SEM Training Notebook

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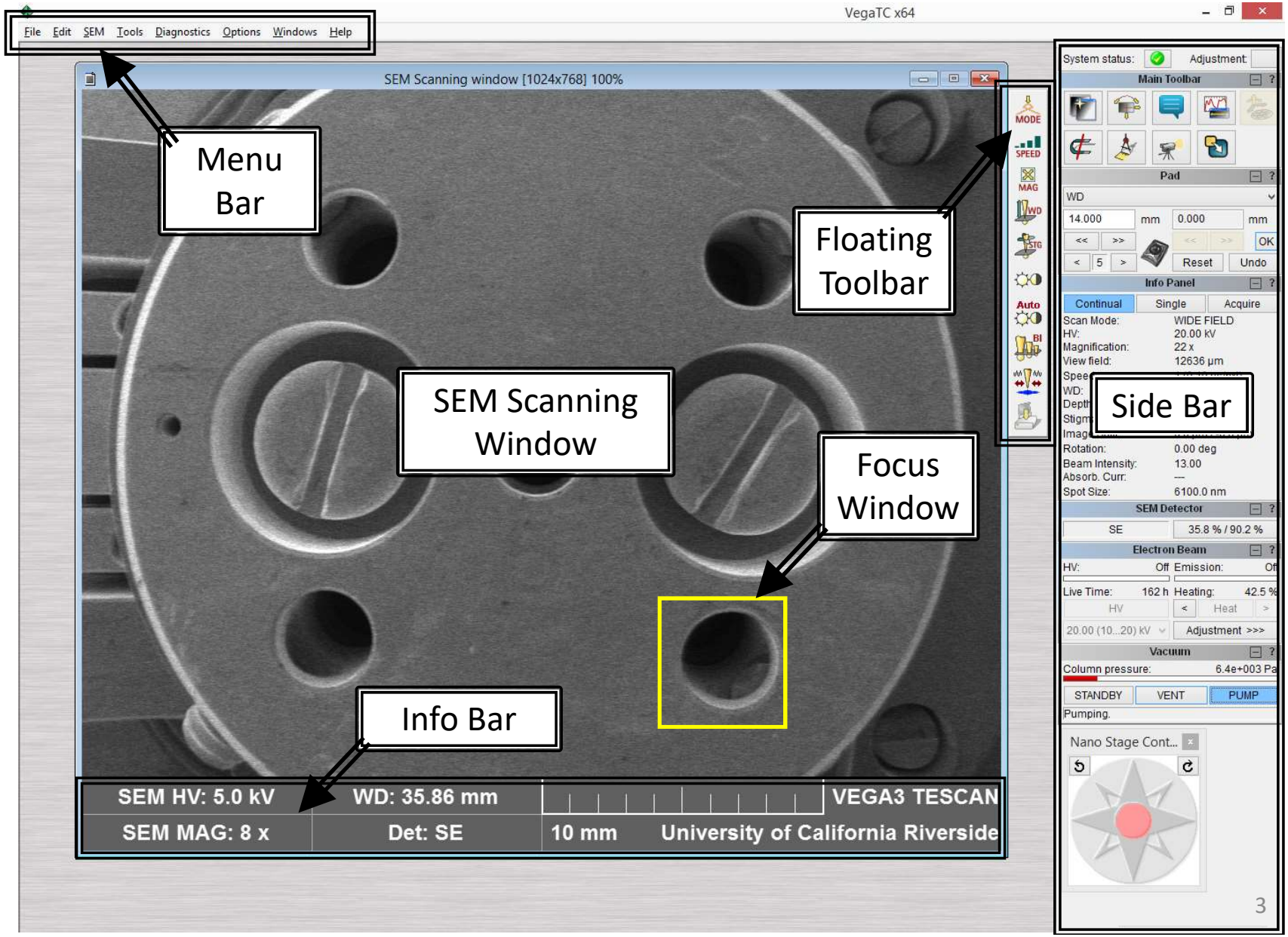
MSE Fee-For-Service Facility
Materials Science and Engineering
University of California, Riverside

March 8, 2018 (rev. 3.5)

