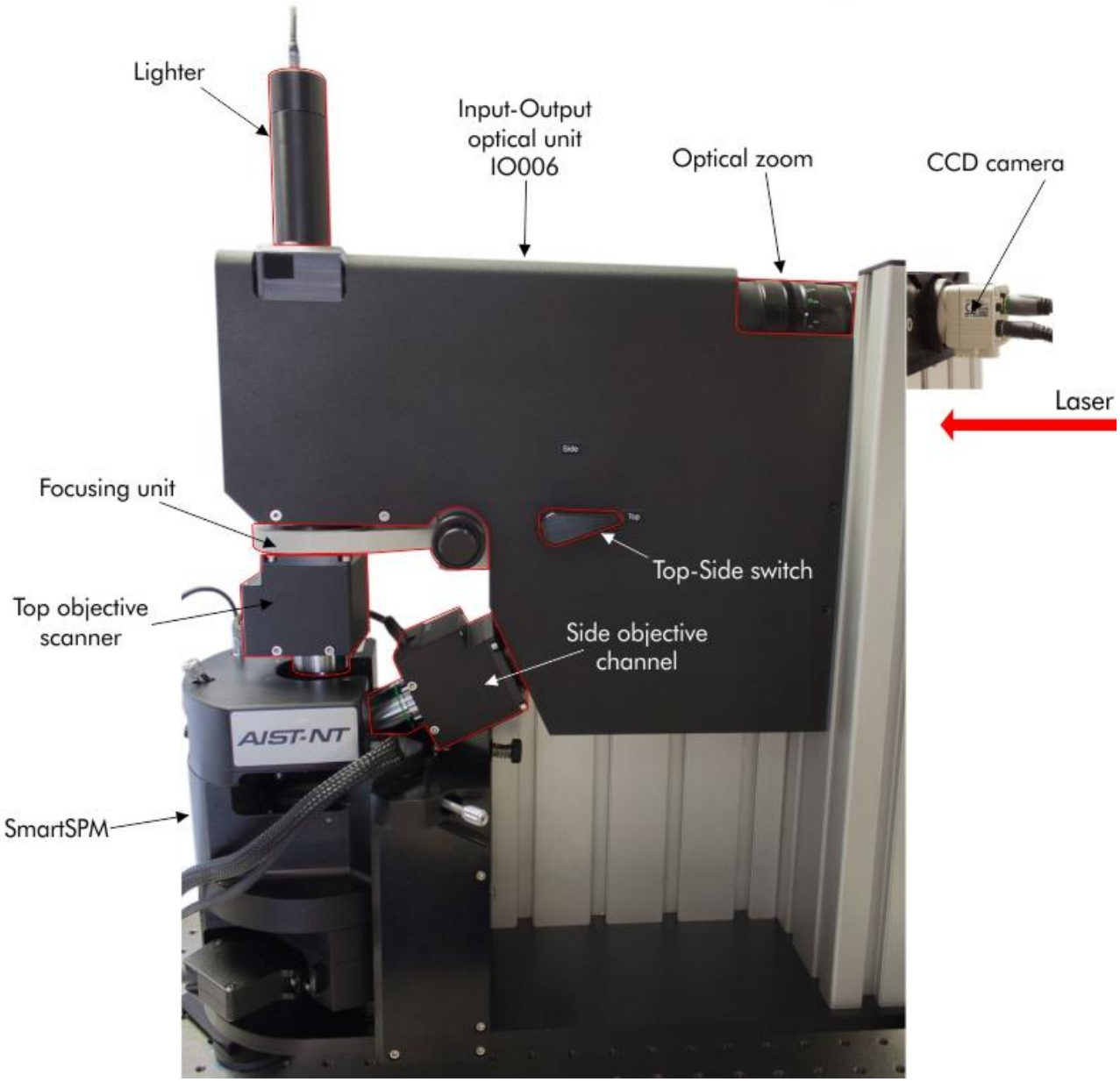
11.1 The overview of the SpecScan window: 29

11.2 Simultaneous AFM RAMAN imaging 36

12. Setup Side objective scanner: 37

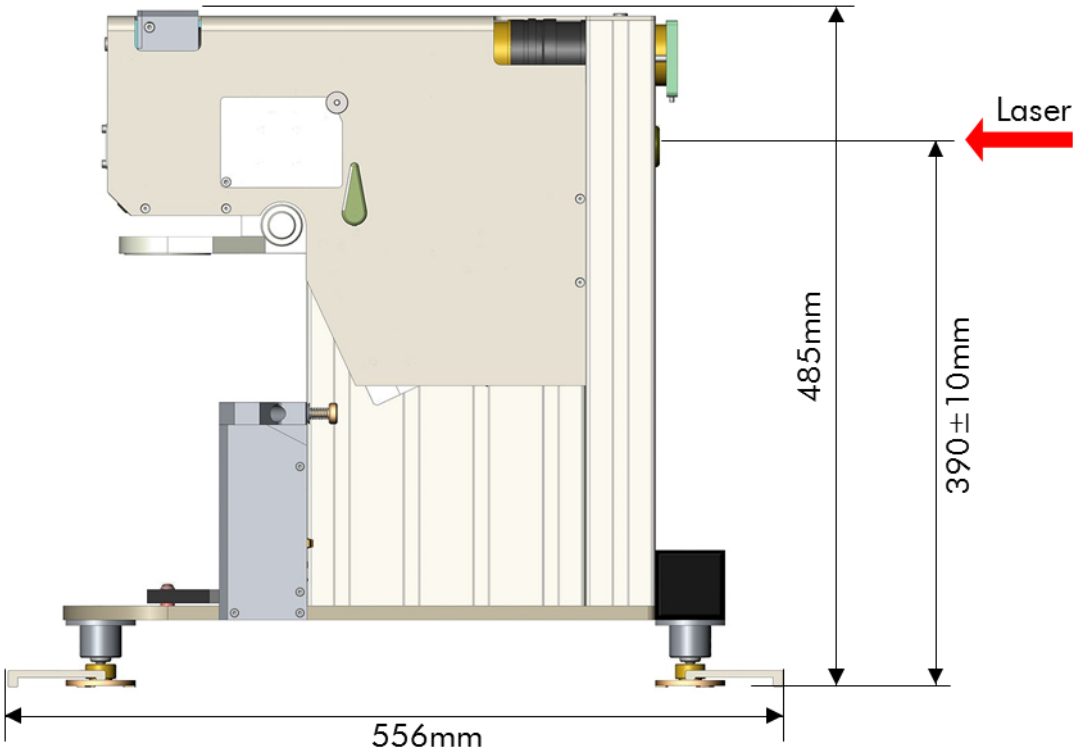
12.1 Simultaneous AFM RAMAN imaging 44

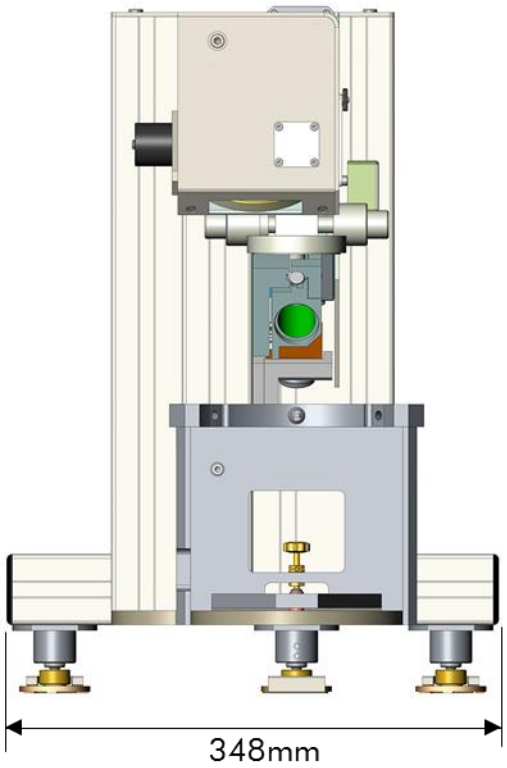
1. OmegaScope-Reflection Configuration.



2. OmegaScope Overall dimensions.

(Shown without the safety enclosure)



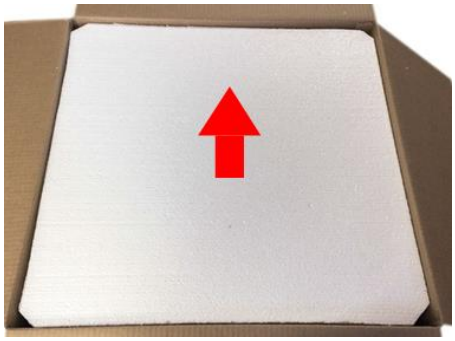


3. Unpacking.

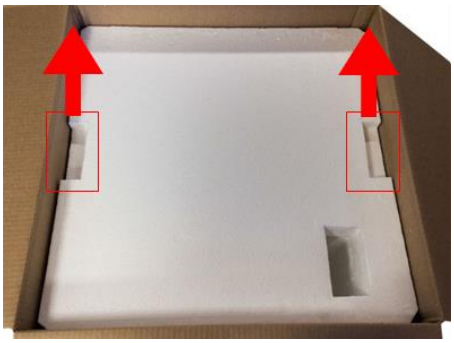
AIST-NT OmegaScope was shipped in packing materials designed to protect it from harm during shipping.

The packing should be inspected for any damage upon delivery; the carrier should note any such damage on the receipt, and sign all copies. Ensure that you retain a copy of the signed delivery paperwork. This will facilitate processing a damage claim with the carrier.

IMPORTANT! Do not flip the package! Otherwise removing the OmegaScope from the package will be impossible.



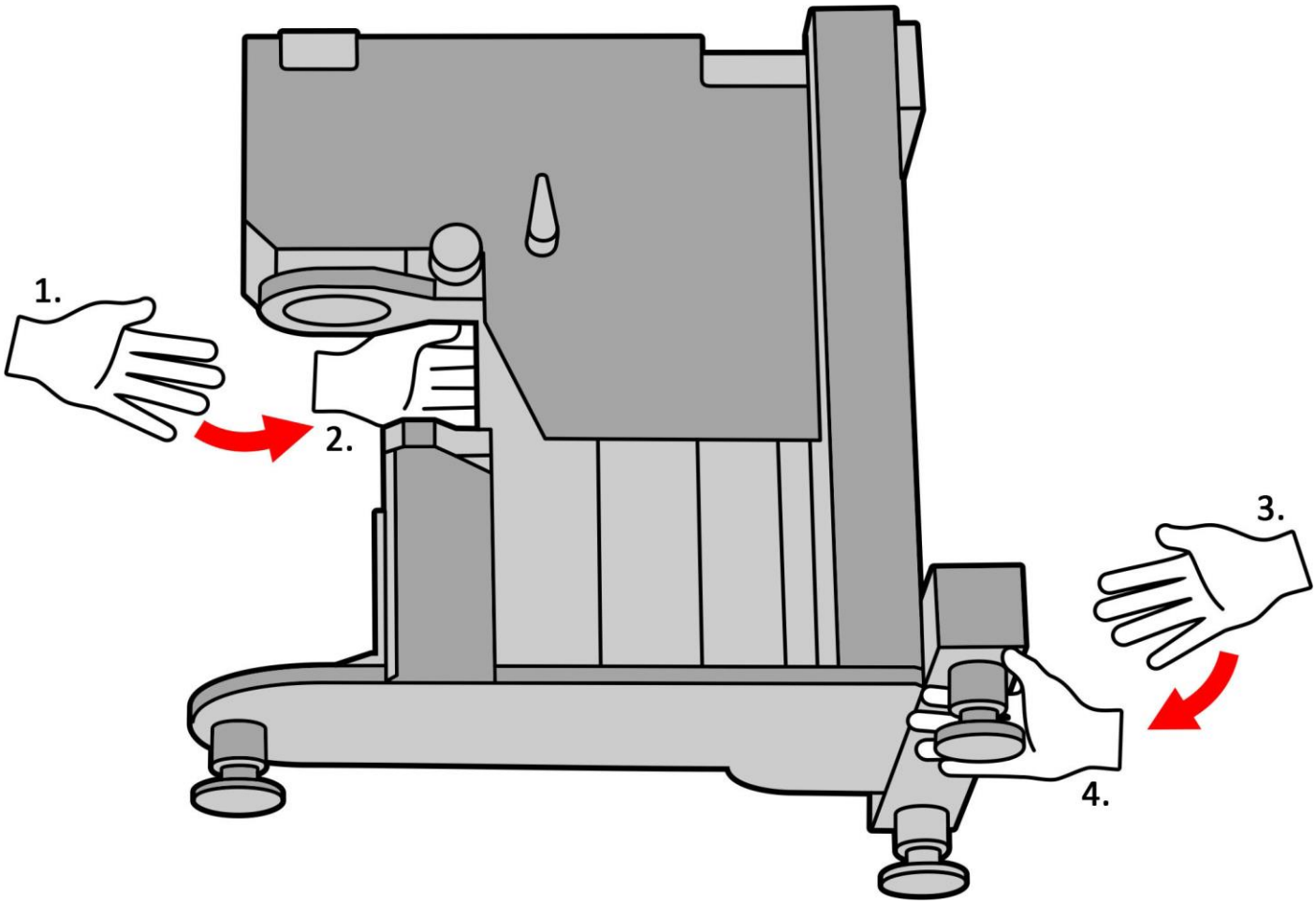
1. Open a box and remove first packing sheet.



2. Gently lift up cover grabbing by opposite grooves.

3. Remove OmegaScope from the box by grab it right bottom leg and holding the it cover on the back side as shown on picture below (next page).

IMPORTANT! The bottom package is unmovable. Do not try to push it off from the box! It may damage OmegaScope.



1-2. Insert your hand into the groove in the package as shown in picture.

3-4. At the same time take the OmegaScope of the right bottom leg as shown in picture.

3.1 Inspection for damage.

Once removed from the shipping container, inspect the instrument for visible evidence of any damage to the outer cases. Check that all readily visible mechanical and electrical components are in their proper places and are intact. If damage is evident, do not operate the instrument. Notify the AIST-NT and the carrier/shipping company immediately.

IMPORTANT: Many public carriers do not recognize claims for concealed damage reported later than 3 days after delivery. For a shipping damage claim, inspection by the carrier agent is also normally required. For this reason, the original packing should be retained as evidence. While the manufacturer is not liable for damage in transit, the company will extend every effort to aid and advise in such circumstances.

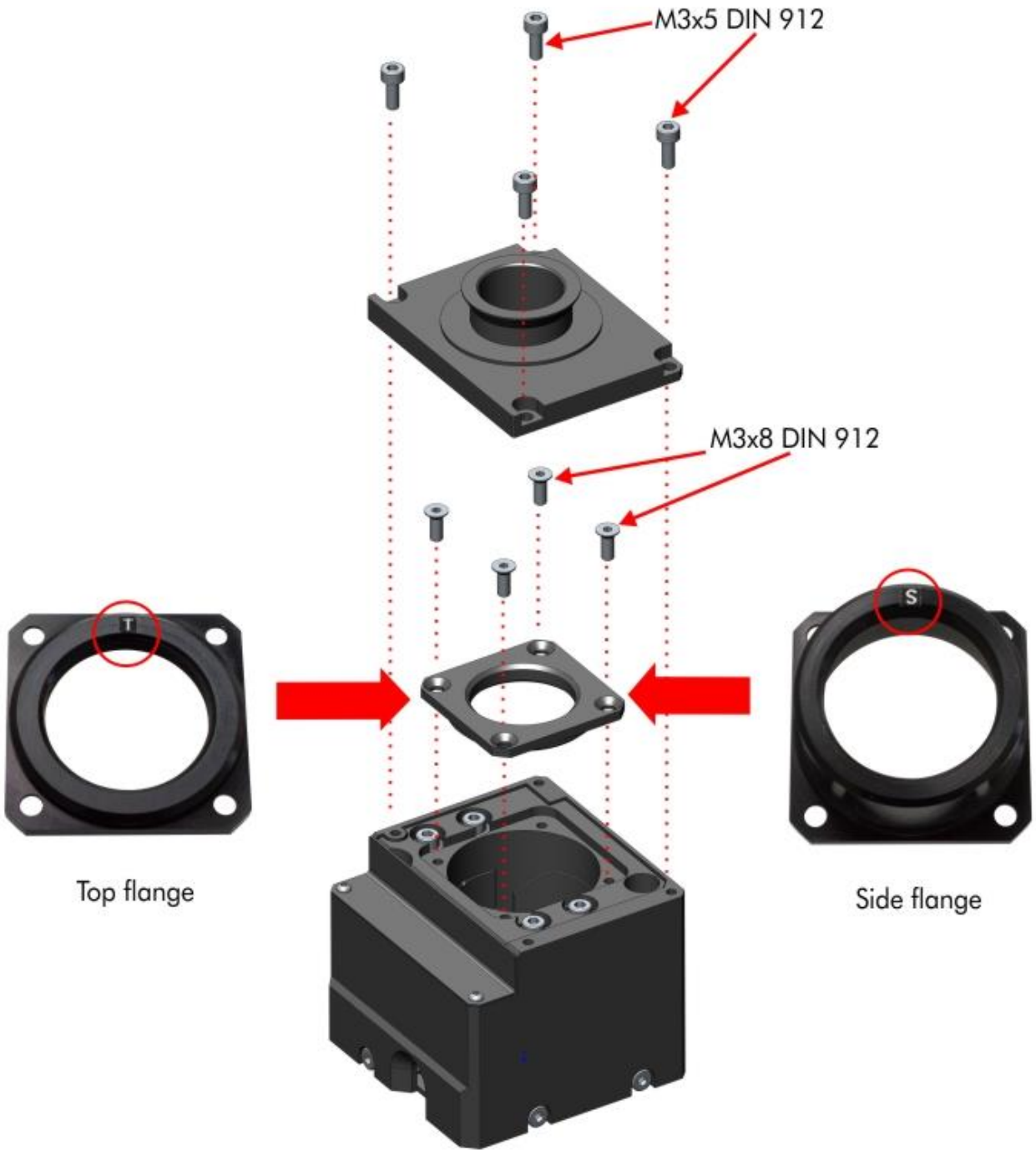
4. Setup Top Channel.

