

# Glovebox ezAFM

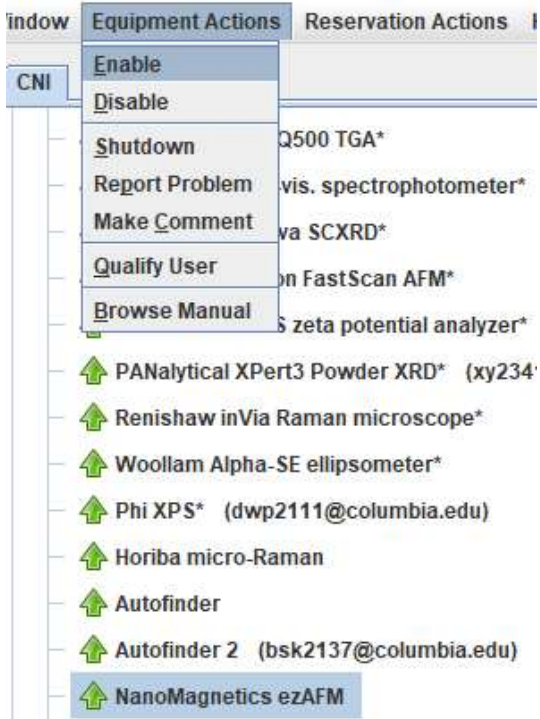
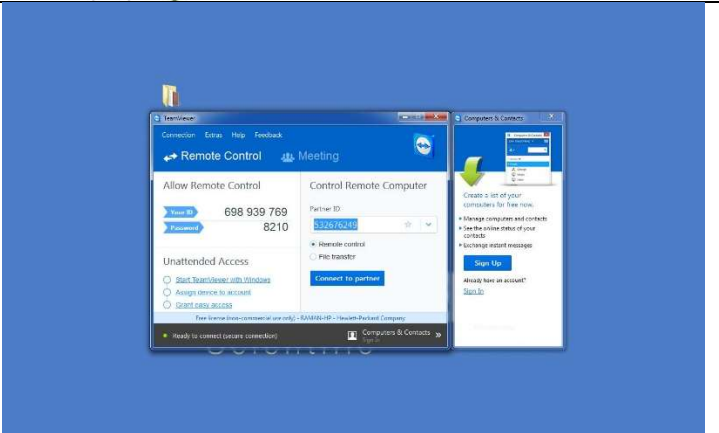
## Standard Operating Procedure



These instructions are intended for reference only, and will *not* replace the thorough training required for proper system operation. Contact a clean room staff member with questions or to report a system problem.

Written by Evan Telford and Nathan Finney, edited by Dr. Dan Paley and Dr. Nava Ariel-Sternberg.



<p><b>1.</b></p>	<p>Enable the tool in <b>BADGER</b></p>	 <p>The screenshot shows a web-based interface with a 'CNI' tab selected. A dropdown menu titled 'Equipment Actions' is open, listing various actions: 'Enable', 'Disable', 'Shutdown', 'Report Problem', 'Make Comment', 'Qualify User', and 'Browse Manual'. Below the menu is a list of equipment items, each with a green upward arrow icon. The 'NanoMagnetics ezAFM' item is highlighted with a blue selection bar.</p>
<p><b>2.</b></p>	<p>ACCESS the COMPUTER: You can access the ezAFM computer using teamviewer on the Horiba computer or your personal computer. If you can't connect to it, you may have to turn on and open teamviewer on the AFM laptop inside the glovebox. ID: 532676249 Password: gloveboxafm</p>	 <p>The screenshot shows the TeamViewer 'Remote Control' window. It displays connection details such as 'Your ID: 698 939 769' and 'Password: 8210'. There are options for 'Unattended Access' and 'Control Remote Computer'. A 'Start Up' button is visible in the bottom right corner of the interface.</p>