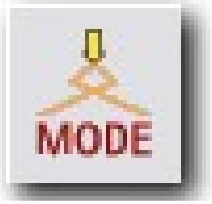
Before you begin…

- ❑ Complete the required safety training modules on UC Learning
  - ❑ Laboratory Safety Orientation (Fundamentals) 2013
  - ❑ Hazardous Waste Management
  - ❑ Compressed Gas Safety
  - ❑ X-Ray Safety
- ❑ Submit a copy of your Training Transcript to Lab Manager
- ❑ Review the MSE SEM Policies and Regulations
- ❑ Fill out the SEM FAU Authorization Form with PI signature
- ❑ Fill out the MSE 150, 250, 309 Authorization Form with PI signature
- ❑ Receive a user name and temporary password for Faces scheduling
- ❑ Arrange a time for SEM training with Lab Manager
- ❑ Schedule a 2 hour block on Faces for your training
- ❑ Familiarize yourself with the graphical user interface (GUI) :A – D
- ❑ Familiarize yourself with SEM fundamentals: E – K

A. GUI


VegaTC x64
File Edit SEM Tools Diagnostics Options Windows Help
SEM Scanning window [1024x768] 100%
Menu Bar
Floating Toolbar
SEM Scanning Window
Focus Window
Side Bar
Info Bar
SEM HV: 5.0 kV
WD: 35.86 mm
VEGA3 TESCAN
SEM MAG: 8 x
Det: SE
10 mm
University of California Riverside
System status:
Adjustment:
Main Toolbar
Pad
Info Panel
Continual
Single
Acquire
Scan Mode: WIDE FIELD
HV: 20.00 kV
Magnification: 22 x
View field: 12636 µm
Rotation: 0.00 deg
Beam Intensity: 13.00
Spot Size: 6100.0 nm
SEM Detector
Electron Beam
Vacuum
Column pressure: 6.4e+003 Pa
STANDBY
VENT
PUMP
Pumping.
Nano Stage Cont...
3

B. Floating Toolbar – 1/2



MODE: Opens the context menu for selecting ***Displaying Modes***

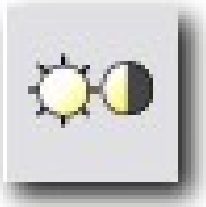
SPEED: Opens the context menu for selecting predefined ***Scan Speeds***

MAG: Left-click sets the ***Magnification*** as active function. Right-click opens context menu with predefined values of magnification.

WD: Left-click sets the ***Focus*** as active function.

STG: Left-click sets the ***Stigmator*** as active function.

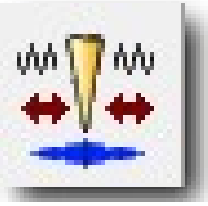
B. Floating Toolbar – 2/2



Brightness: Left-click sets the ***Brightness and Contrast*** control as active function

Auto: Left-click starts ***Automatic Brightness and Contrast***

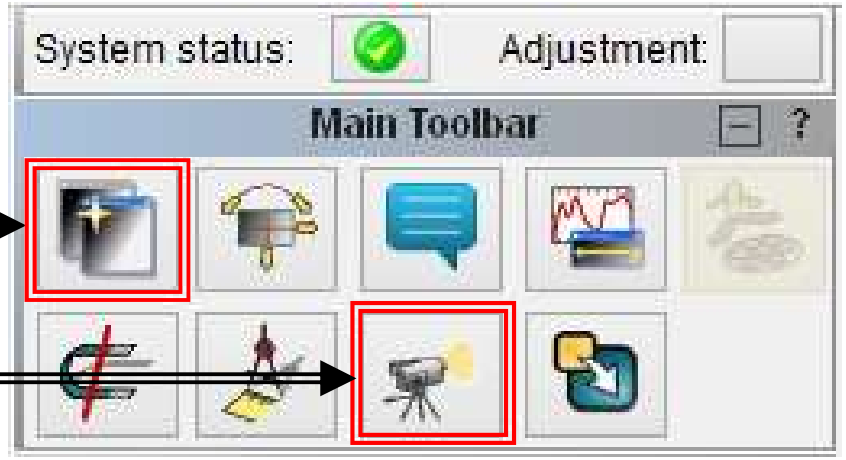
BI: Left-click sets the ***Beam Intensity*** as active function