4.1 Prepare an objective scanner for Top channel.

1. Check on the objective scanner for correct flange. In case of wrong flange follow the steps 2-3.

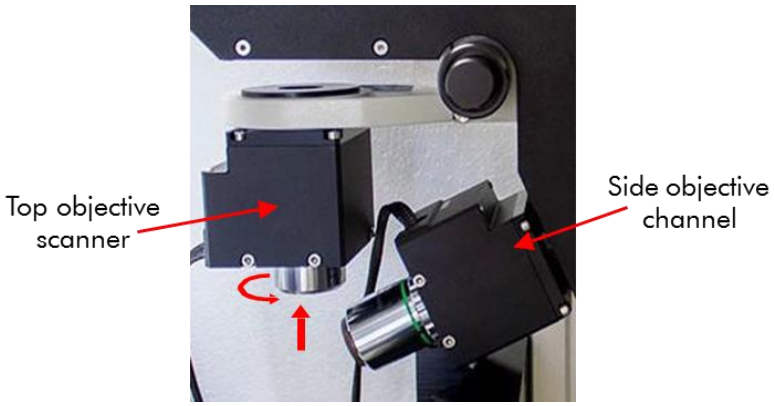
2. Disassemble the objective scanner as shown below:

3. Place the correct flange.



Correct position of an objective scanner is shown below:

4. Take 10x objective and screw it into the Top objective scanner (Figure 9-10):

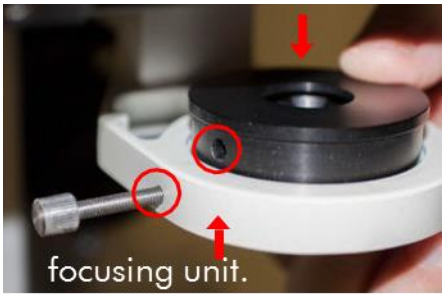


NOTE: If you need only Top objective we recommend to remove Side objective to prevent it damage during installation of SmartSPM on OmegaScope. It also will be easier to install SmartSPM.

4.2 Setup Top objective scanner.

1. Install a proper flange and align both holes with a screwdriver:

Flange for top objective scanner



Place the flange into the focusing unit. Align both holes for screw.

Use screwdriver to adjust holes.

2. Take the objective scanner and fix it into the flange:

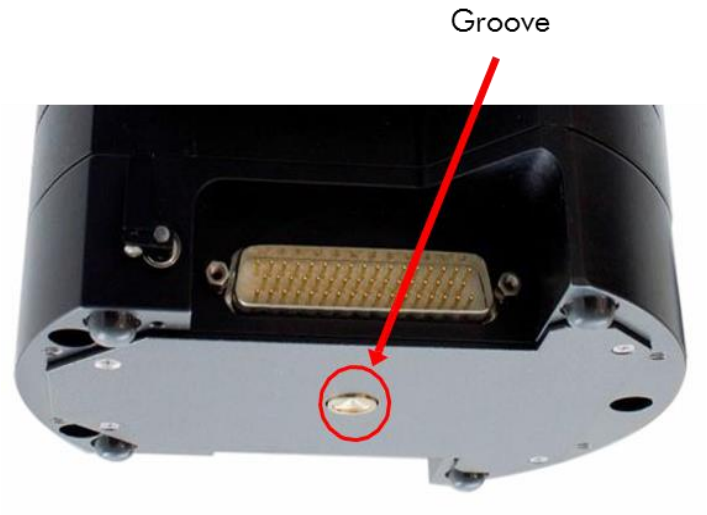
Top objective scanner

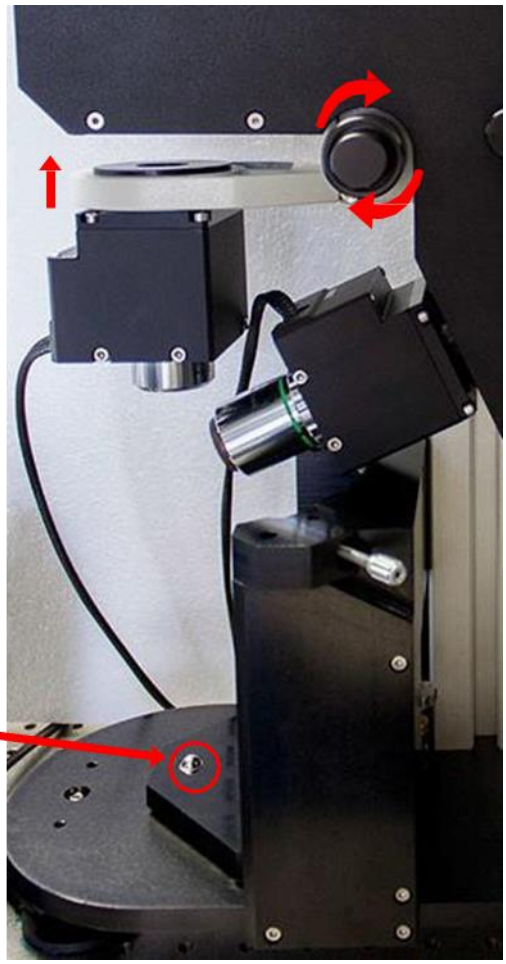
Place the objective scanner into the flange

5. Setup SmartSPM into the system.

NOTE: Before installing SmartSPM raise the focusing unit up.

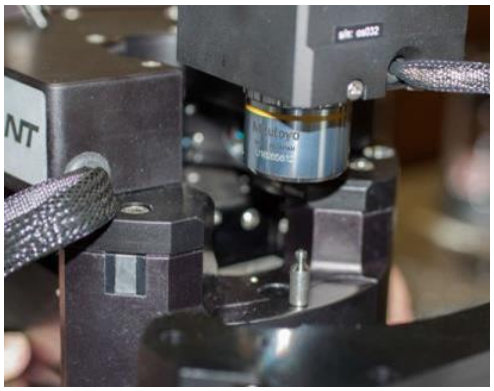
NOTE: At the base of SmartSPM there's a small groove, which must fit the hinge on the stand of OmegaScope. During the installation, check if the SmartSPM got a hinge in the groove.



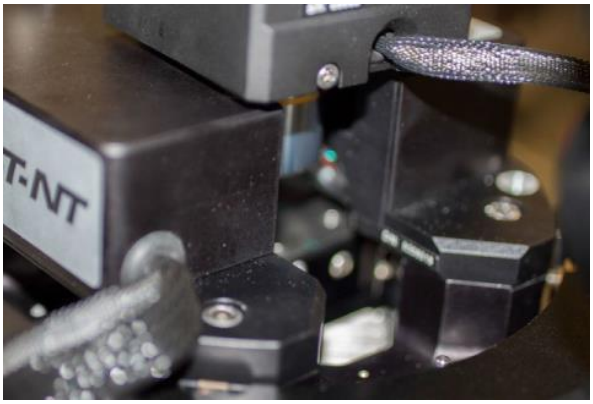


NOTE: To avoid objective damage move SmartSPM under objectives when installing it into OmegaScope.

1. Carefully move SmartSPM under the objective:



Moving SmartSPM under the objective.

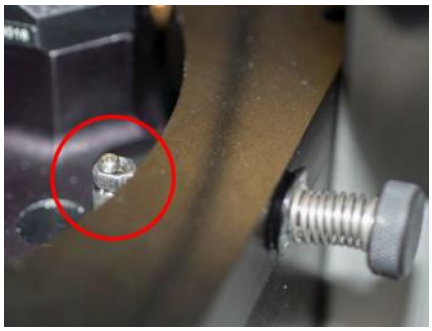


Correct position of SmartSPM.

2. Holding SmartSPM by hand tighten the screw on the other side:

Screw to tighten Smart.

Hook the bolt by screw.



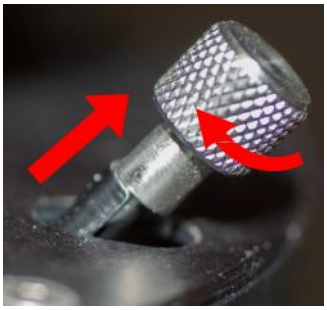
Right position of the screw.

3. Finally SmartSPM should be positioned as shown below:

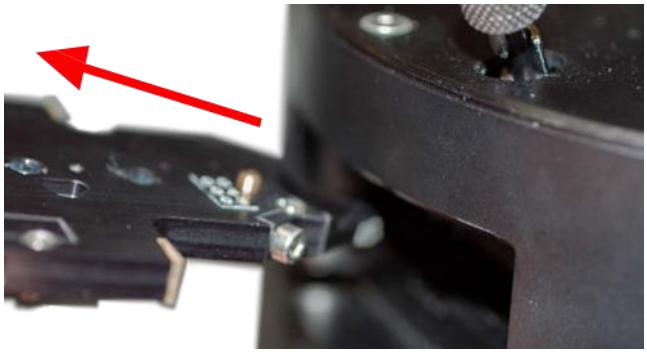
6. Remove cantilever from SmartSPM.

1. Move sample down from the probe by pressing the **“new tip”** button on the **ZMotor Ctrl** panel.
2. Disconnect the probe holder electric connector from the AFM head.

3. Pull the latch of a support of the probe holder up and turn it clockwise on 180°. After turning, the latch stays in its up position.

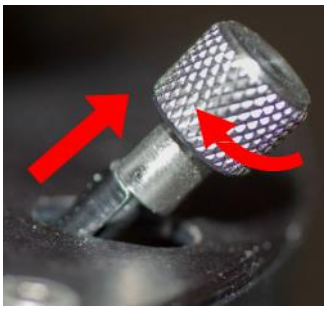


4. Carefully remove the probe holder from the head.

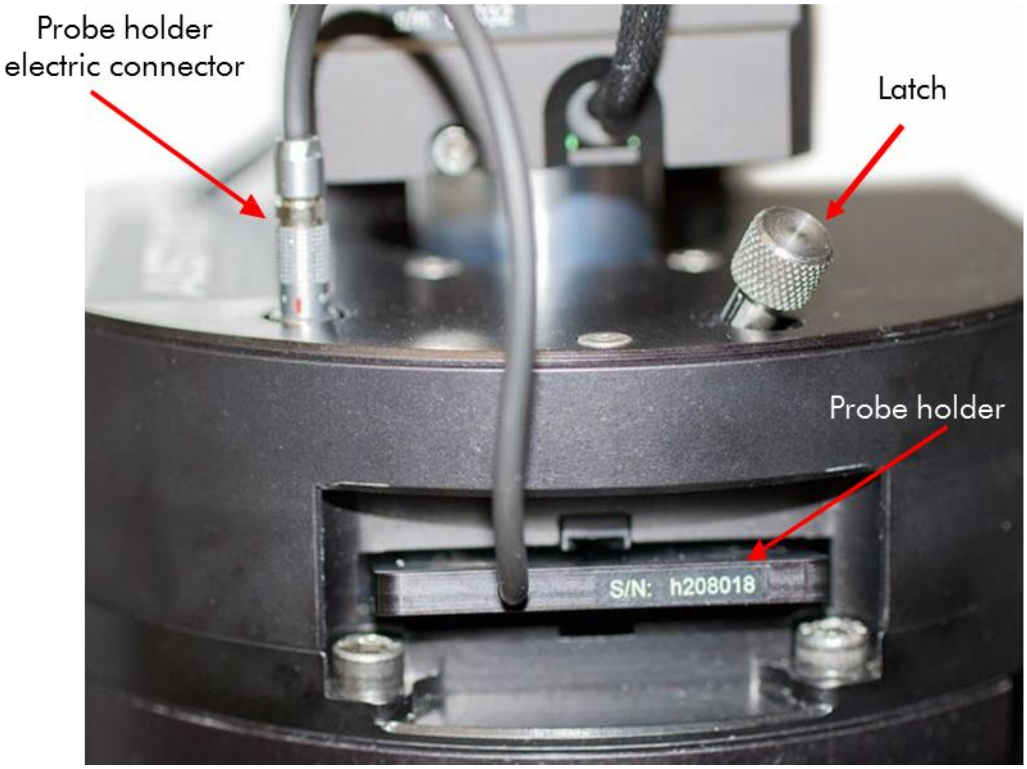


7. Place cantilever into SmartSPM.

1. Move sample down from the probe by pressing the “new tip” button on the ZMotor Ctrl panel.
2. Disconnect the probe holder electric connector from the AFM head.
3. Pull the latch of a support of the probe holder up and turn it clockwise on 180°. After turning, the latch stays in its up position.

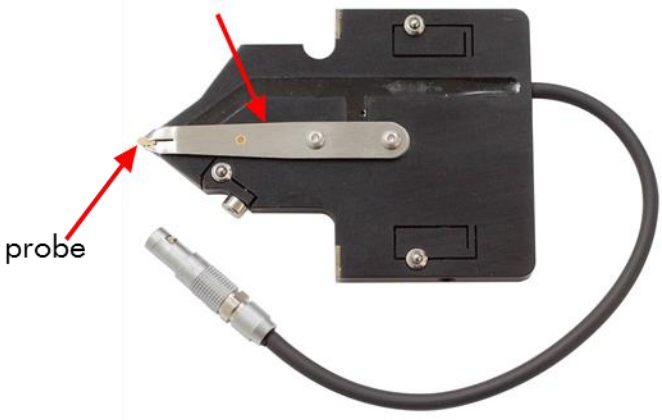


4. Carefully remove the probe holder from the head.



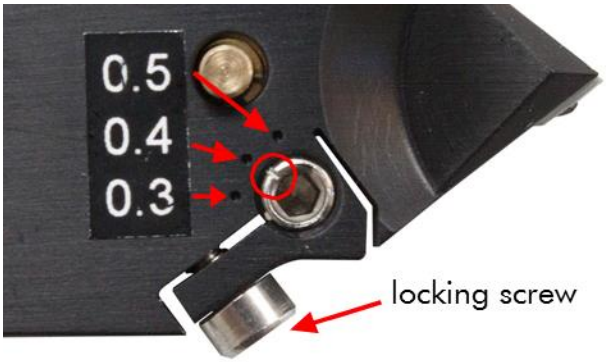
7.1 Prepare the probe.

1. Put the probe holder upside-down on the table.



The probe holder with the installed probe.

2. Check the mark to fit width of the probe:
Loosen the locking screw, so that the stop screw could be rotated with a little resistance. For adjustment onto the needed probe thickness, turn the front set screw so that the groove is in front of the mark corresponding to the thickness of the used probe. After adjustment, tighten the locking screw.



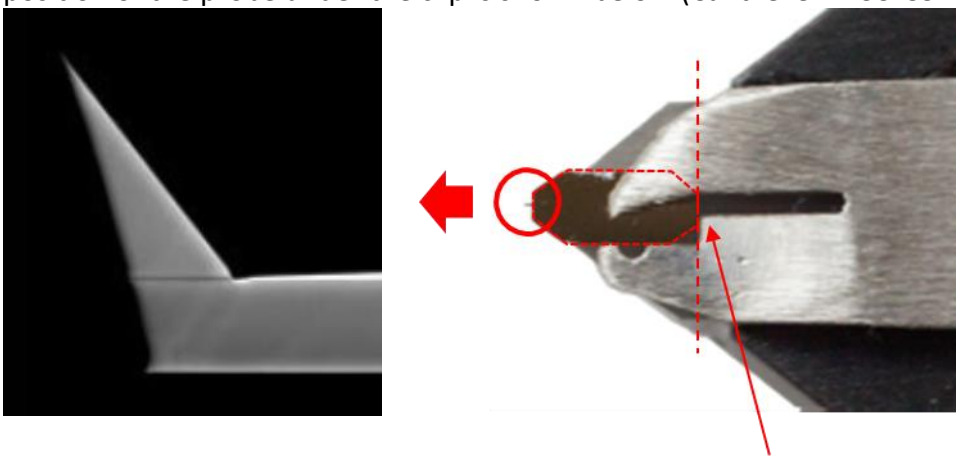
3. Gently open up the probe's spring clip by pressing it down to table surface:

NOTE: For top access probe should be direct optical view of the tip. For example: ACCESS-NC-GG series with width of 0.3mm.