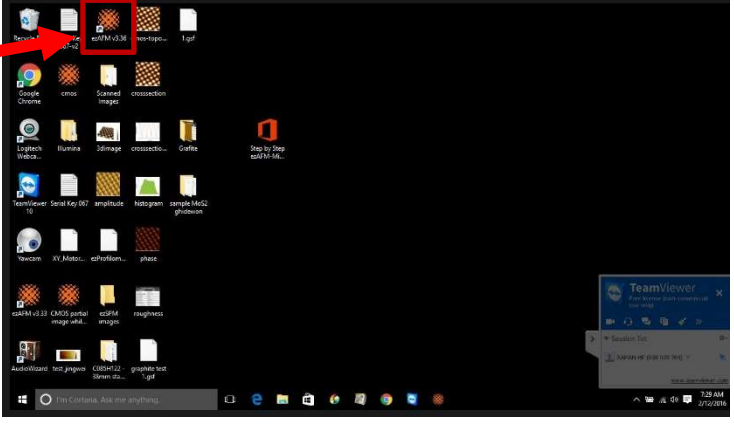
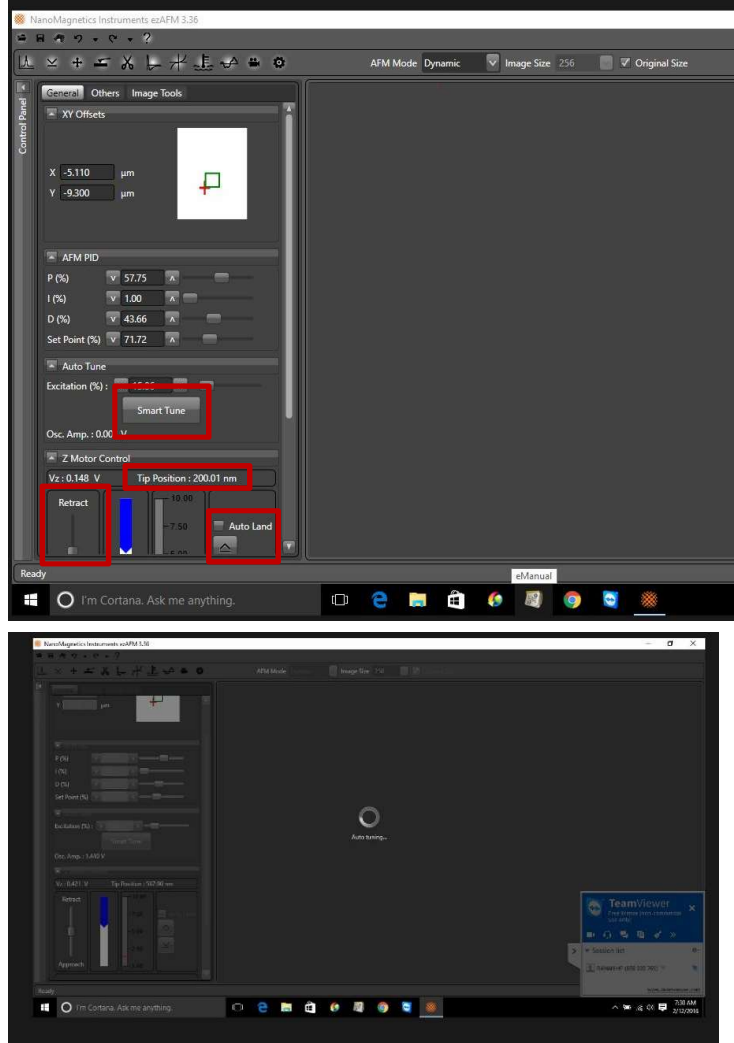