Manual Column Centering: Left-click starts the manual column centering process

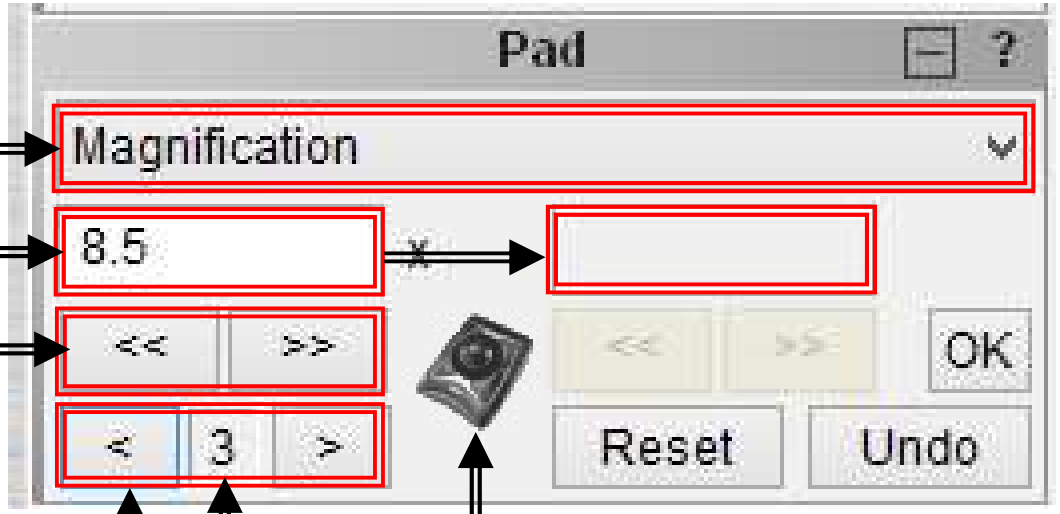
Acquire: Left-click starts the ***Image Acquisition***

C. Sidebar – 1/5



Opens new scanning window

Opens up IR Camera



Indicates Active Function

Current value(s) of Active Function

Incremental changes of Active Function

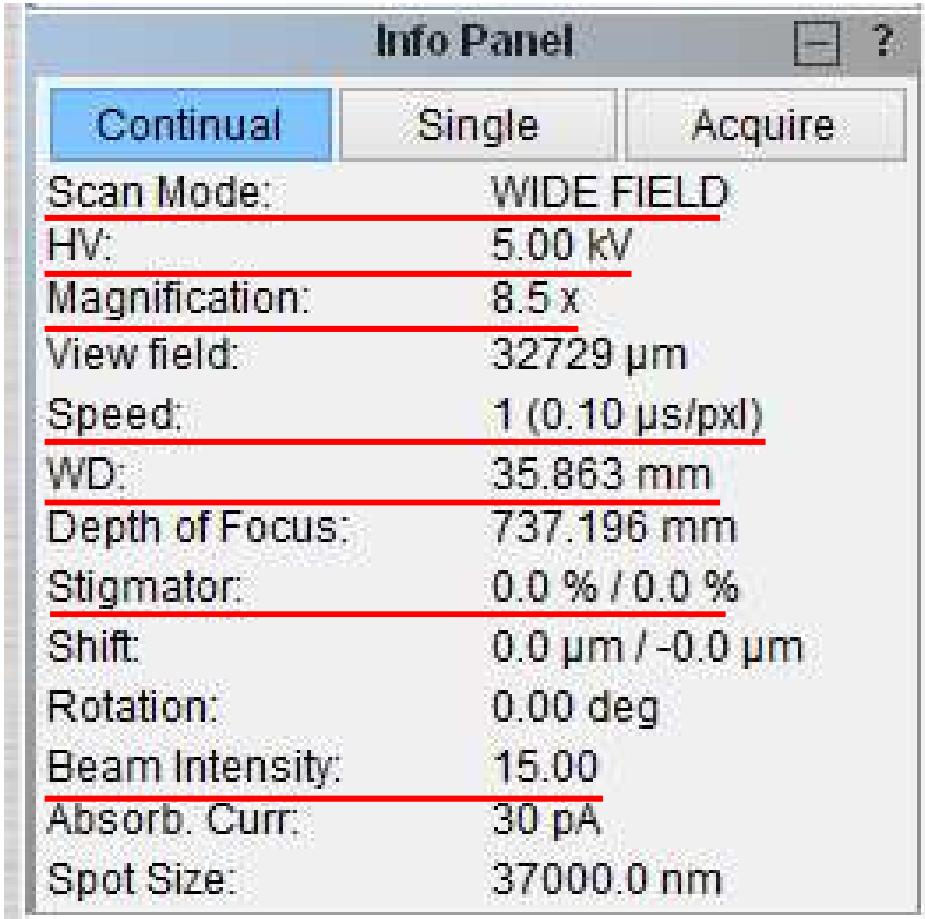
Changes Sensitivity of Increment buttons and Trackball
1 = Fine, 9 = Course

Current value of Sensitivity

Flashing Trackball Icon = Trackball is locked

C. Sidebar – 2/5

Info Panel shows all the important parameters of the microscope, and at the same time allows a quick set-up of all the most frequently used functions.