4. Take one probe from the box using tweezers. Please notice that each probe lies inside the gel box, so its tip is up and re ecting side is down. One-cantilever probe chip lies oriented to the box hinges.

5. Using tweezers carefully place the probe under the clip as shown below:

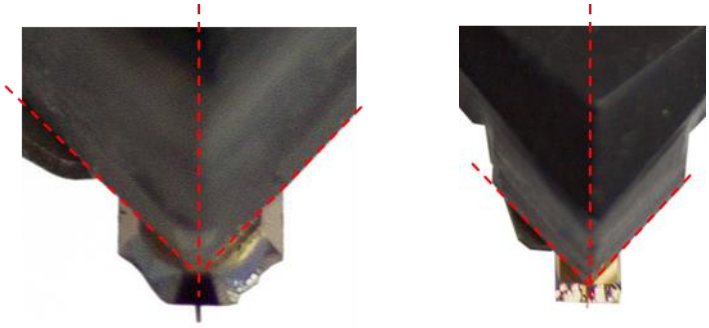
6. The correct position of the probe under the clip is shown below (Cantilever: ACCESS-NC-GG):



NOTE: Move the opposite side of cantilever as close as possible to this corner.

NOTE: Some types of cantilevers may be 2-sided. (One tip on each opposite side) In this case it's important the second tip can be viewed through carve in the holder (long narrow line).

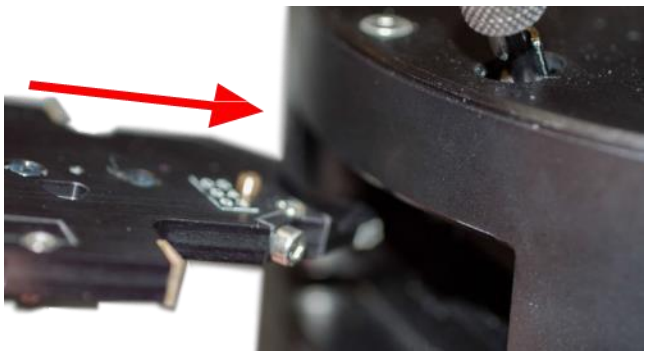
7. Carefully flip the probe holder and check if the tip of the triangle is on the middle of the probe and as close as possible to the edge of the probe cheap. Example is shown below:



Probe installed correctly

8. Check the latch in up position.

9. Install the probe holder into the measuring head:
WARNING! To avoid tip / sample damage make sure the sample is far from the working probe level.



10. Fix the probe with the latch by turning it one more time clockwise to 180°. If the latch was already up skip the step 8.

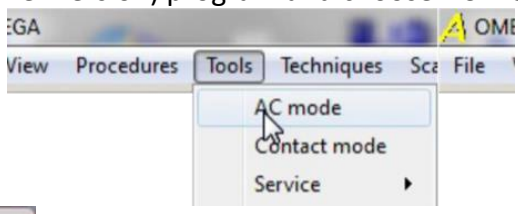
Down position of the latch

11. Attach probe holder electric connector, so that the red stripe mark on the connector is opposite to the same mark on the jack:

Attached electric connector

8. Align cantilever with AIST-NT program.

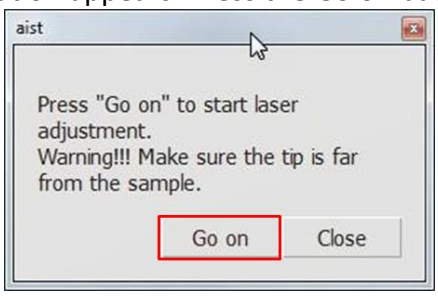
1. Go to AIST-NT 3.5.36 (or newer version) program and choose AC mode from Tools menu:



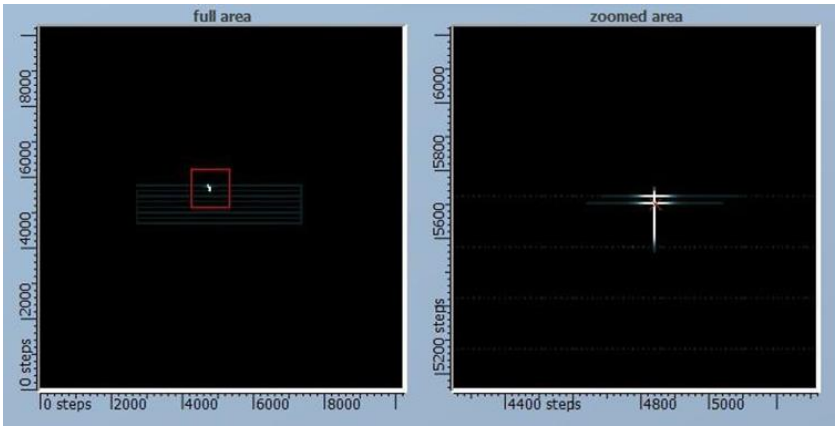
2. Press the **Auto** 

button to start.

3. Before process start the notification appears. Press the Go on button to start laser adjustment.

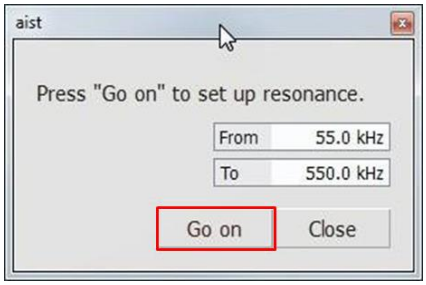


NOTE: This notification window may not appear if you already did laser adjustment earlier. For example if you want to replace cantilever after laser adjustment. In this case just wait until final message "Auto is complete" appear.



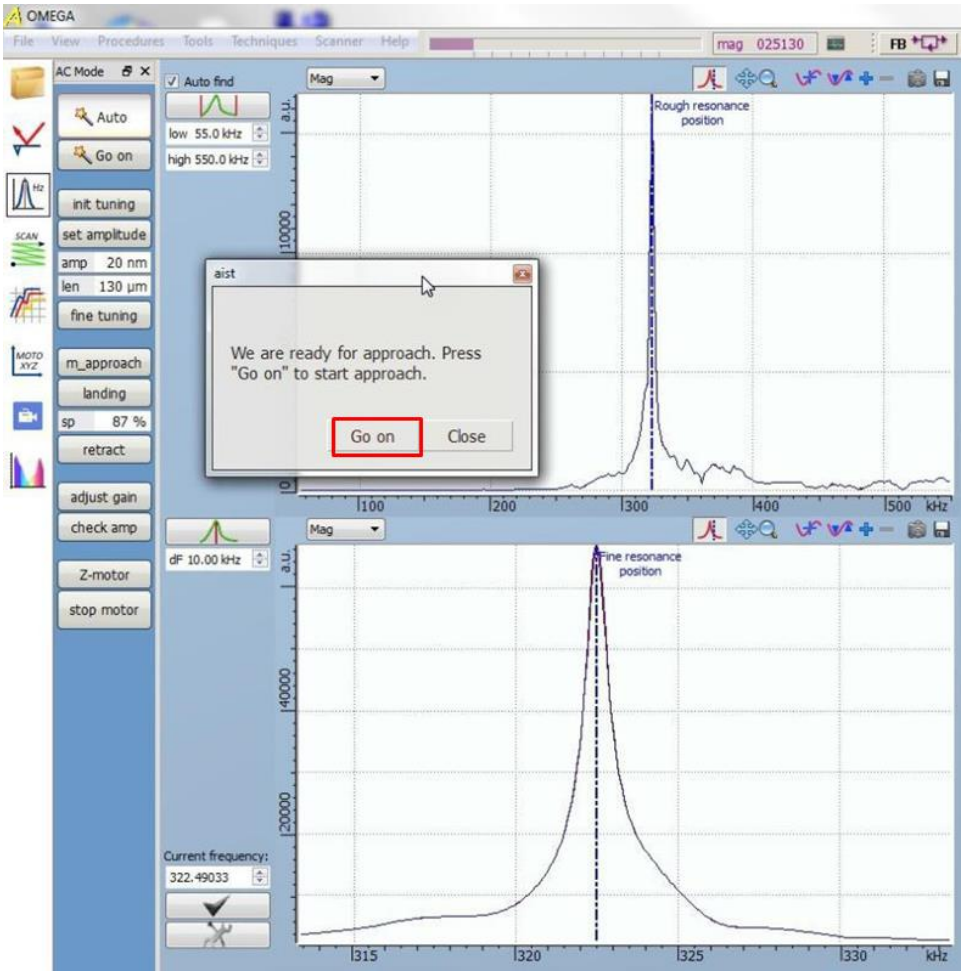
The image of cantilever in the Laser Adjustment window. The successful align of cantilever.

4. If cantilever align successfully next notification appears. Press **Go on** button.



NOTE: This notification window may not appear if you already did laser adjustment earlier.

5. Program will switch to Resonance window. After successful resonance alignment press **Go on** for approach to surface.

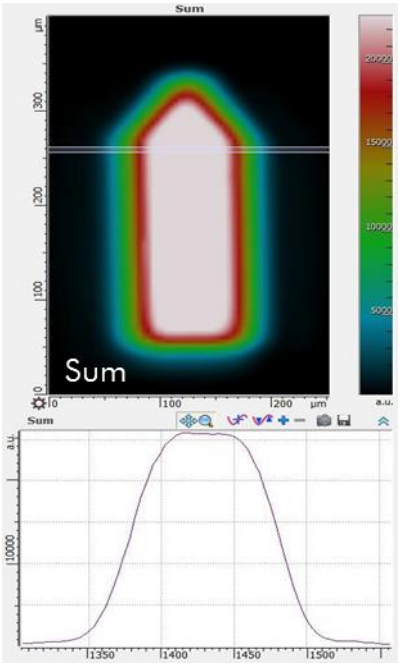


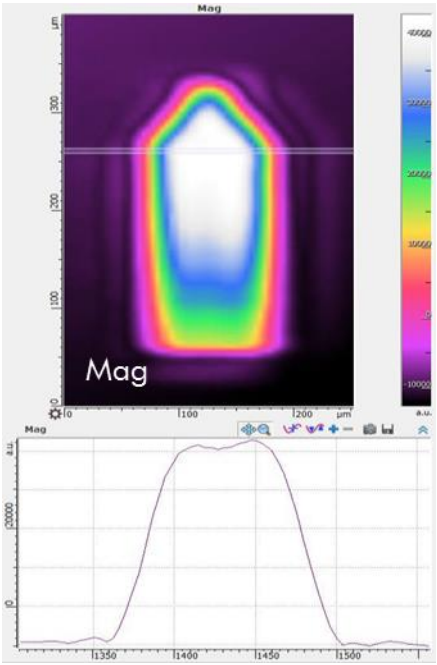
6. Wait until message **"Auto is complete"** appears. When press **Close** button on notification window.

8.1 Additional means of checking the correct thickness setting cantilever.

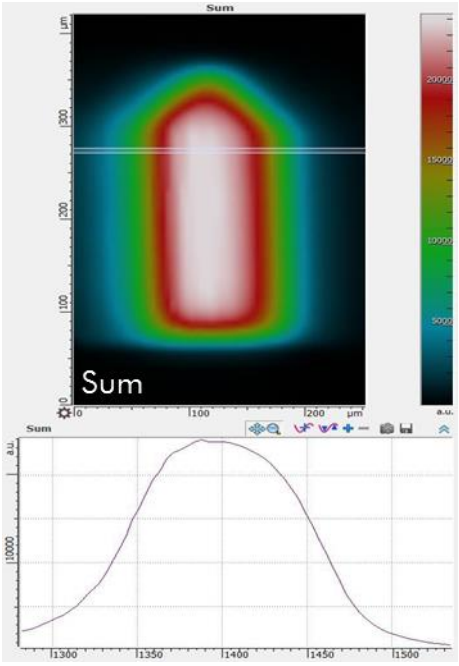
If the new cantilever thickness alignment was performed (see page 9) then it's possible to check it by run **"Moto Scan"** mode (see annex 4.9 of SmartSPM manual).

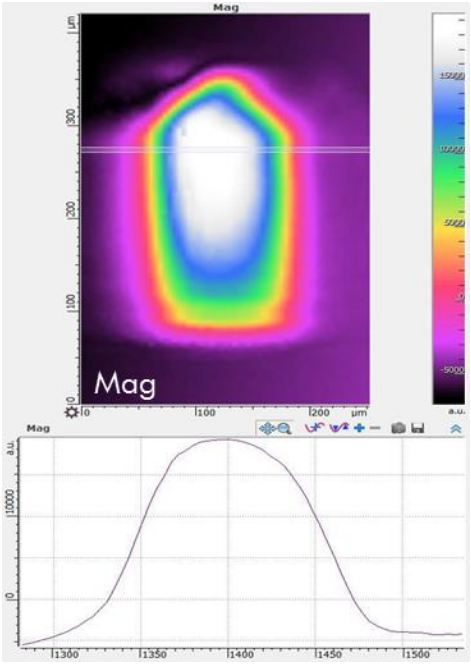
WARNING! Before to do that be sure that the sample is far enough from the tip.
Examples of good and bad alignment are shown below:





Good alignment





Bad alignment

9. Adjustment of system

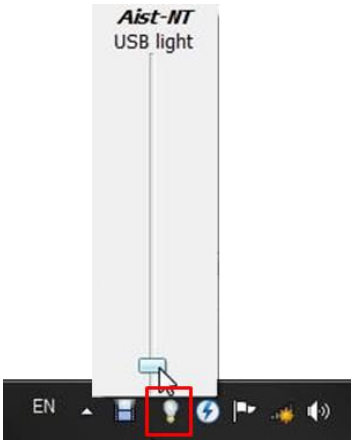
1. Switch OmegaScope's wheel to semi-transparent mirror (see middle pictures below):

No hole-no mirror

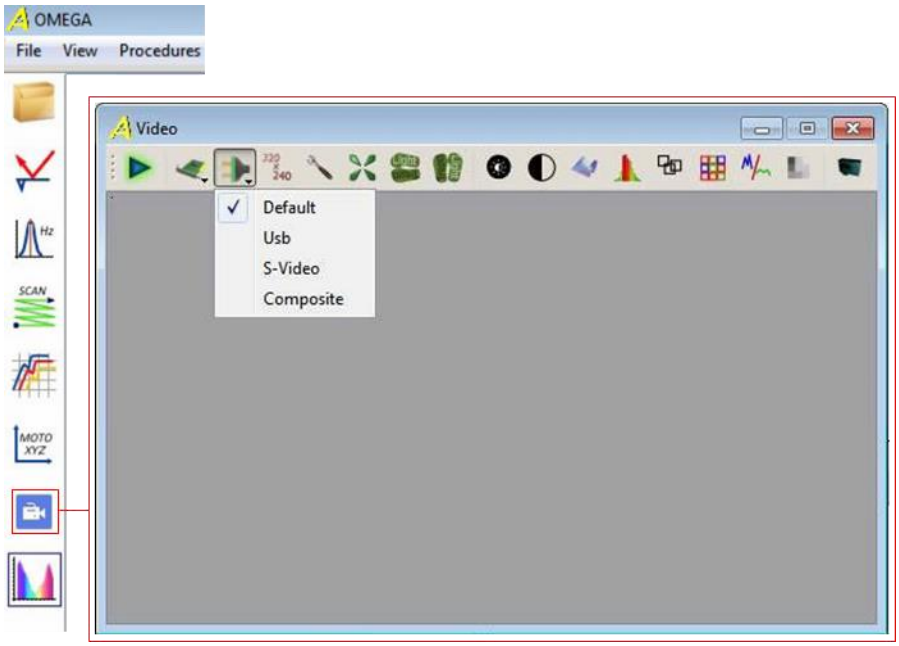
One hole-semi transparent mirror

Two holes-100% mirror

2. Turn On the Lighter. To properly install Lighter see **lighter-instruction.pdf**



3. Switch AIST-NT program to camera window by pressing  button. When press  button and choose video camera installed on Input-Output unit.



NOTE: Lighter icon is placed at the bottom right angle of PC monitor near to timer.