**3.**

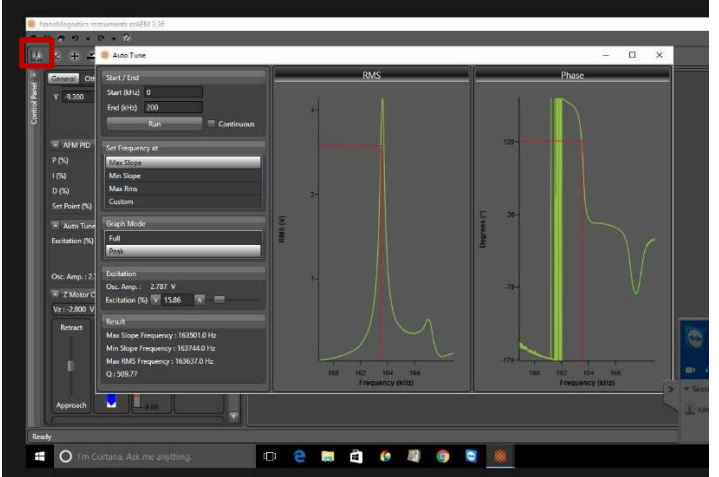
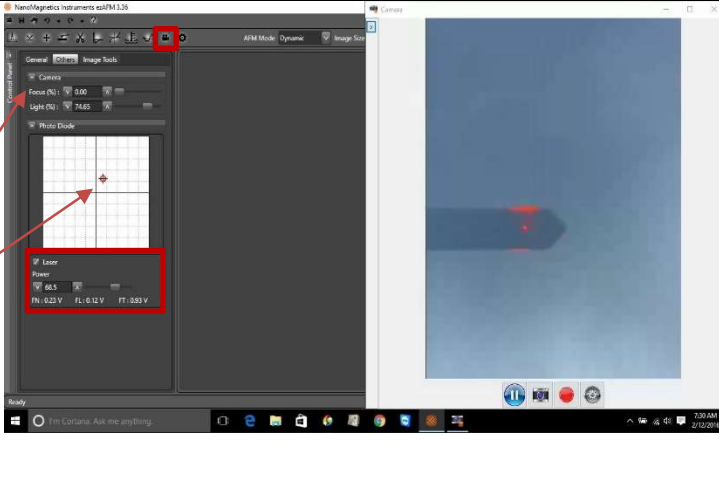
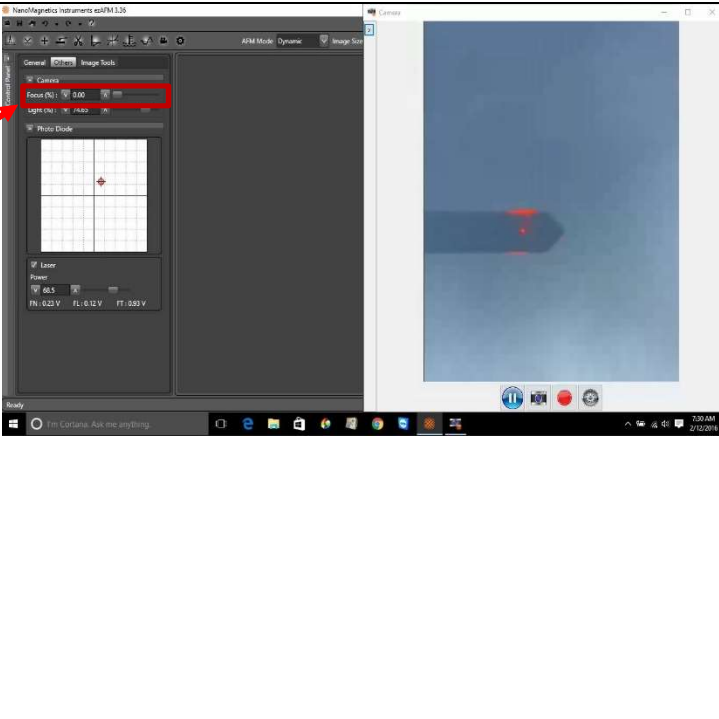
**LOAD SAMPLE:**

First remove the scan head carefully by unplugging the wire between the stage and scan head, then placing your left hand on the base of the stage and your right hand on the top of the scan head (image 1). Tilt the scan head towards your right hand and remove it (image 2). You can place the scan head (with the tip side facing up) next to the AFM on the floor of the glovebox. To load your sample onto the stage, you can remove the circular metal plate (which is held in place by magnets only) (image 3) and fix your chip to the circular plate with double sided tape. Place the circular plate back on the stage in the center (you should feel the magnets hold it in place). Put the scan head back in reverse (place the right edge of the scan head down on the stage, then tilt the left end down). The scan head should be flush with the stage.