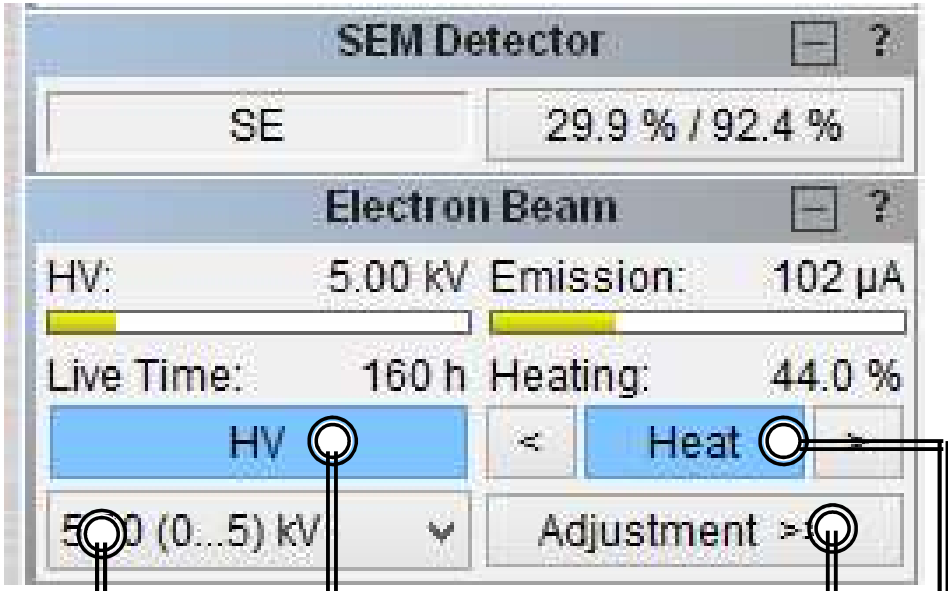


- ***Continual*** button stops or starts scanning
- ***Single*** button starts scanning of a single frame and then stops scanning
- ***Acquire*** button starts the acquisition process
- ***HV*** button sets the High Voltage value as active function
- ***Depth of Focus*** shows estimated range sample surface is in focus
- ***Absorb. Curr.*** shows the electron current absorbed by the sample
- ***Spot Size*** shows the sample impinging beam size

C. Sidebar – 3/5

Detector Panel shows active detector.

Electron Beam Panel controls filament heating and high voltage range.



- ***SE*** indicates Secondary Electron detector is active
  - %/% shows Brightness/Contrast
- ***HV*** shows high voltage value
- ***Emission*** shows current emitted
- ***Live Time*** shows total working time of filament
- ***Heating*** shows relative value of filament heating current in %