Run video


Last video camera


Choose hardware input channel


Video resolution


Settings


High pass filter


Feature emphasis


Flip an image around X-axis


Flip an image around Y-axis


Brightness range


Full range


Save current image as pixmap


Subtract surface


Equalize histogram

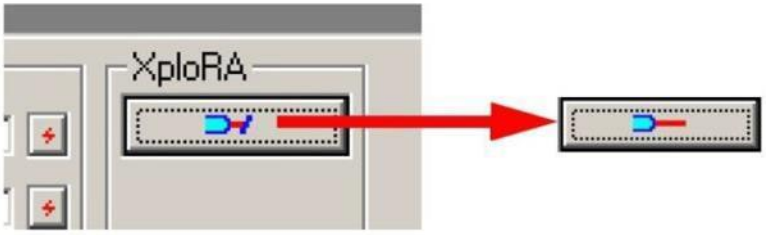

Sobel


Medin


Time smoothing

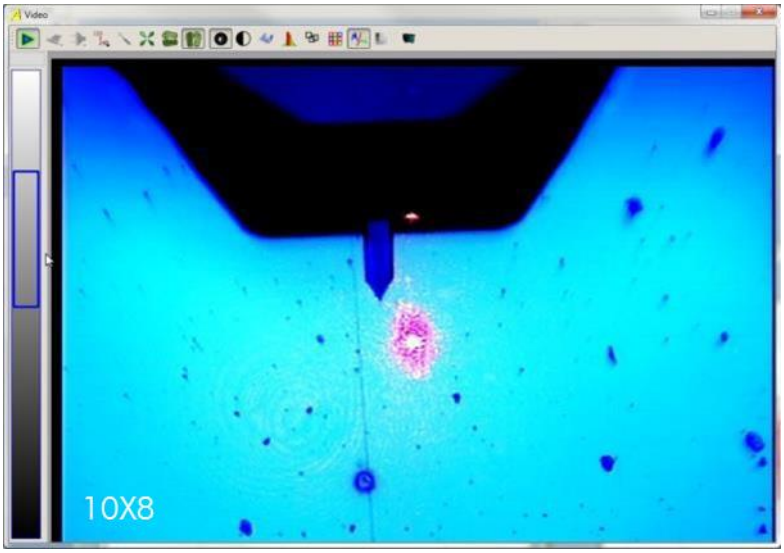
4. Turn laser power to minimum (for example see the LabRam, XploRA System User Manual from HORIBA).

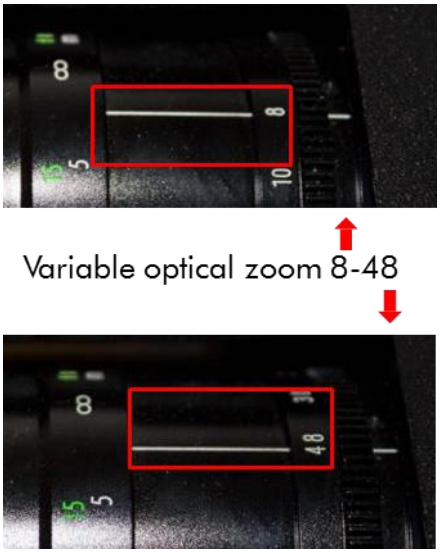
5. Power On the laser (see the LabRam, XploRA System User Manual from HORIBA):



Laser OFF Laser ON

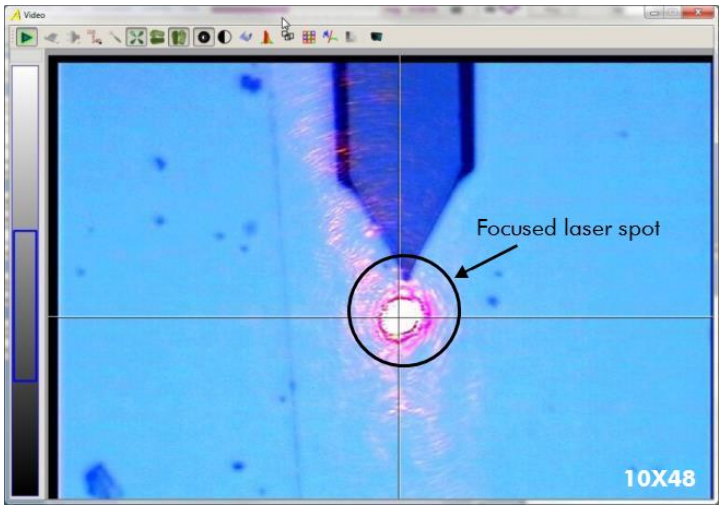
6. Set zoom 8. Then focusing laser spot by moving focusing unit. You will see the sample surface and cantilever.



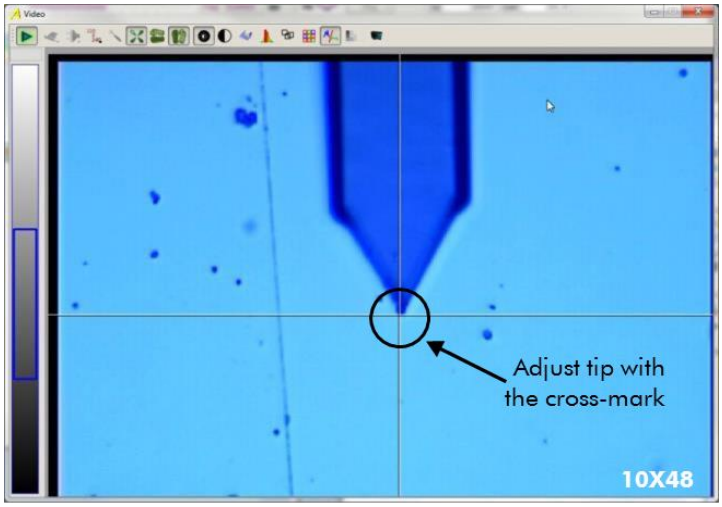


7. Move probe to laser spot by turning two screws in opposite corners of SmartSPM.

8. Set zoom 48. Press button and mark the laser spot by cross-mark.



9. Switch off the laser and move the probe to the cross-mark.



10. Set 100x objective

1. Set the 100x objective instead of 10x. To do this follow the steps in section **“Setup Top objective scanner”.**

NOTE: We recommended to move out SmartSPM from OmegaScope. To do this:

1. Press the **“new tip”** button on the **ZMotor Ctrl** panel.
2. Move up the focusing unit with Top objective scanner.
3. Holding SmartSPM by hand move out the screw on the other side. When move out SmartSPM.

2. Replace an objective. Follow the step described in section **“Setup Top objective scanner”.**

3. Setup SmartSPM. Follow the step described in annex **“Setup SmartSPM into the system”.**

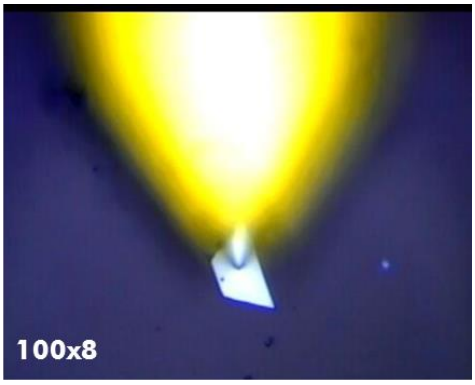
4. Press the Auto 

button to start approach procedure.

11. Work with sample

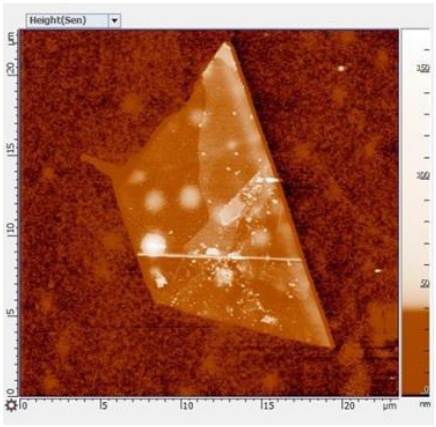
For spectroscopy mapping better to use sample with RAMAN active spectra. For example Si or graphene akes on Si. All next examples were made with graphene on Si. *(Sample courtesy of prof. Lukas Eng, IAAP, Dresden, Germany.)*

1. Move focusing unit down to get an optical image on camera window.

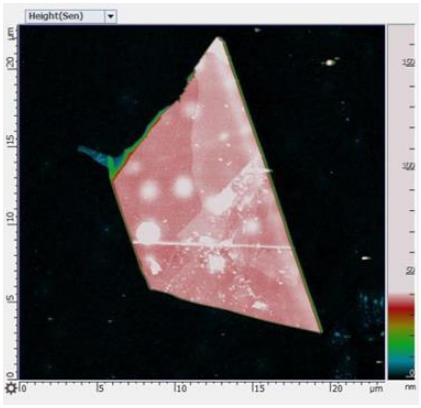


2. Find graphene flake 10-20 um size by motorized 5x5 mm stage of SmartSPM and locate tip on this flake.

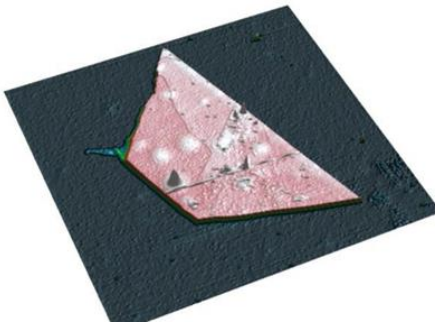
3. Get an AFM image of graphene ake (AFM topography 25x25 um):



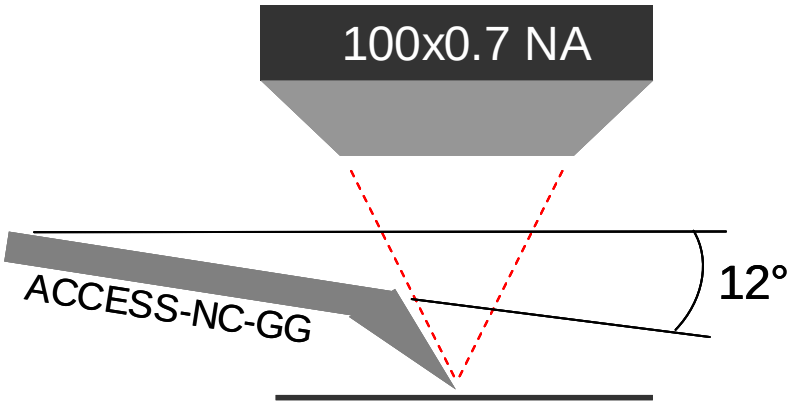
Topography image by **Full color range equalized by histogram.** 

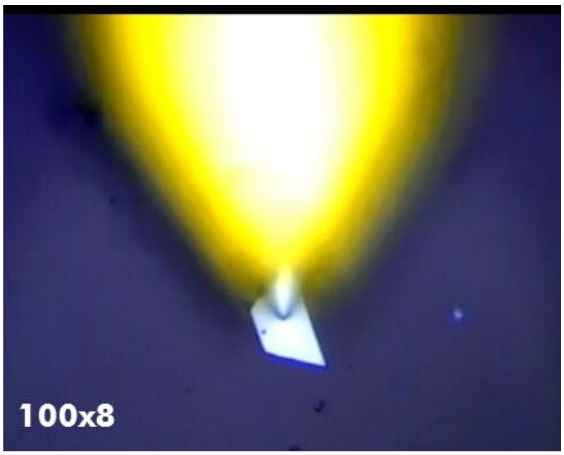


Topography image by **Automatic color range.** 

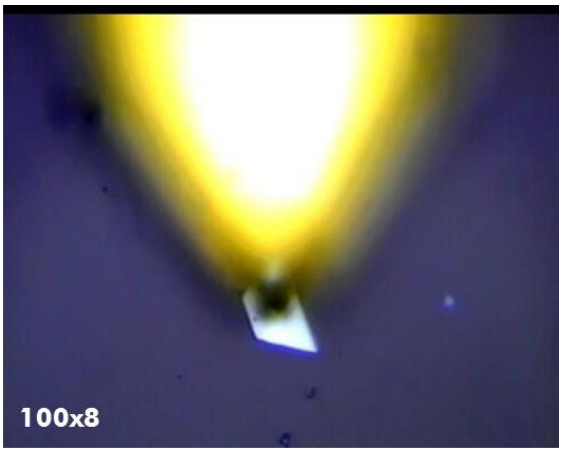


Topography image by **Show 3D raster view.** 

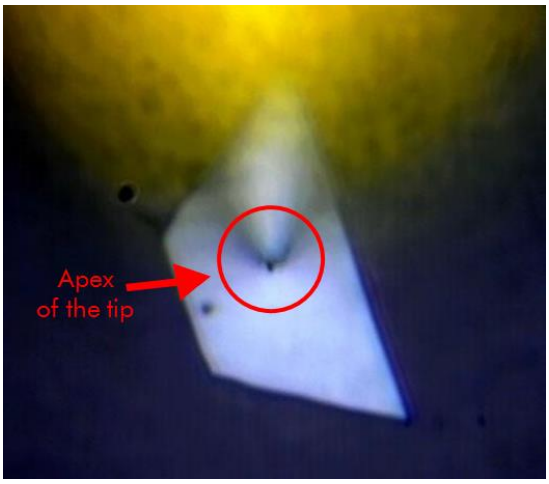




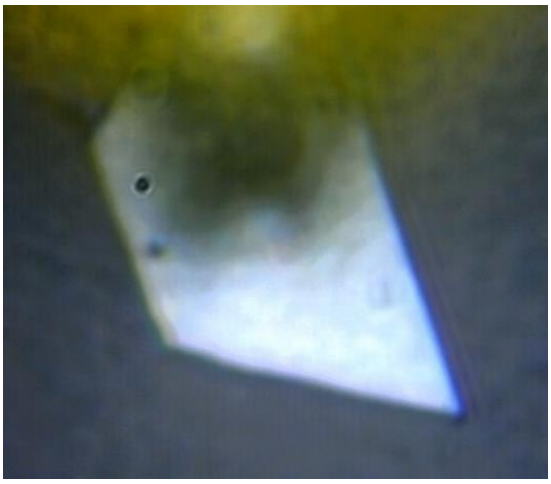
Probe is good.



Probe is bad.



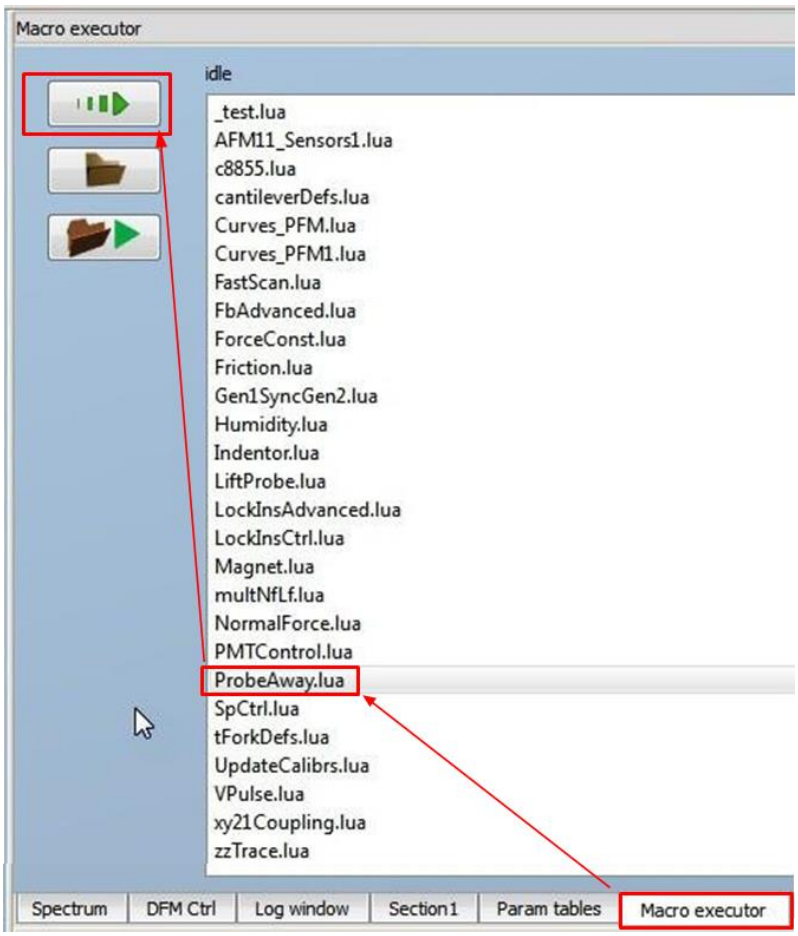
If the probe is good we can see sample through it.