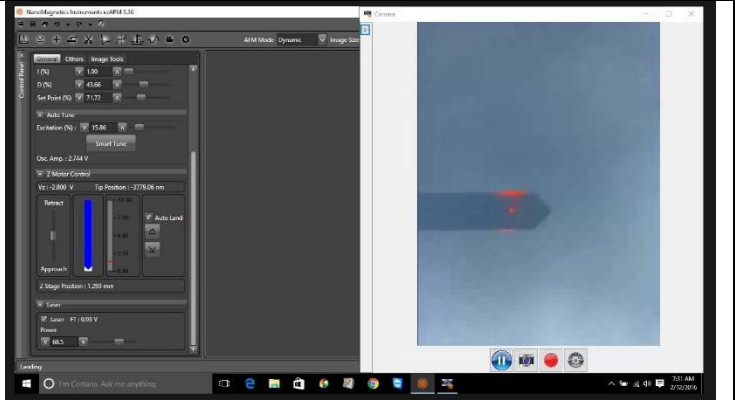
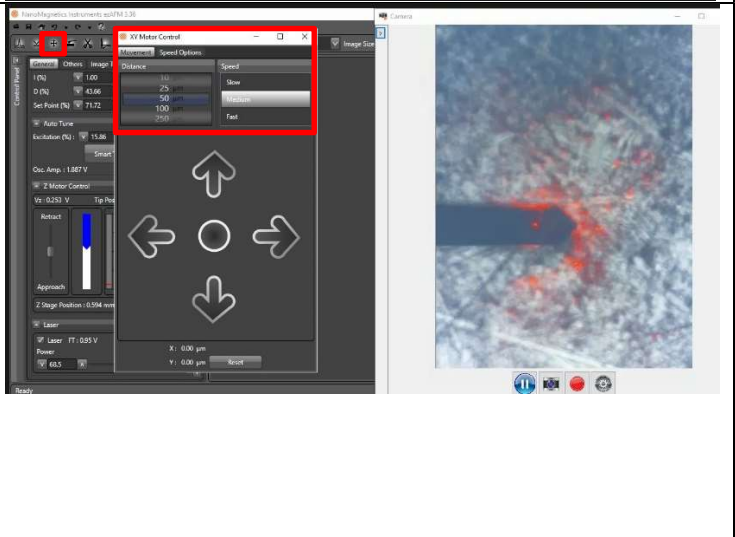
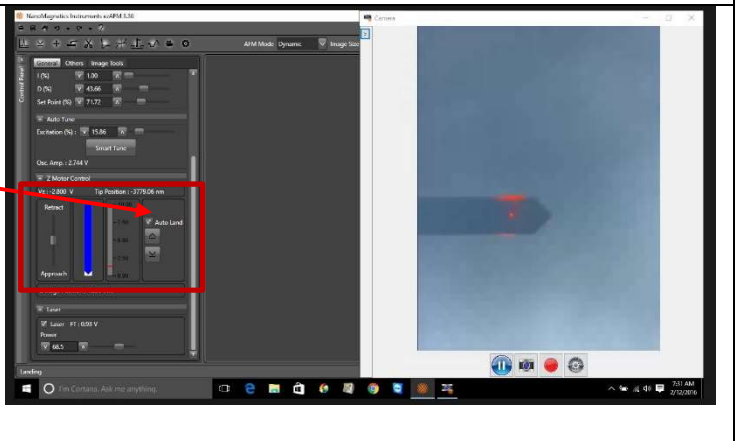


<p><b>4.</b></p>	<p><b>OPEN ezAFM SOFTWARE:</b> Click on ezAFMv3.36.</p>	
<p><b>5.</b></p>	<p><b>STAGE HEIGHT and SMART TUNE:</b> Make sure the stage is sufficiently above your sample. For 2D structures on SiO<sub>2</sub>/Si chips Z position should be above 1.5 mm. You can adjust the Z height by changing the bar on the bottom left or moving the stage in discrete steps by clicking on the button on the bottom right side. The click on “Smart Tune” to tune the system to automatically calibrate the feedback diode and autotune the cantilever. If it’s tuning, you should see the screen on the right. You can check the Q factor by clicking on the autotune function. It will display the Q</p>	



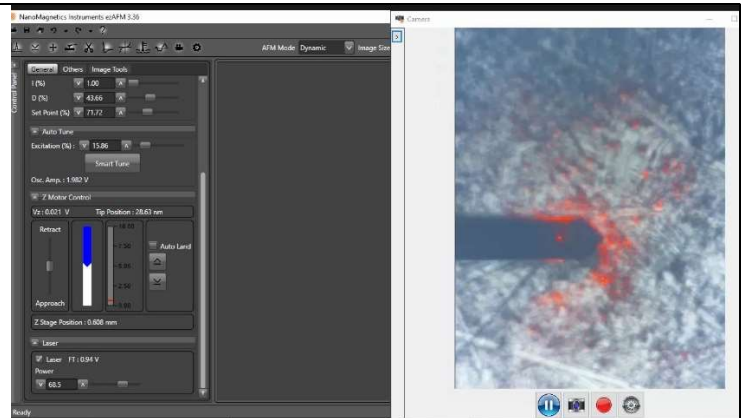
	<p>factor acquired during smart tuning.</p>	
<p>6.</p>	<p><b>CANTILEVER IMAGE:</b> You can see the cantilever by opening the optical camera view (video camera icon). Under the “Others” tab, you can adjust the focus of the camera, view the position of the laser on the photodiode, and the laser power.</p>	
<p>7.</p>	<p><b>FOCUSING ON YOUR SAMPLE:</b> under the “others” tab, change the focus of the optical camera so it’s focussed below the tip (100%) (image 1). Using the slider under the “general” tab, approach the sample until it comes into focus.</p>	