Heat starts or stops filament heating

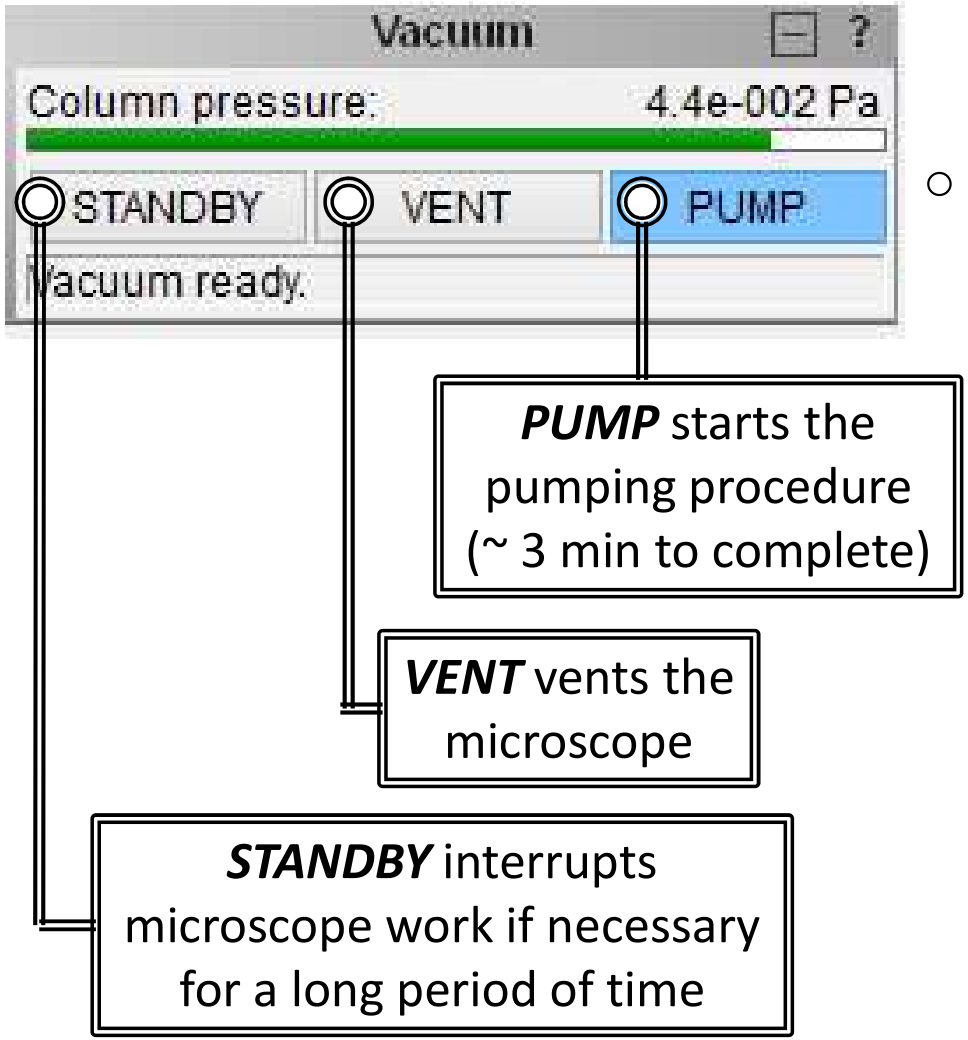
Adjustment opens context menu

HV turns the high voltage on and off

HV Drop Down selects HV range

C. Sidebar – 4/5

Vacuum Panel controls the vacuum system.

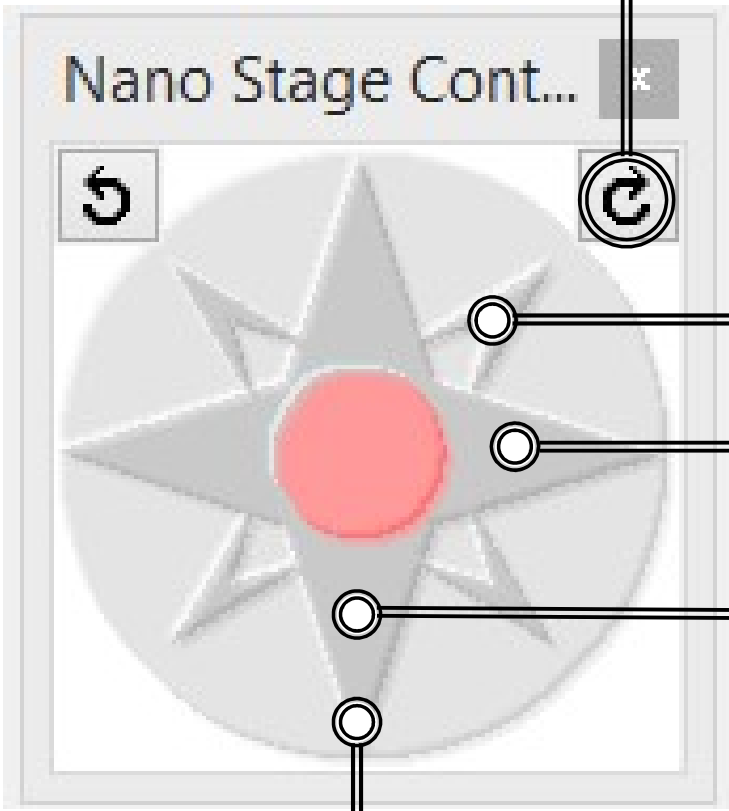


- ***Column Pressure*** indicates the value of the pressure in the column
  - Red = Not Ready
  - Green = Ready
- ***Status*** shows state of vacuum
  - ***Venting*** = *still venting*
  - ***Venting finished*** = *venting is finished and chamber can be opened*
  - ***Pumping*** = *still pumping*
  - ***Vacuum ready*** = chamber is pumped down to sufficient vacuum
  - ***Vacuum off*** = vacuum is in standby mode

C. Sidebar – 5/5

Nano Stage Control controls the specimen stage movement.