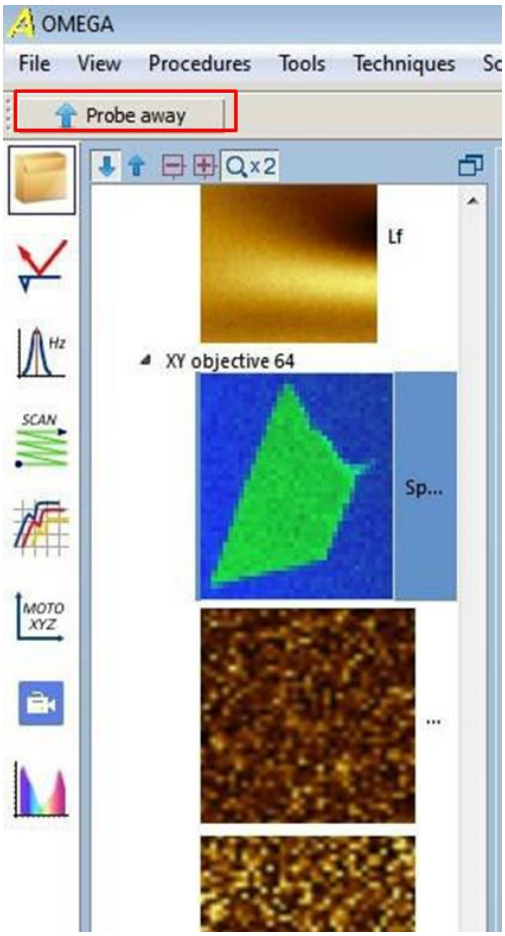


If the probe is bad we not see sample through it.

4. Run **Probeaway.lua** macros. To do it go to **"Macro executor" > macros >** press **Run** button.

When press **Probe away** Probe away button.



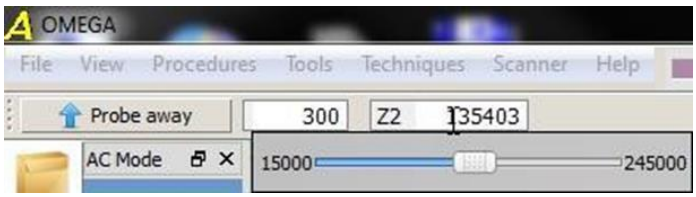


5. Switch off the Lighter.

6. Switch OmegaScope's wheel to 100% mirror.

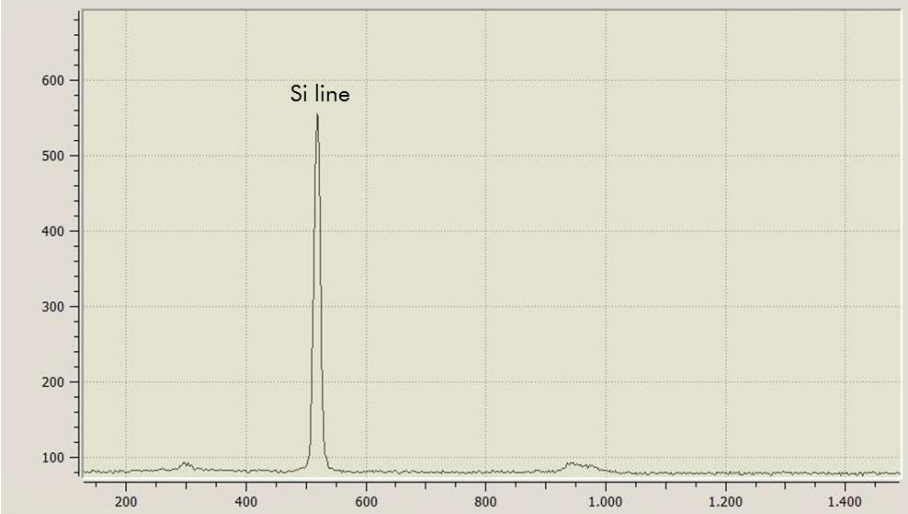
7. Switch on laser. Set maximum laser power.

8. Set maximum laser power. Set Z-objective scanner in the middle of range 130000 (for AIST-NT ver. 3.5.36 or newer).



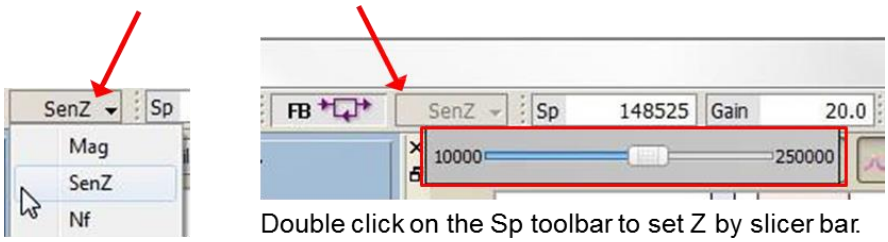
NOTE: Laser power depends on sample you use for alignment.

9. Get RAMAN spectrum (see manual LabRam, XploRA System User Manual from HORIBA):



10. By the knob of focusing unit get maximum RAMAN signal of Si. For ne laser focus adjustment move sample up and down by Z-piezo set point (Sp) control:

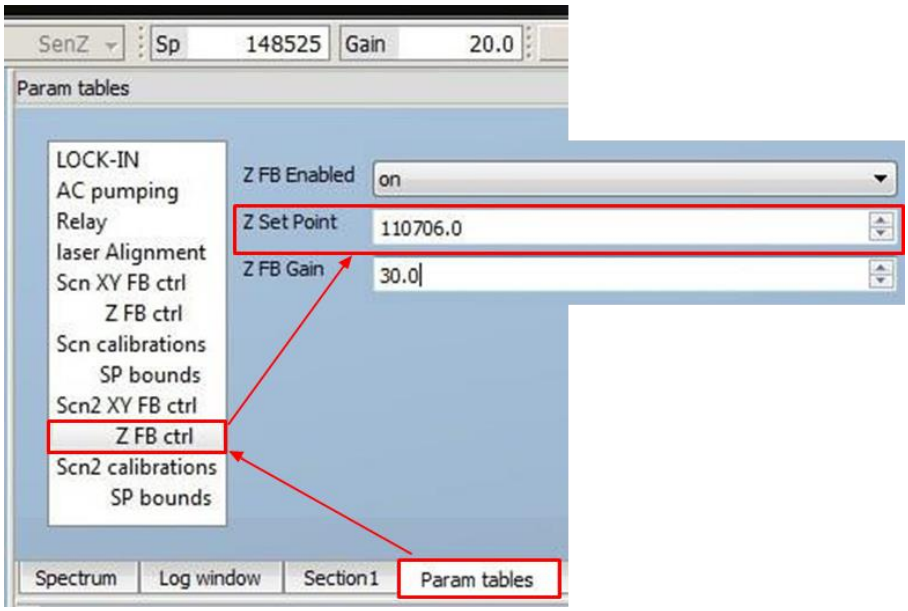
NOTE: Feedback signal should be set to **SenZ.**



Double click on the Sp toolbar to set Z by slicer bar.

Another option for the Z-focusing to use Z-piezo control of Top objective scanner.

Go to **“Param tables” >”Z FB ctrl”** (under **Scn2 XY FB ctrl**) and change **“Z Set Point”**.

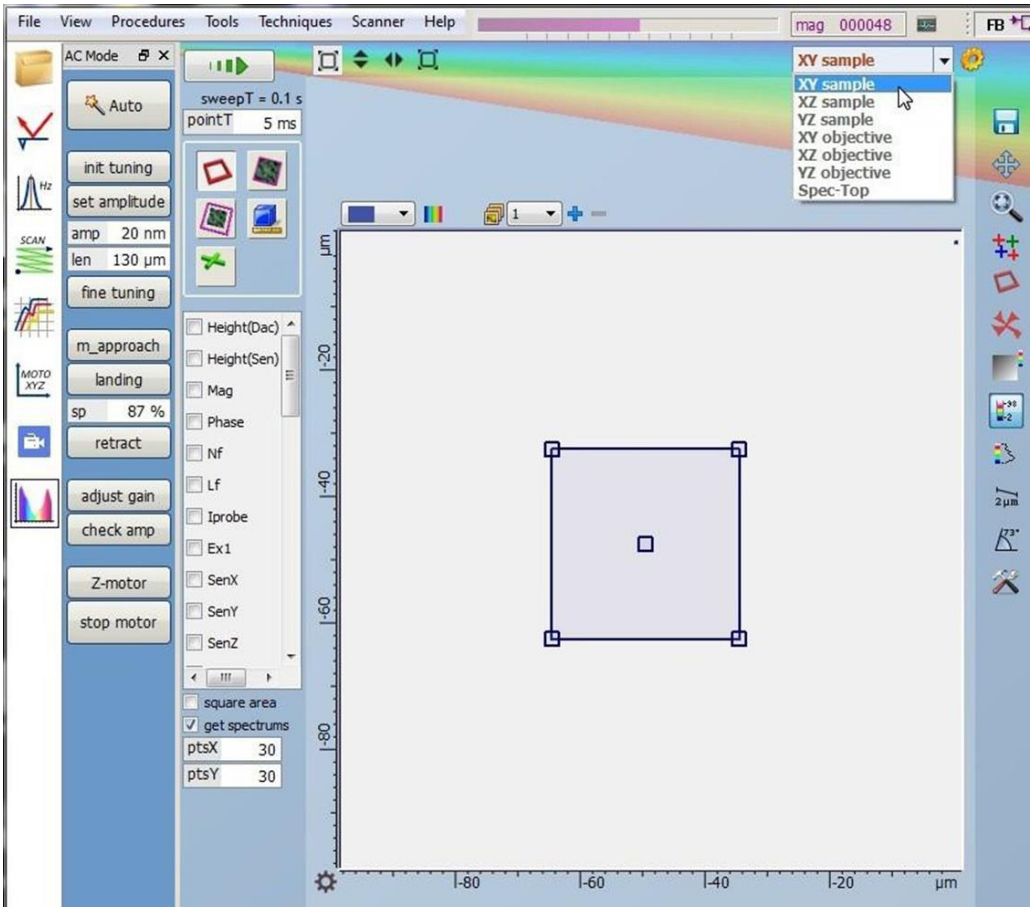


10. Go to SpecScan window. Press **SpecScan**  button on main procedures selection window.

11. In the **“Scan mode settings”** menu choose scan mode **XY sample**:

12. In **XY objective** mode the picture may be flipped. To correct this press the button at video window or select “Inverse X2” (only in AIST-NT program ver. 3.5.36 or newer).

11.1 The overview of the SpecScan window:



 Scan area selection — select scan area manually with mouse.

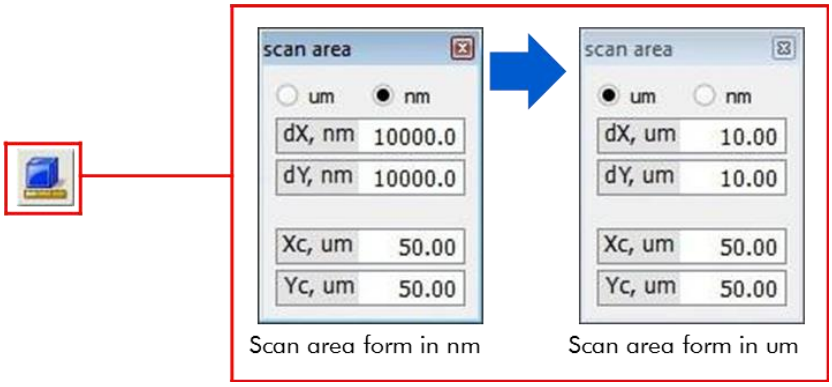
 View full available scan area

 Scanner position control

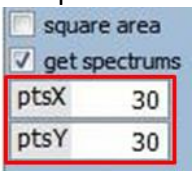
 View selected scan area — zoom to selected scan area

 Open area form — select the scanning area more accurately.

13. Set Scan area, for example 30x30 um. To do this you may press  button when set scan area by drag corners of the blue rectangle.
Another option is the set scan area by pressing  button and type it.

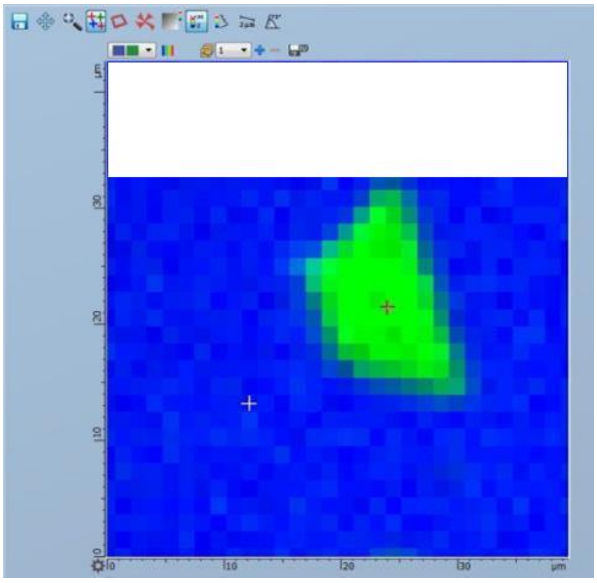


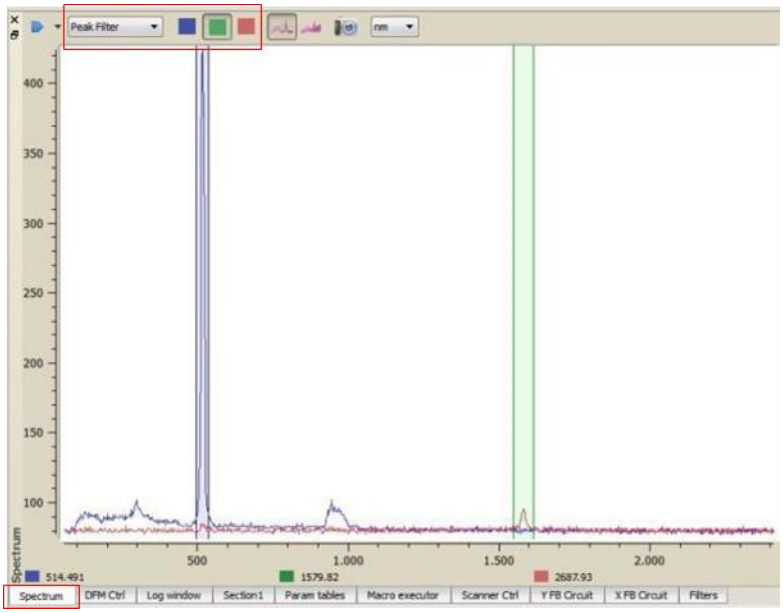
14. Set the points, for example 30x30:



15. Press Run  button to start mapping.

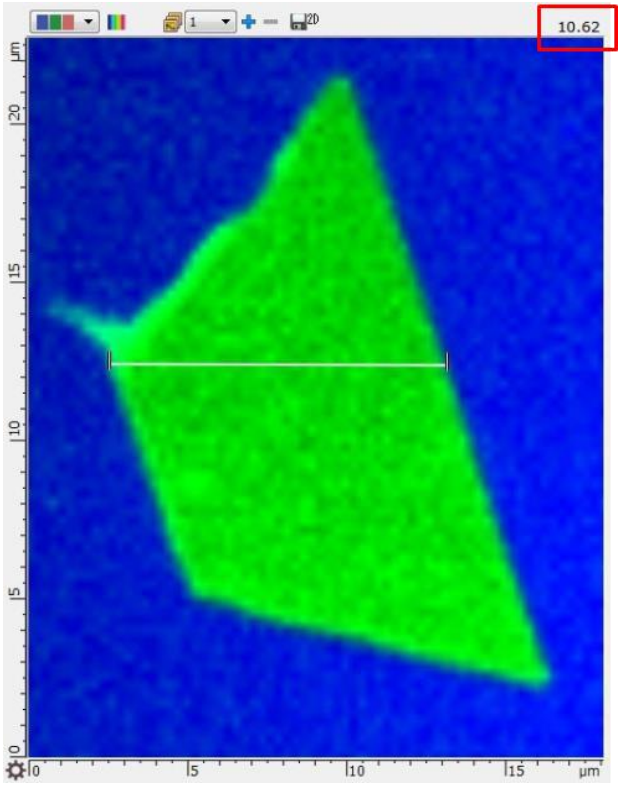
16. On the right side and Spectrum window. Using RGB buttons you can select RAMAN lines. For example blue color correspond peak intensity of Si 520 band. Green color — G band of graphene.