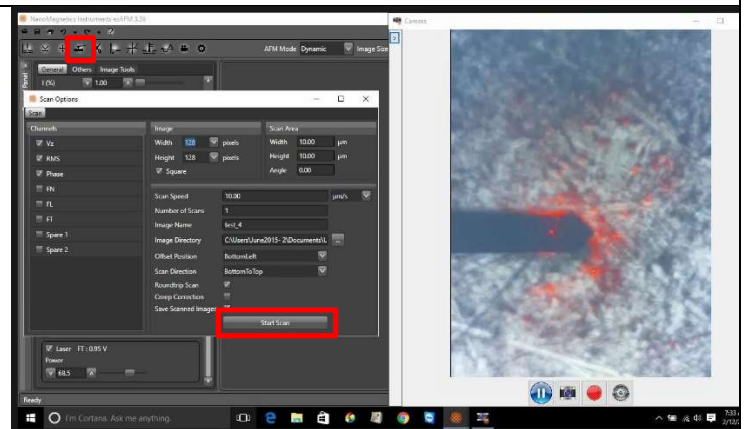
		
<p><b>8.</b></p>	<p><b>MOVING THE STAGE:</b> Click on the “Stage Control” icon (arrows cross in 90 degrees). The XY Motor Control window will open up. You can change step size or “Distance” (do not use 250 um) and movement “speed” (do not use “fast”). Click on the 4 arrows to move the stage in the corresponding direction.</p>	
<p><b>9.</b></p>	<p><b>LANDING ON THE SAMPLE:</b> Once you have found your desired scanning area, adjust the focus (in the “Others” tab) back to 0%. Click the Autoland button and the tool will automatically lower the tip to the sample.</p>	



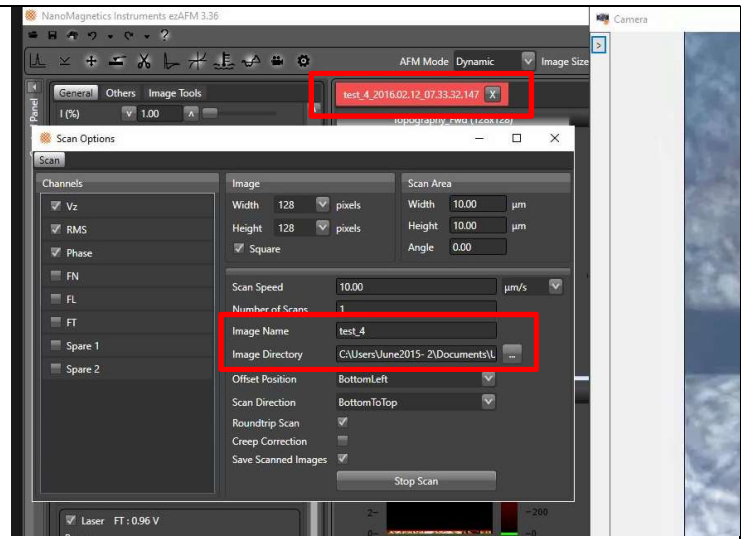
**10. CHECK CANTILEVER DEFLECTION:** Once the tip has landed, you should see your sample optically and the diode indicator should indicate contact (white portion of the bar is approximately half of the scale). If the bar is not ~50% white, use the buttons to retract or approach until the bar is ~50% white.



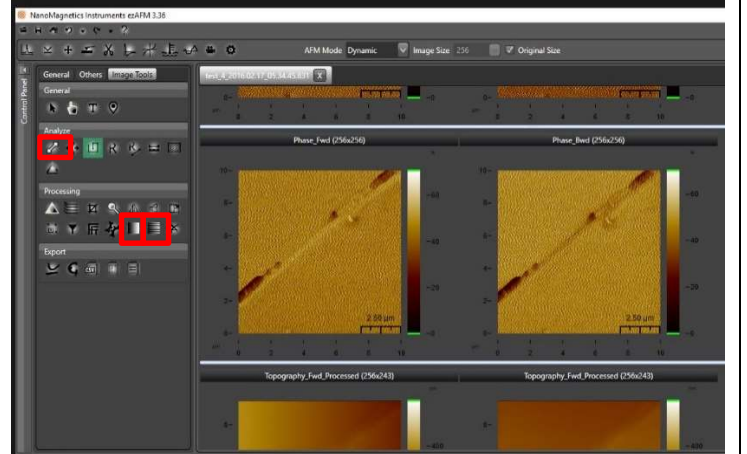
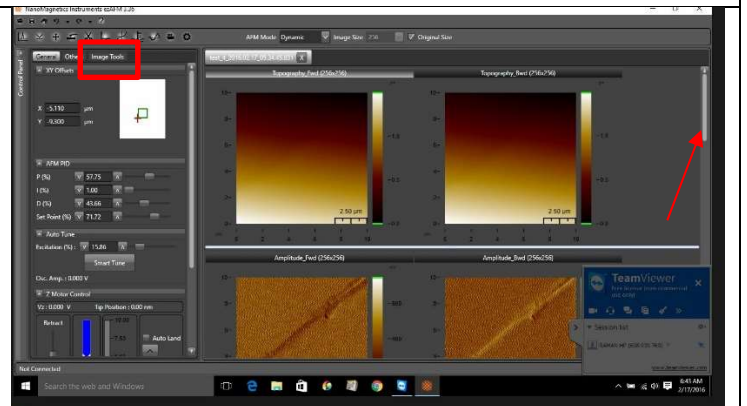
**11. SCAN PARAMETERS:** Click on the scan icon and the scan options window will open. Adjust the scan parameters. Scan area, speed, etc. Suggested scan pixels are 128 for a coarse scan and 512 for a fine scan. Suggested scan speed is 1Hz (scan width/scan speed). The maximum scan size is 30  $\mu\text{m}$ . When you're ready press: "Start Scan" and you will see the tip scanning on the right side of the screen.