If missing, find in **Menu** under **SEM > Nano Stage Control**



Rotation buttons rotate the stage

Diagonal stage movement

X-dir stage movement

Y-dir stage movement

Distance from center is proportional to magnitude of movement (large)

D. SEM Image Parameters

Windows

Aspect Ratio of Image = 4:3

Resolution = 1024 x 768

Averaging

Accumulation = Disable

(Prone to vibrational noise and drift)

Acquisition

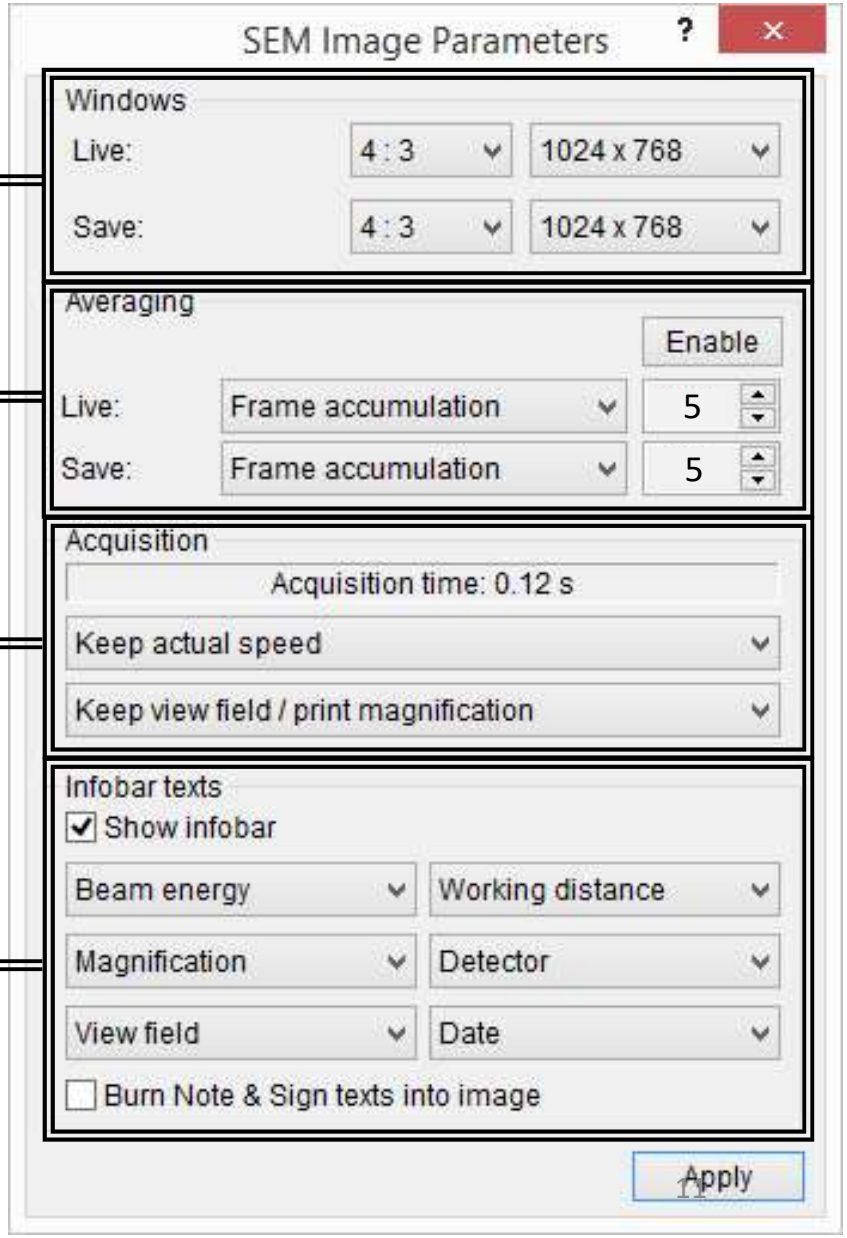
Keep Actual Speed

Keep view field/print magnification

Infobar Texts

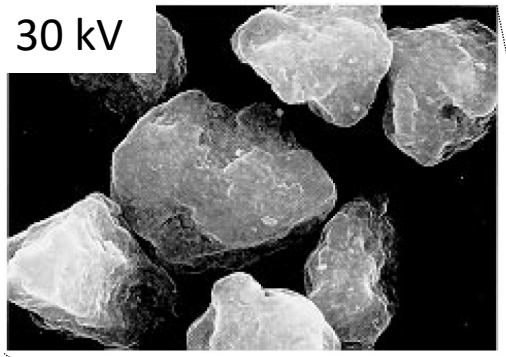
Show Infobar:

Beam Energy, Working Distance, View Field, Detector, Vacuum, Scan Mode

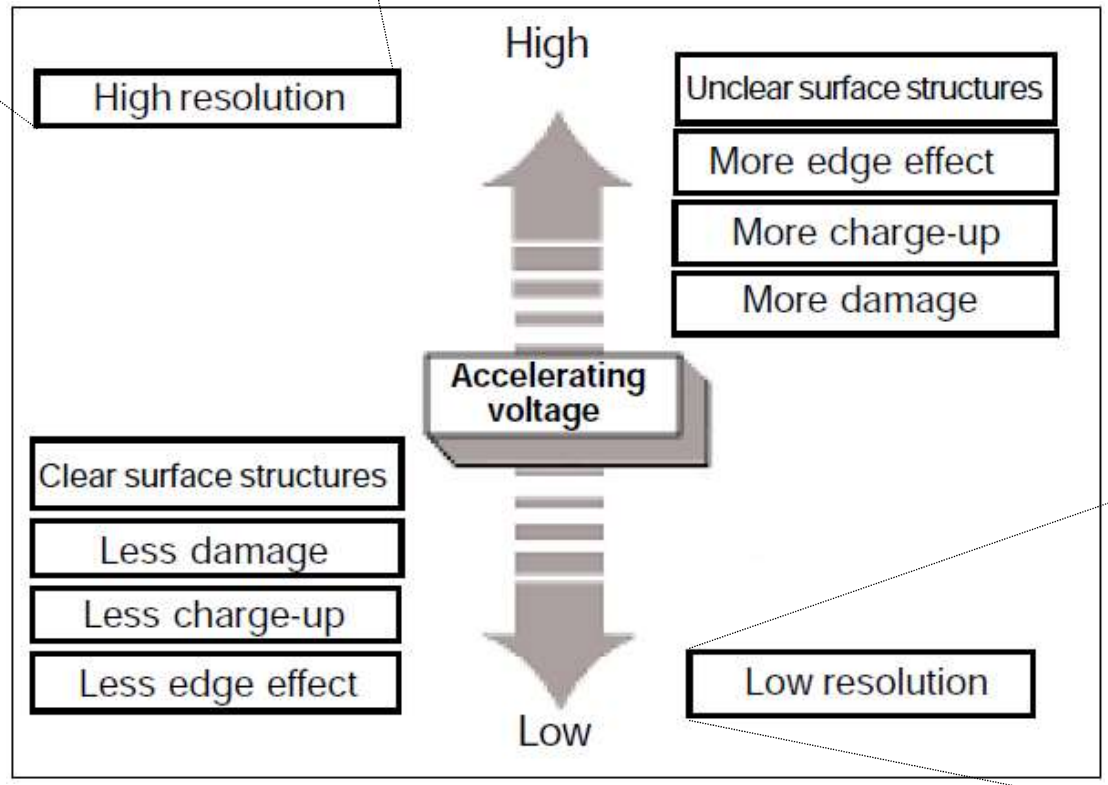


E. Accelerating Voltage – 1/2

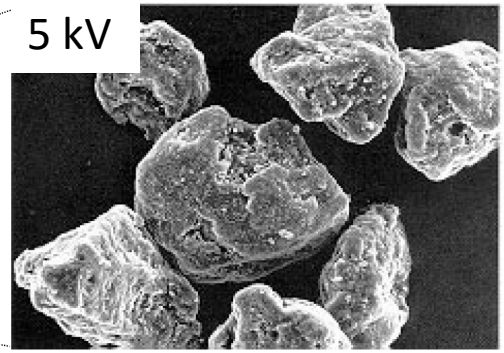
30 kV



Recommendation: Start at **5 kV** and increase voltage incrementally to balance resolution to surface structures