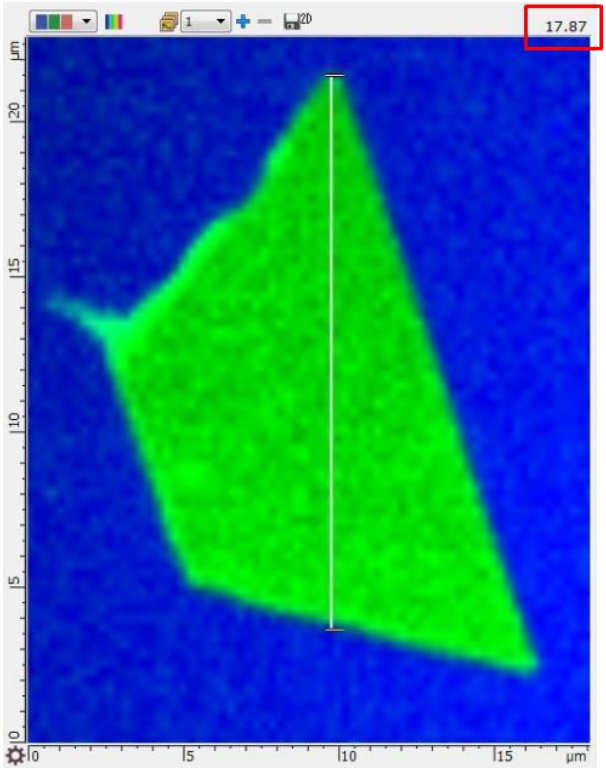




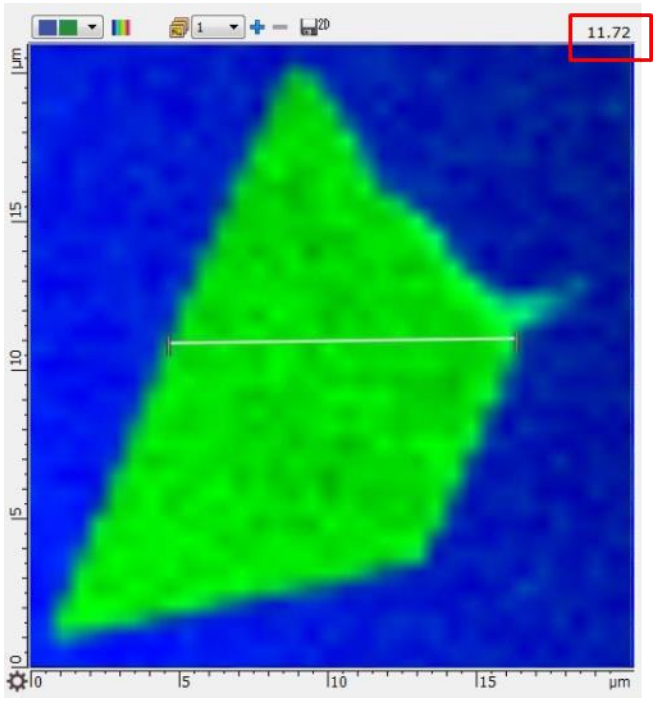
17. Set frame around graphene flake and get mapping with higher resolution (for example 70x80).

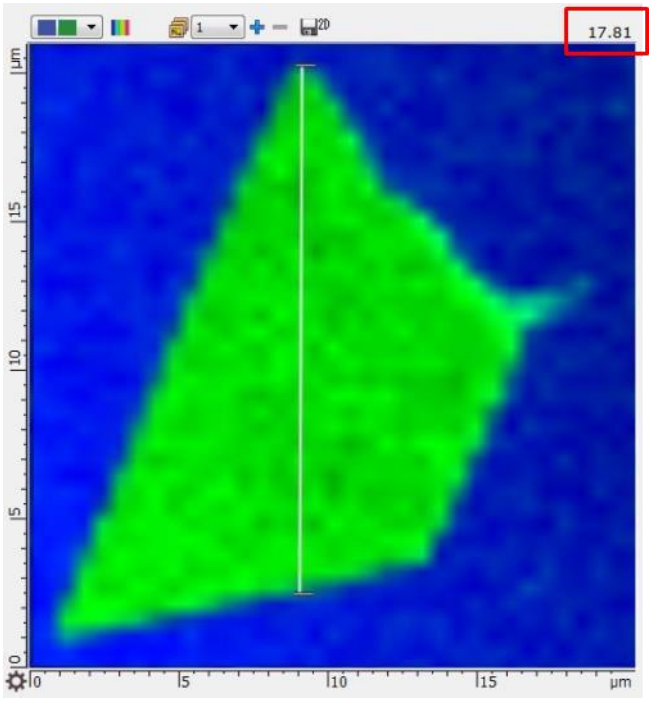
Use  measure flake dimensions. See examples below:



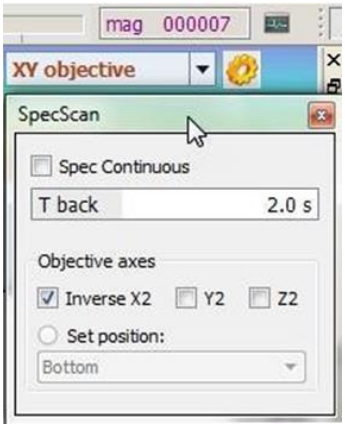


18. Select XY objective mode. Set Scan area 20x20 um and 30x30 points. Run map.

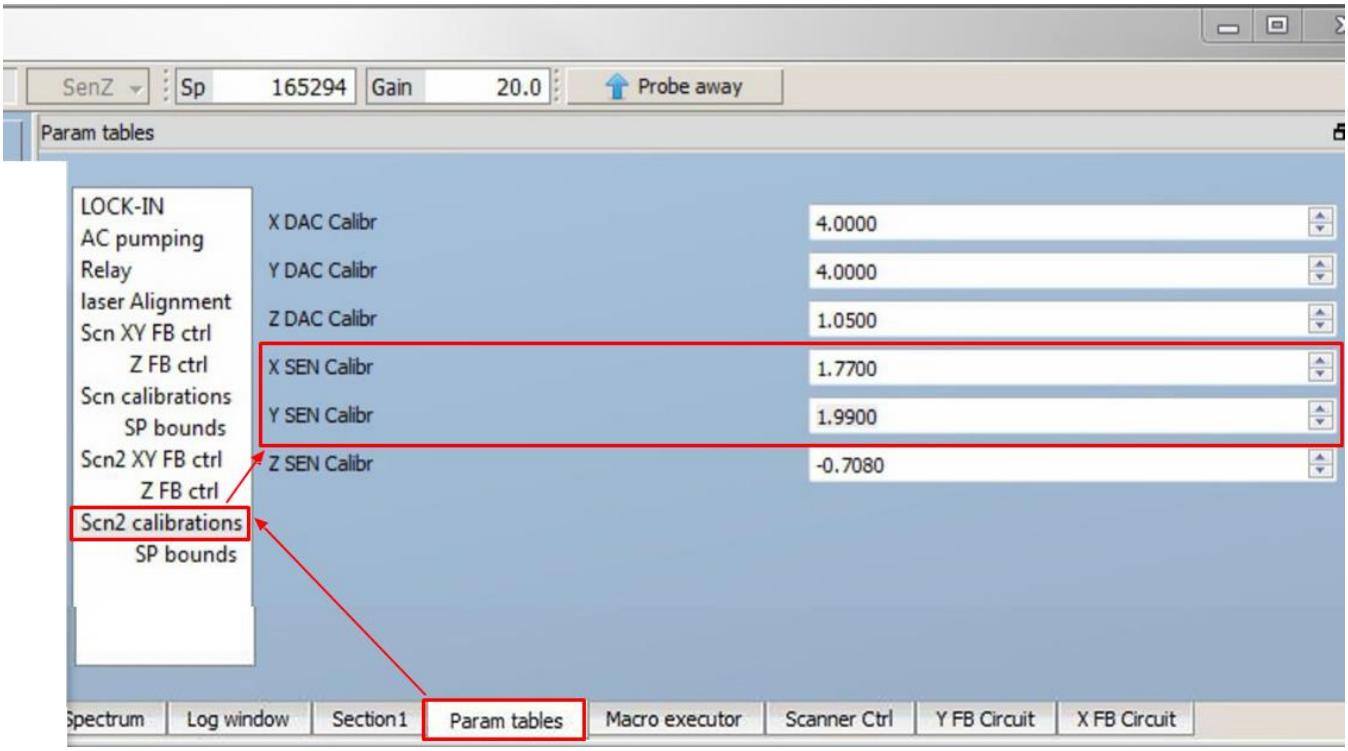




NOTE: In XY objective the picture may be flipped by X-axis. To correct this press  button on video window toolbar or select "Inverse X2" in scan mode (only in AIST-NT program ver. 3.5.36 or newer). See example below:

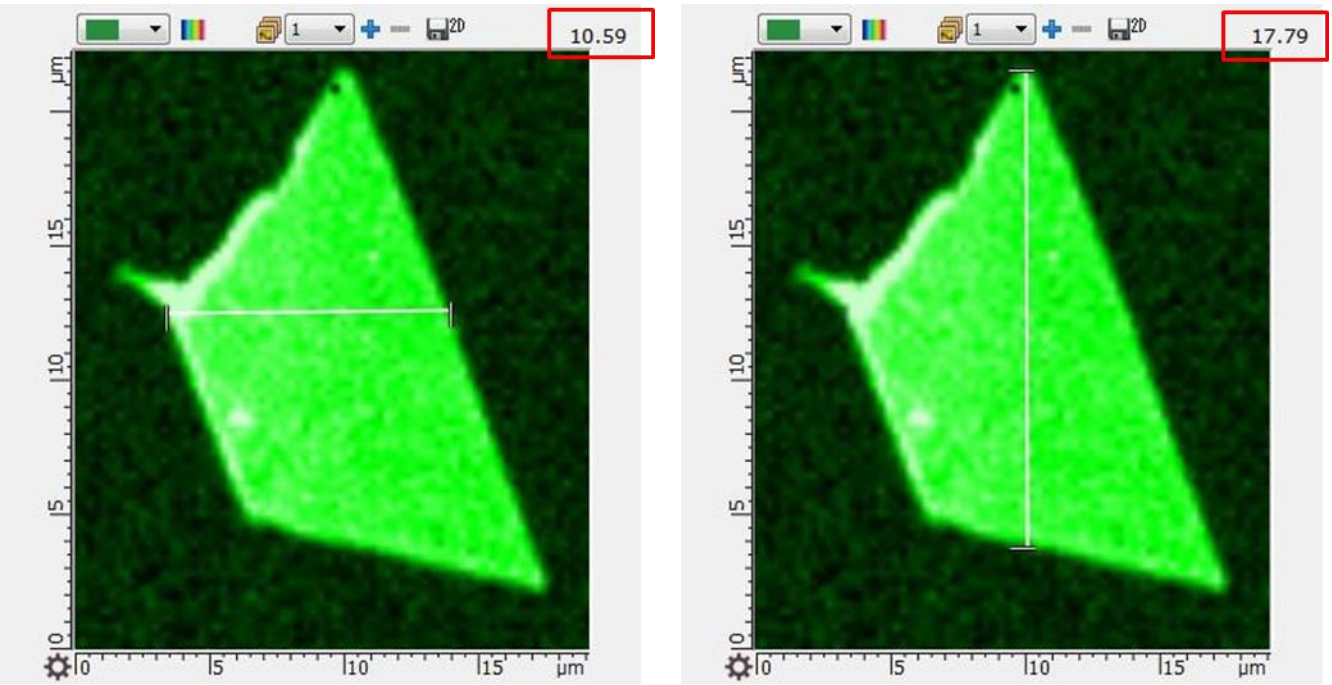


19. Calculate correct XY calibration for objective scanner. Set it to **Param tables**.

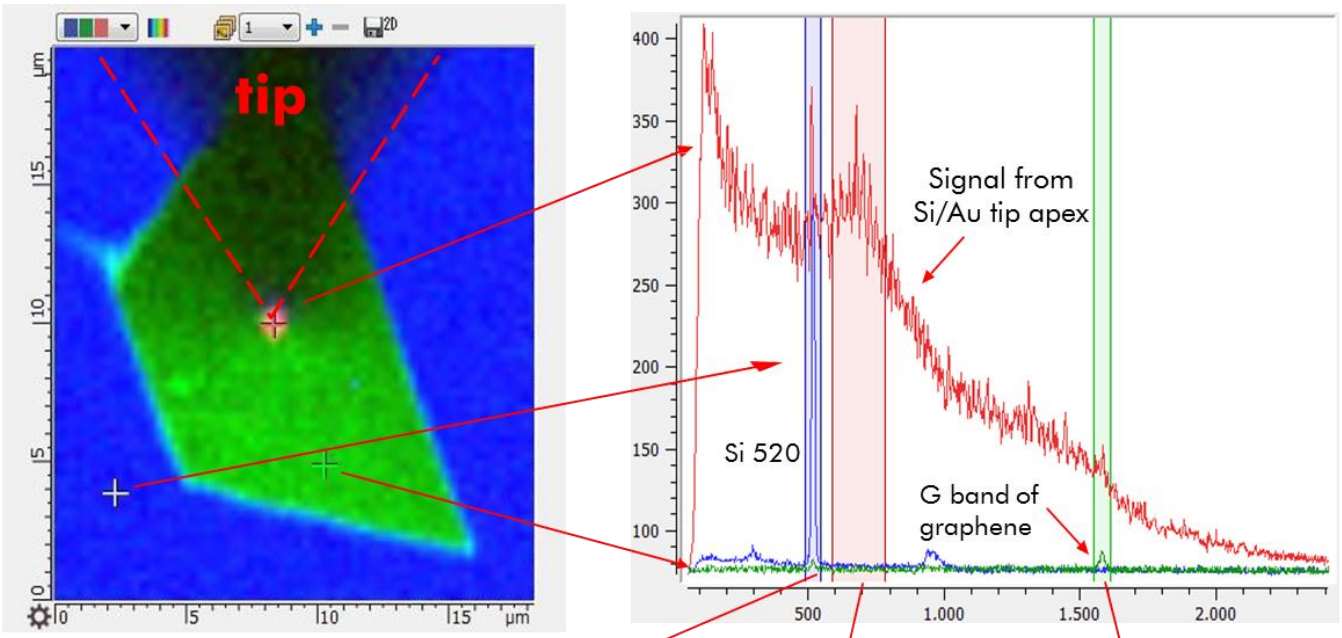


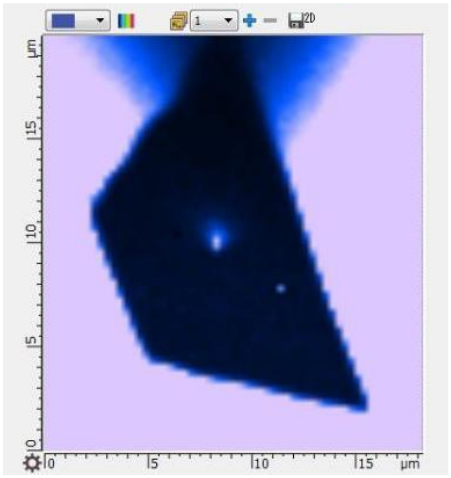
NOTE: Calibration parameters depends on objective length.

20. Get mapping by objective scanner with new calibration parameters. See example below:

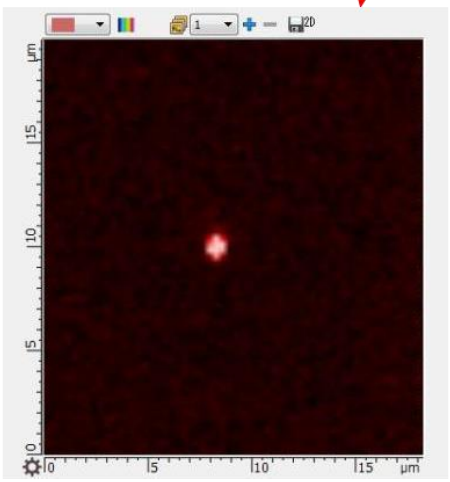


21. Unpress **“Probe away”** button. Tip automatically will land to previous point of graphene flake. Get RAMAN map by **XY objective** (see below).