**12.** SAVE IMAGE: Once scan is complete your image will be saved in the designated location and you can start image processing.



**13.** IMAGES AND DATA PROCESSING: After the scan is complete you should see six plots on the right hand side of the screen. Topography FWD/BWD, Amplitude FWD/BWD, and phase FWD/BWD. Scroll down the bar on the right hand side to see the lower images. Image processing is done by going to “Image Tools” tab. You have many options that you can explore. The most commonly used ones are the line cut in the analyze section to provide information on topography along a line. The plane fit, and line fit in the Processing section to reduce impact of artifacts.

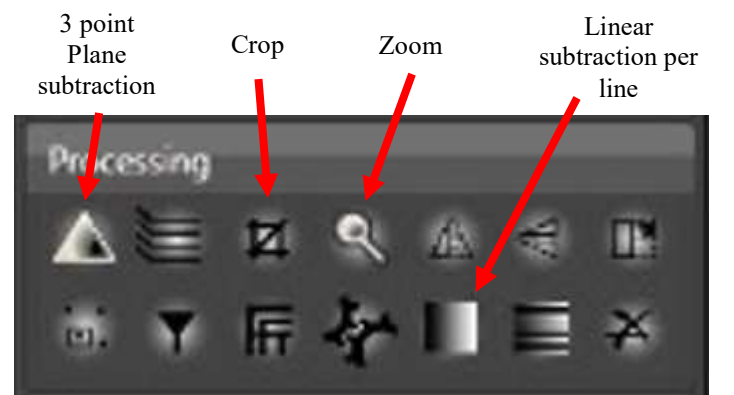
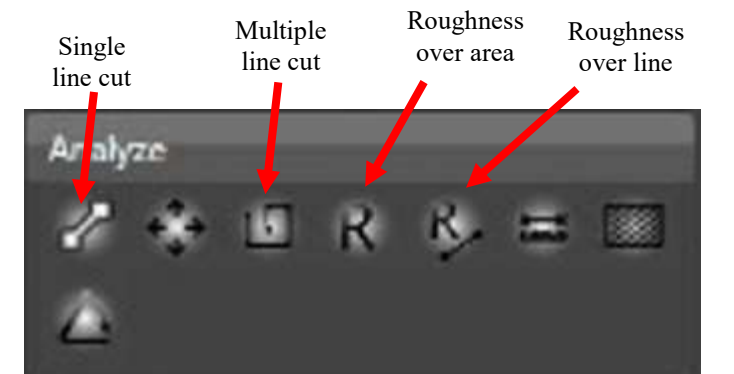
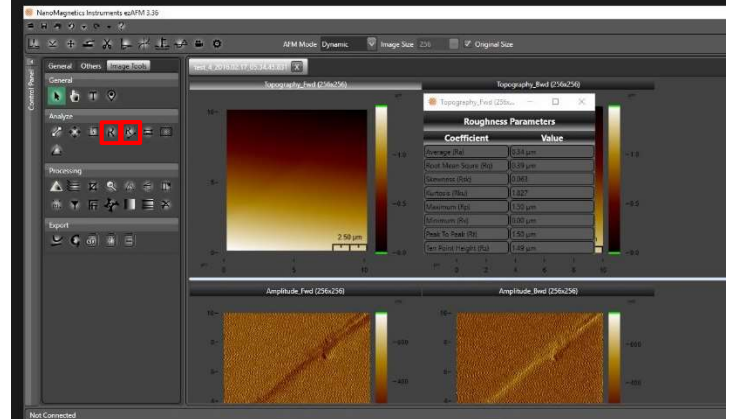
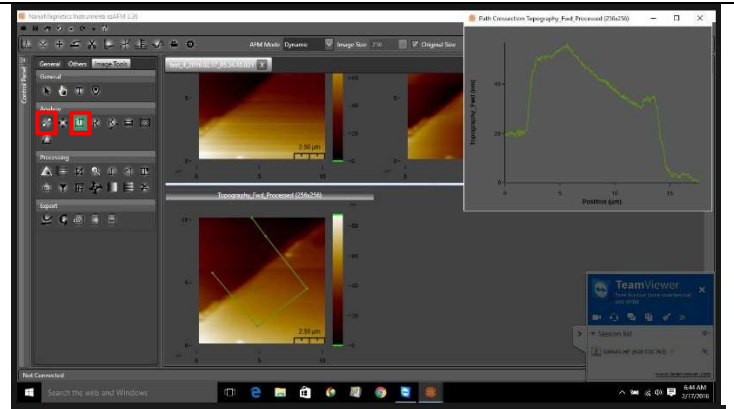