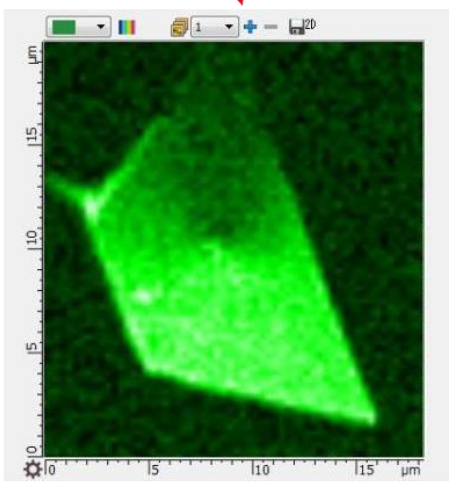




Map Si 520 band

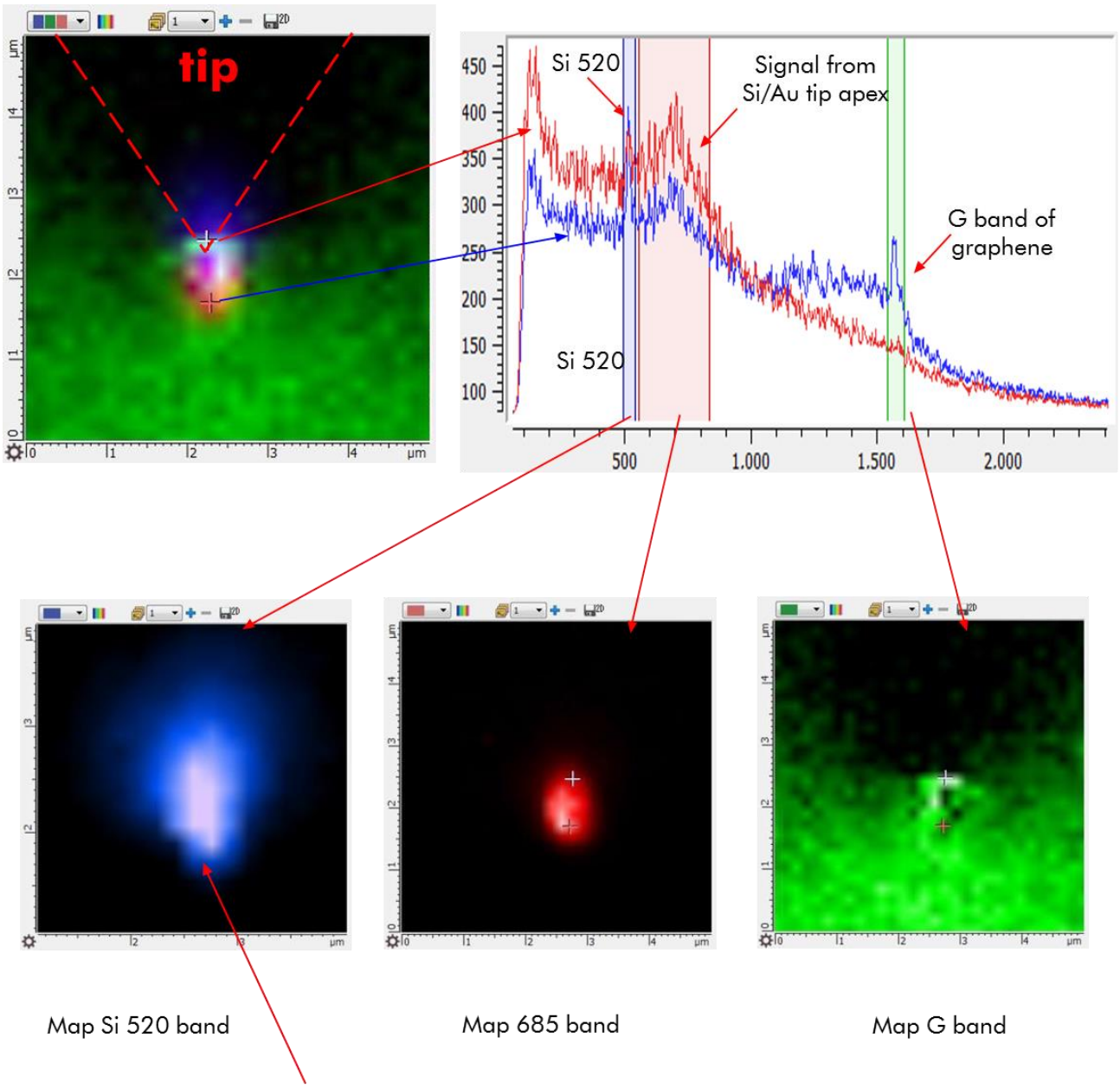


Map 685 band



Map G band

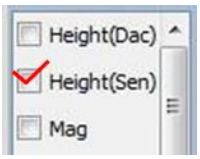
22. Set scan frame around tip apex (bright blue spot in the center of graphene flake). Get RAMAN map.

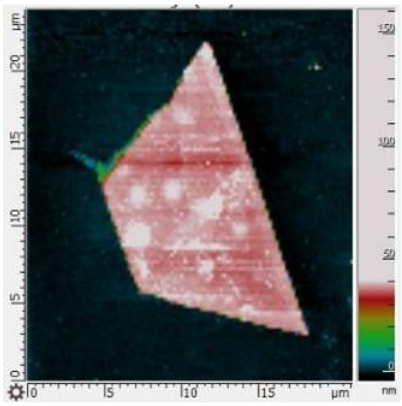


23. Point laser focus at apex of the tip. Press  button and select apex by mouse.

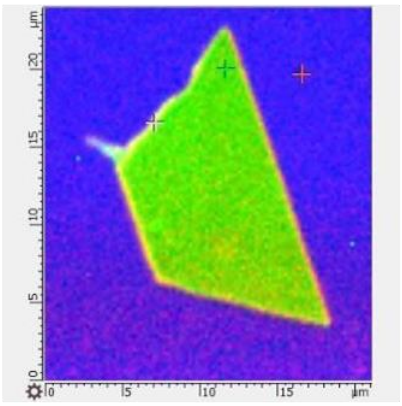
11.2 Simultaneous AFM RAMAN imaging

1. Set **XY sample** mode. Set AFM Signals.

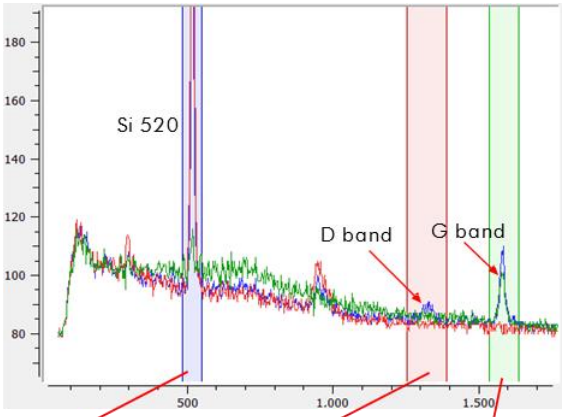


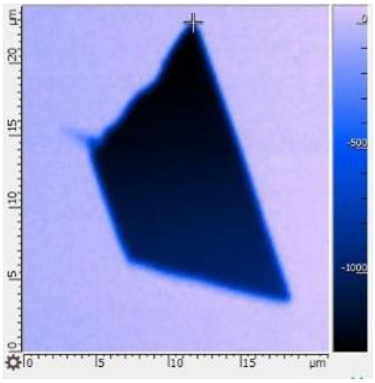


AFM topography 20x20 um

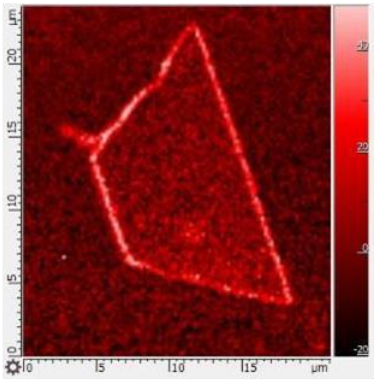


RAMAN map

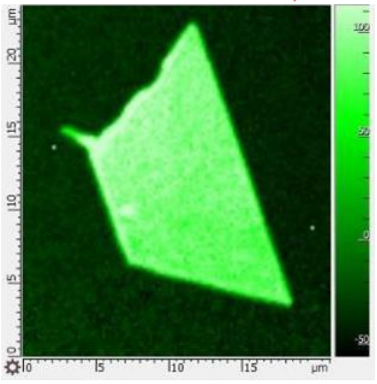




Map Si 520 band



Map D band



Map G band

12. Setup Side objective scanner:

1. Remove the scanner from the probe by pressing the “new tip” button on the ZMotor Ctrl panel.
2. Remove SmartSPM:

1. Press the **“new tip”** button on the **ZMotor Ctrl** panel.

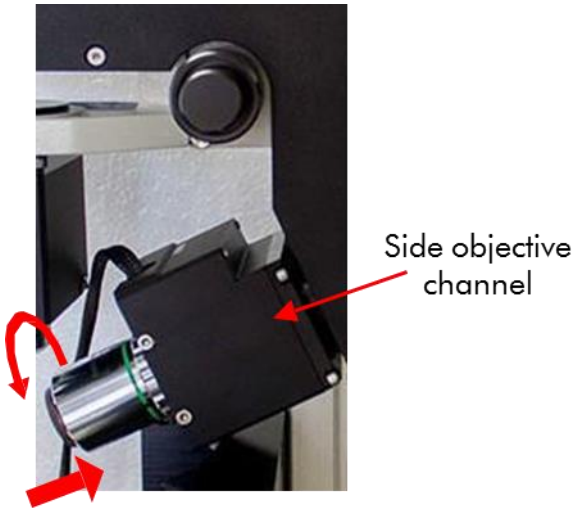
2. Move up the focusing unit with Top objective scanner.

3. Holding SmartSPM by hand move out the screw on the other side (see page). When move out SmartSPM.

3. Remove the objective scanner from Top channel (see page 6-7).

Flange for Top channel

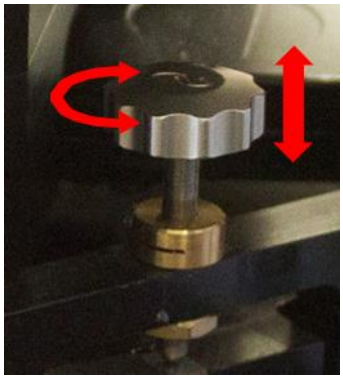
4. Install the Side flange into the objective scanner (see page 5).
5. Install 20x or 50x objective into the objective scanner.

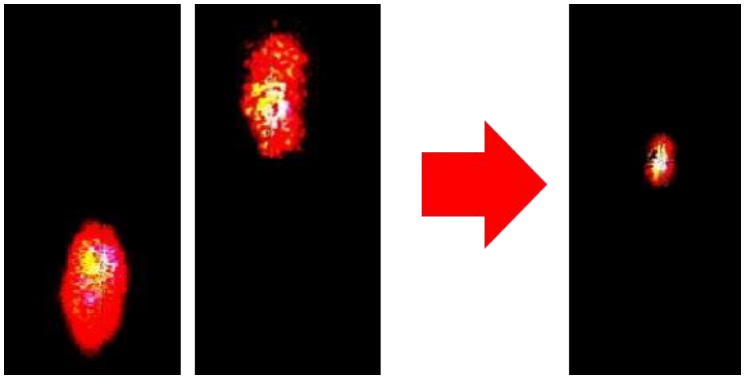


6. Install Objective scanner into the Side channel.
7. Remove the flange for objective scanner from focusing unit and install a simple flange. Then install 10x objective.

8. Move the focusing unit up in order to install SmartSPM.
9. Install SmartSPM (see pages 8-9).
10. Follow instructions on pages 14-19.

11. Set Top-Side switch to Side position. See the marks on the cover of OmegaScope next to Top-Side switch.
12. Switch OmegaScope's wheel to no-mirror (see page 17). Set zoom 8.
13. Press Probe away button.
14. Turning the screw at the bottom of SmartSPM until you see in a video window a laser spot from Side channel. Get a minimum laser spot.

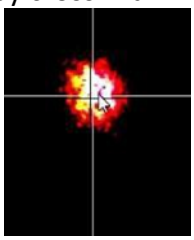




Unfocused spot Focused spot

NOTE: In some sample surfaces (with high reflection) the laser spot may not be seen in camera window. In this case we recommend to use black paper instead.

15. Press  button and mark the laser spot by cross-mark.



Focused spot at zoom 48

16. Unpress Probe away button. Move the cantilever to the cross-mark by turning two screws in opposite corners of SmartSPM (see page 1).

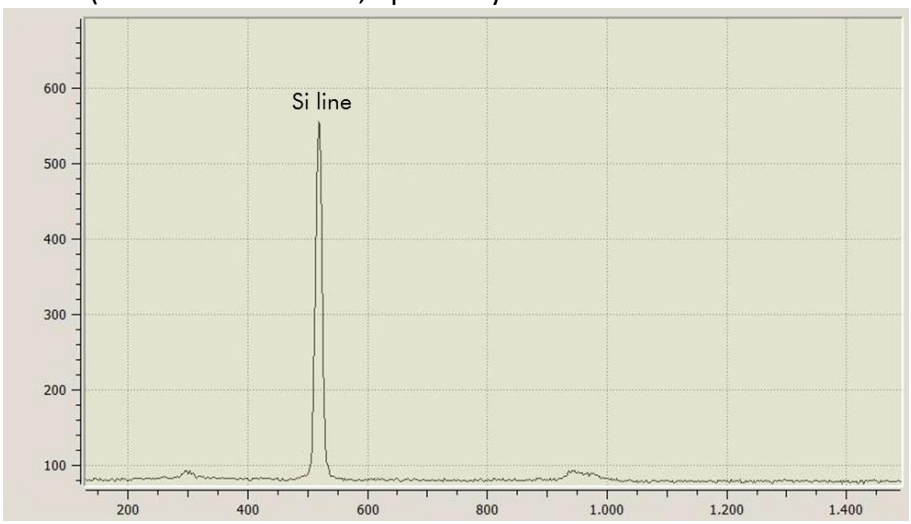
NOTE: Laser power depends on sample you use for alignment.

17. Press Probe away button. Find graphene flake and locate cross-mark on this flake.

18. Switch on laser and set maximum laser power. Set Z-objective scanner in the middle of range 130000 (see page 24) or by Param Tables (see page 25).

NOTE: Laser power depends on sample you use for alignment.

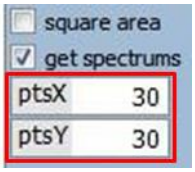
19. Get RAMAN spectrum (see manual LabRam, XploRA System User Manual from HORIBA):



20. By screw at the bottom of SmartSPM get maximum RAMAN signal of Si.

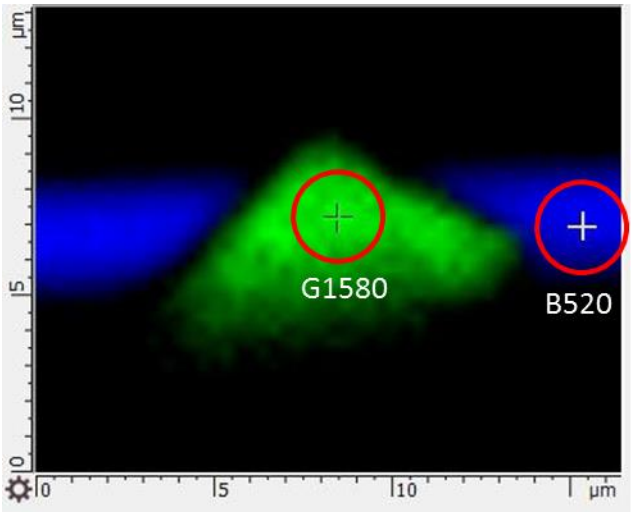
21. Set scan mode to **XY objective**. Set Scan area, for example 30x30 um. To do this you may press  button when set scan area by drag corners of the blue rectangle. Another option is the set scan area by pressing  button and type it.

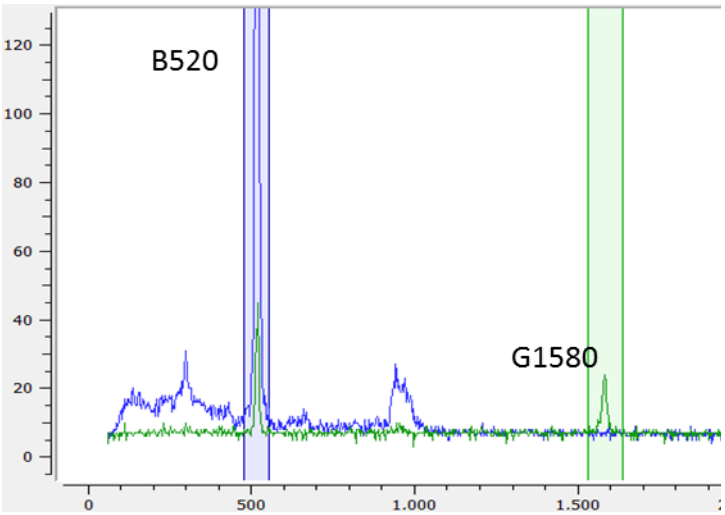
22. Set the points, for example 30x30:



23. Press Run  button to start mapping.

24. On the right side and Spectrum window. Using RGB buttons you can select RAMAN lines. For example blue color correspond peak intensity of Si 520 band. Green color — G band of graphene.

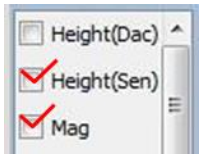


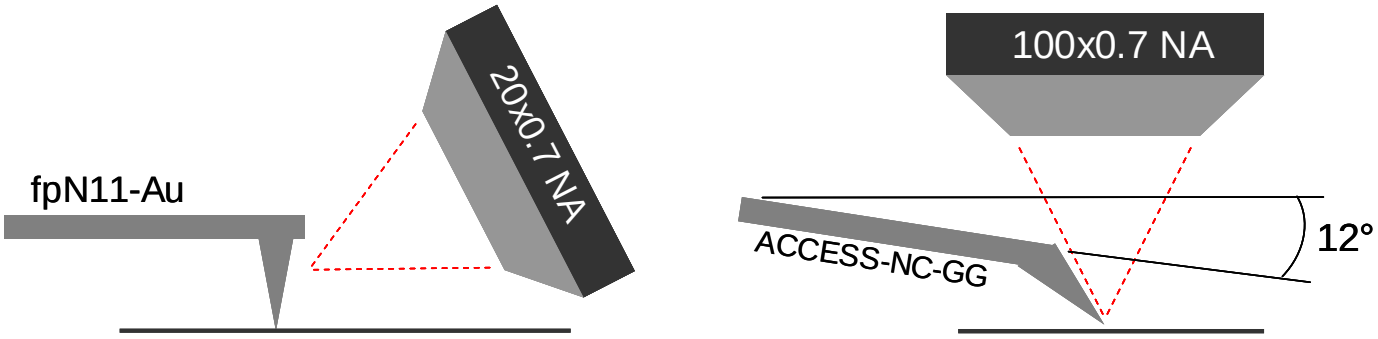


25. Get an AFM image of graphene flake (AFM topography 25x25 um). See page 21.

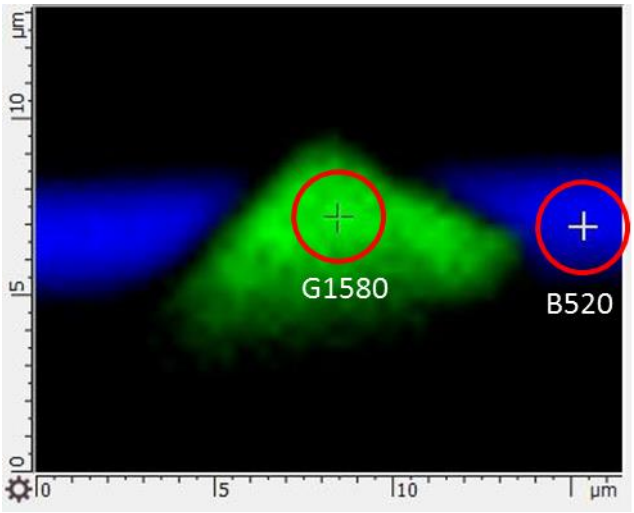
26. Go to SpecScan window. Press SpecScan  button on main procedures selection window.

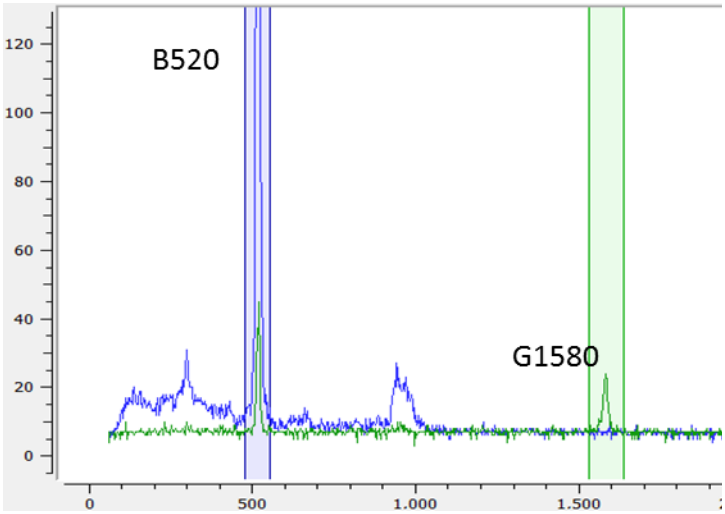
27. Set XY objective mode. Set AFM Signals.





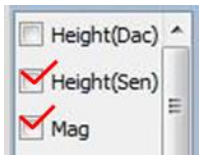
28. Get RAMAN map by XY objective.



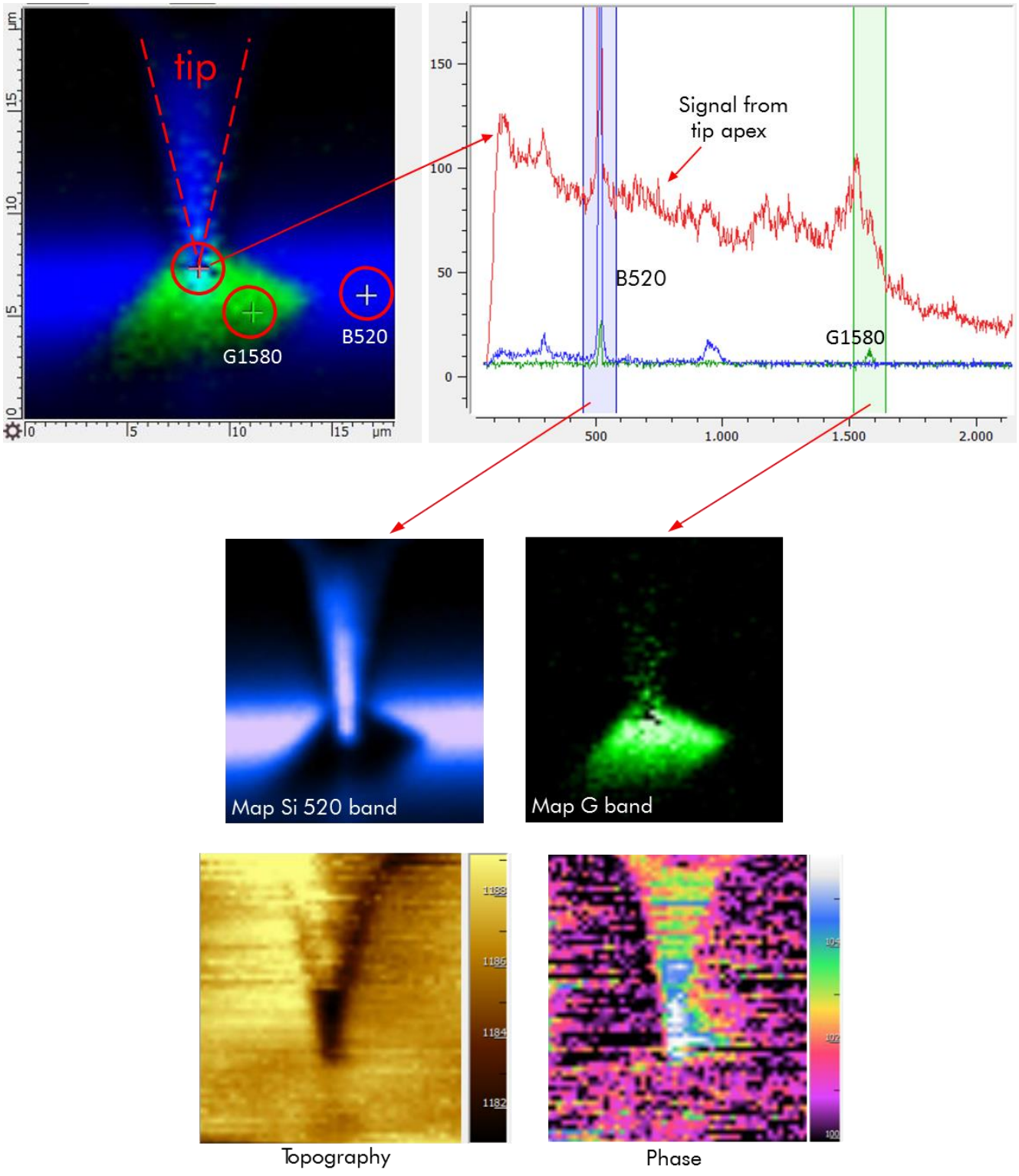


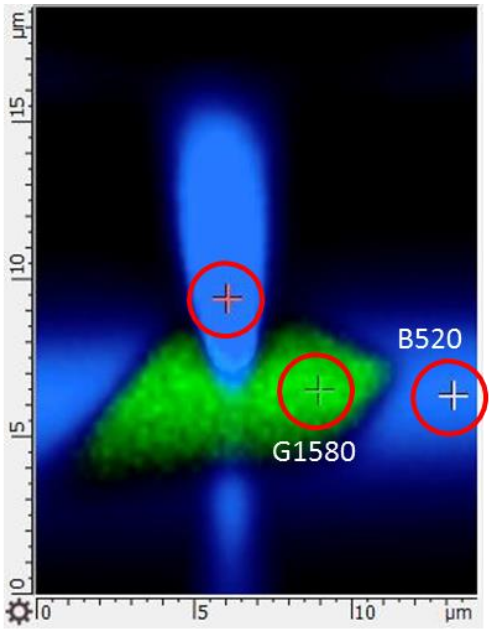
29. Go to SpecScan window. Press SpecScan  button on main procedures selection window.

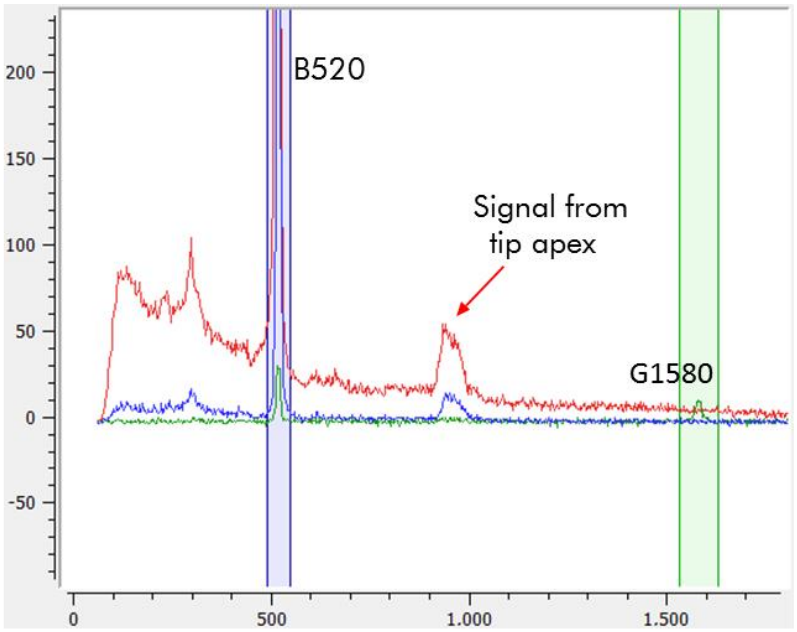
30. Set XY objective mode. Set AFM Signals.

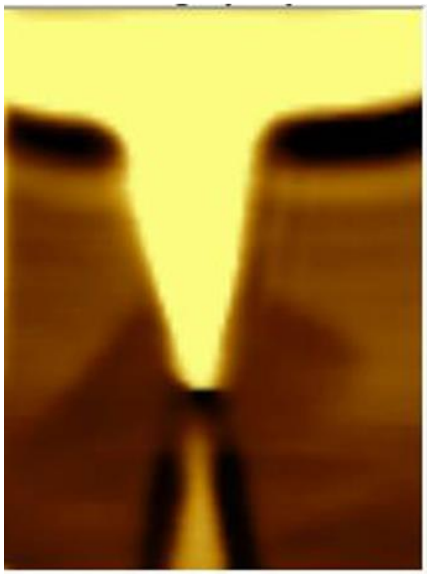


31. Get RAMAN map by XY objective.

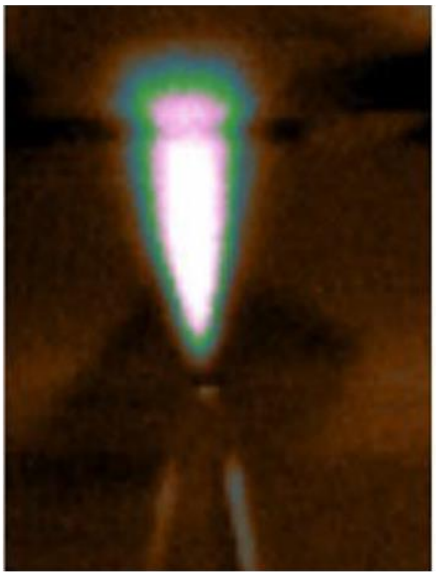




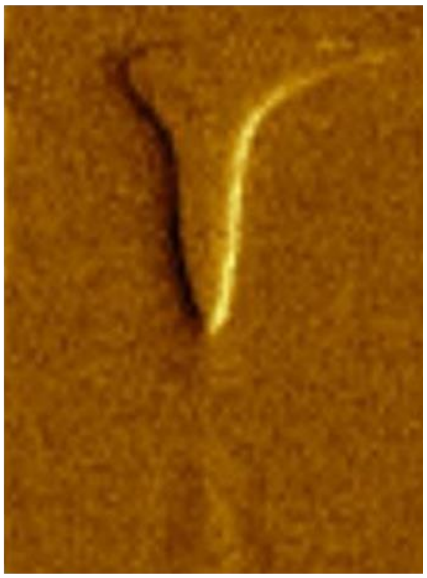




Topography



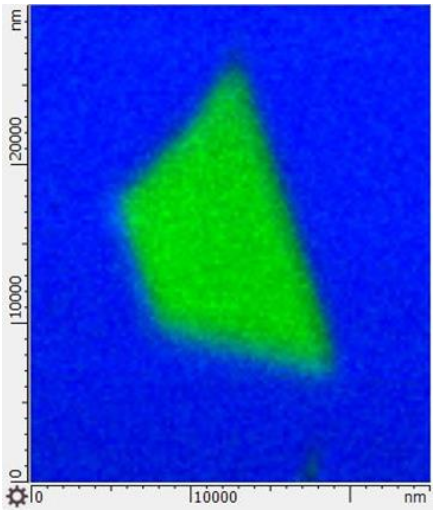
Phase



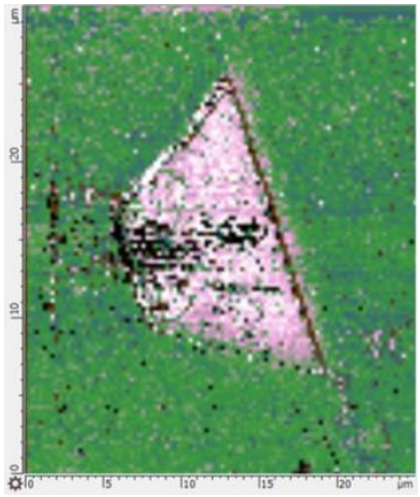
Mag

12.1 Simultaneous AFM RAMAN imaging

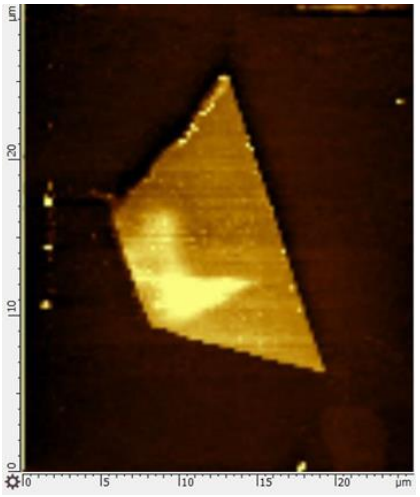
1. Set XY sample mode. Set AFM Signals: Height and Phase. Get RAMAN map.



RAMAN map at Si-520 band (Blue) and G-band (Green)

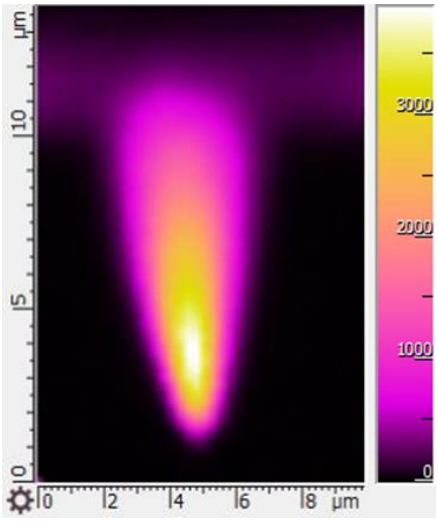


Topography

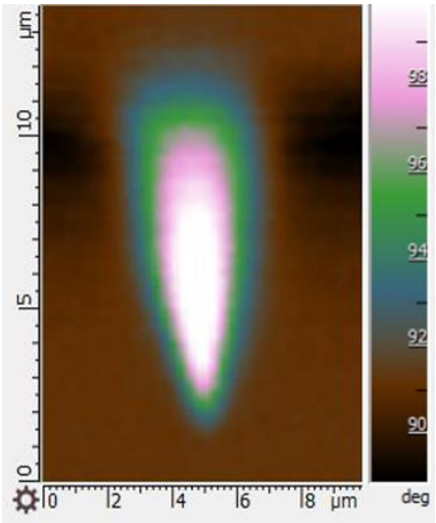


Phase

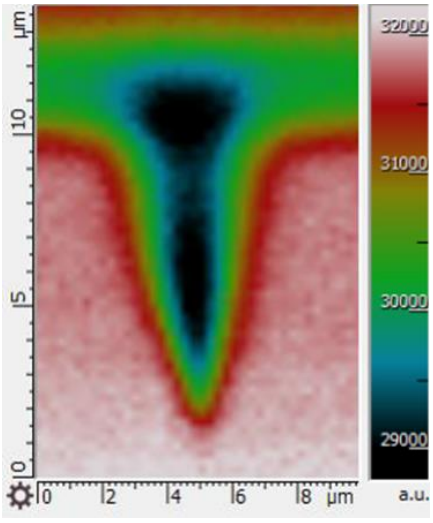
2. In case of cantilever replacement for new one, it's possible to co-localized laser focus on the apex of the tip by getting RAMAN map before approach to the surface.



RAMAN map at Si-520 band made by objective scanner.



Phase



Mag