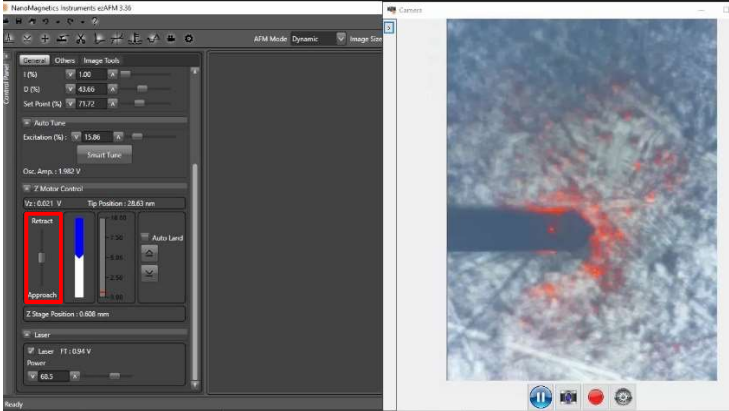



**14. ANALYSES EXAMPLES:**  
 Multiple line cut topography plot (image 1): Single or multiple line cuts of your scan can be taking by selecting one of the options (denoted in red boxes), then dragging over the desired cut region with the mouse.


Calculating the roughness (image 2): single line or area roughness can be calculated by selecting one of the options (denoted in red boxes), then dragging over the desired line/region with the mouse.

Additional analysis: some additional analysis/processes are denoted in image 3. Hovering over the icon with the mouse will show you which analysis will be performed.











<p><b>15.</b> RETRACTING STAGE: When you are finished scanning, retract the stage using the slide bar on the left-hand side of the “general” tab (in red). The “Z Stage Position” should be left above 1.5 mm.</p>		
<p><b>16.</b> UNLOAD SAMPLE AND CLOSE SOFTWARE: unload your sample following the same procedure as loading. Leave the metal circular stage plate empty. Close the software when you are finished.</p>		



																																																																																												
<p><b>17.</b> LOG BOOK: fill out the logbook, located on the Horiba/AFM Computer. This includes such this as <b>Name(s); UNI(s); Group(s); Date; Start Time; End Time; Tool(s) / Components Used; BRIEF summary of work &amp; any notes that will help maintain the system.</b></p>	<table border="1" style="width: 100%; border-collapse: collapse; font-size: small;"> <thead> <tr> <th>17</th> <th>Name(s)</th> <th>Uni(s)</th> <th>Group</th> <th>Date</th> <th>Start Time</th> <th>End Time</th> <th>Tool(s) Used</th> <th>Notes / Comments</th> </tr> </thead> <tbody> <tr> <td>18</td> <td>Nathan Engoy</td> <td>nr2109</td> <td>Hone</td> <td>01/19/16</td> <td>05:00:00 PM</td> <td>08:30:00 PM</td> <td>Horiba Transfer Station</td> <td>Evolution / Flake Finding. Dan Rhodes was also using the system while I was present.</td> </tr> <tr> <td>19</td> <td>Nathan Engoy</td> <td>nr2110</td> <td>Hone</td> <td>01/19/16</td> <td>11:00:00 AM</td> <td></td> <td>Horiba Vibration Isolator (surface for evolution)</td> <td>Evolution / Flake Finding. Dan Rhodes was also using the system while I was present.</td> </tr> <tr> <td>20</td> <td>Jenny Rhodes, Paul Zingers</td> <td>ja2103</td> <td>Hone</td> <td>01/20/16</td> <td>09:00:00 AM</td> <td>12:20:00 PM</td> <td>Horiba</td> <td>Flake Finding / Raman Measurements</td> </tr> <tr> <td>21</td> <td>Nathan Engoy, Daniel Rhodes</td> <td>nr2109</td> <td>Hone</td> <td>01/20/16</td> <td>12:00:00 PM</td> <td>12:00:00 AM</td> <td>Horiba Transfer Station AFM</td> <td>Evolution / Flake Finding / Raman Measurements / AFM</td> </tr> <tr> <td>22</td> <td>Nathan Engoy, Daniel Rhodes</td> <td>nr2109</td> <td>Hone</td> <td>01/21/16</td> <td>11:30:00 AM</td> <td>01:00:00 PM</td> <td>AFM, Horiba Transfer Station</td> <td>Troubleshooting AFM (change tip?)</td> </tr> <tr> <td>23</td> <td>Olavi</td> <td>osa2114</td> <td>Hone</td> <td>01/24/16</td> <td>11:30:00 AM</td> <td>01:00:00 PM</td> <td>Horiba Vibration Isolator (surface for evolution)</td> <td>Horiba detector didn't cool down in the hour I had the software open.</td> </tr> <tr> <td>24</td> <td>Olavi</td> <td>osa2114</td> <td>Hone</td> <td>01/25/16</td> <td>10:30:00 AM</td> <td>05:00:00 PM</td> <td>Horiba Vibration Isolator (surface for evolution)</td> <td></td> </tr> <tr> <td>25</td> <td>Olavi</td> <td>osa2114</td> <td>Hone</td> <td>01/25/16</td> <td>10:30:00 AM</td> <td>12:30:00 PM</td> <td>Horiba Vibration Isolator (surface for evolution)</td> <td></td> </tr> <tr> <td>26</td> <td>Jenny</td> <td>ja2103</td> <td>Hone</td> <td>01/26/16</td> <td>02:30:00 PM</td> <td></td> <td>Horiba</td> <td>Flake Finding / Raman Measurements</td> </tr> </tbody> </table>		17	Name(s)	Uni(s)	Group	Date	Start Time	End Time	Tool(s) Used	Notes / Comments	18	Nathan Engoy	nr2109	Hone	01/19/16	05:00:00 PM	08:30:00 PM	Horiba Transfer Station	Evolution / Flake Finding. Dan Rhodes was also using the system while I was present.	19	Nathan Engoy	nr2110	Hone	01/19/16	11:00:00 AM		Horiba Vibration Isolator (surface for evolution)	Evolution / Flake Finding. Dan Rhodes was also using the system while I was present.	20	Jenny Rhodes, Paul Zingers	ja2103	Hone	01/20/16	09:00:00 AM	12:20:00 PM	Horiba	Flake Finding / Raman Measurements	21	Nathan Engoy, Daniel Rhodes	nr2109	Hone	01/20/16	12:00:00 PM	12:00:00 AM	Horiba Transfer Station AFM	Evolution / Flake Finding / Raman Measurements / AFM	22	Nathan Engoy, Daniel Rhodes	nr2109	Hone	01/21/16	11:30:00 AM	01:00:00 PM	AFM, Horiba Transfer Station	Troubleshooting AFM (change tip?)	23	Olavi	osa2114	Hone	01/24/16	11:30:00 AM	01:00:00 PM	Horiba Vibration Isolator (surface for evolution)	Horiba detector didn't cool down in the hour I had the software open.	24	Olavi	osa2114	Hone	01/25/16	10:30:00 AM	05:00:00 PM	Horiba Vibration Isolator (surface for evolution)		25	Olavi	osa2114	Hone	01/25/16	10:30:00 AM	12:30:00 PM	Horiba Vibration Isolator (surface for evolution)		26	Jenny	ja2103	Hone	01/26/16	02:30:00 PM		Horiba	Flake Finding / Raman Measurements
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**18. BADGER LOGOUT:** Don't forget to disable the tool in badger after you're done.

Equipment Actions	Reservation Actions	History Ac
Enable		
<b>Disable</b>		
Shutdown	Q500 TGA*	
Report Problem	vis. spectrophotometer*	
Make Comment	va SCXRD*	
Qualify User	on FastScan AFM* (ahd2114@colu	
Browse Manual	S zeta potential analyzer*	
 PANalytical XPert3 Powder XRD* (xy2341@columl		
 Renishaw inVia Raman microscope*		
 Woollam Alpha-SE ellipsometer*		
 Phi XPS* (dwp2111@columbia.edu)		
 Horiba micro-Raman		
 Autofinder		
 Autofinder 2 (bsk2137@columbia.edu)		
 NanoMagnetics ezAFM (na2661@columbia.edu)		