5 kV



E. Accelerating Voltage – 2/2

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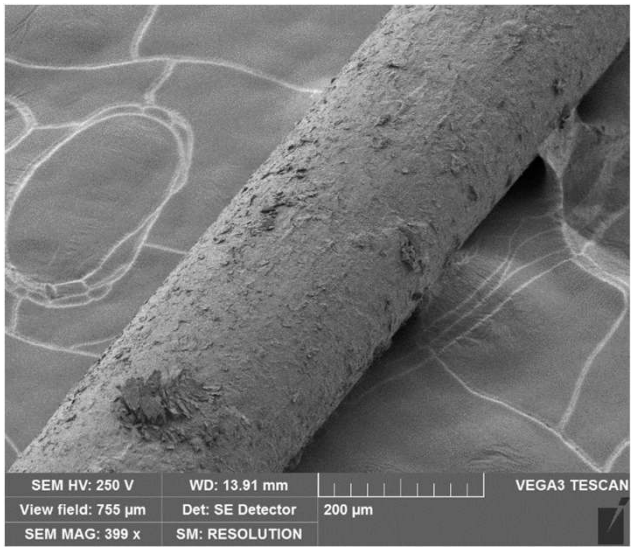
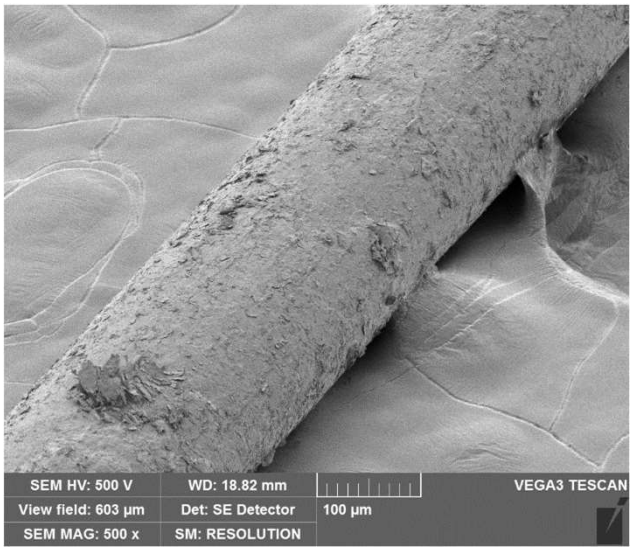
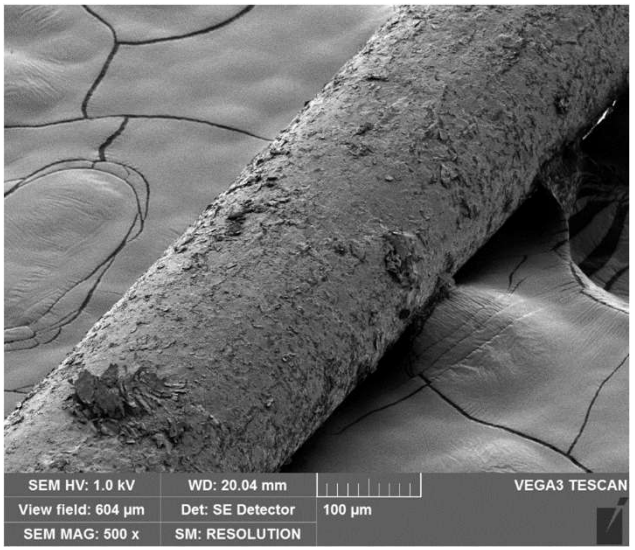
250 V



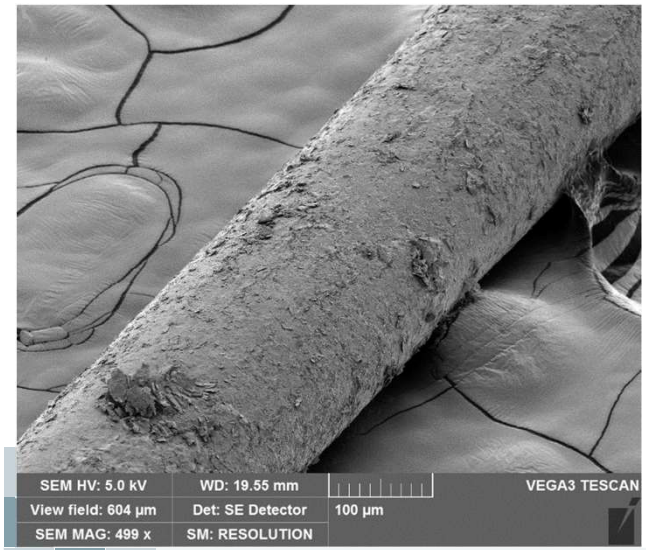
500 V



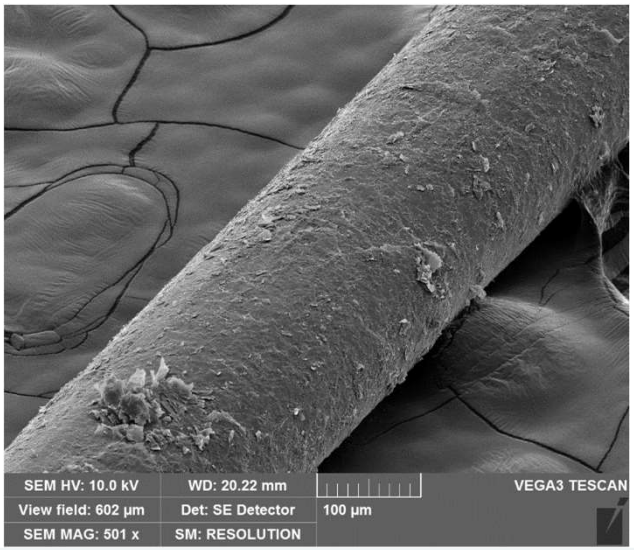
1 kV



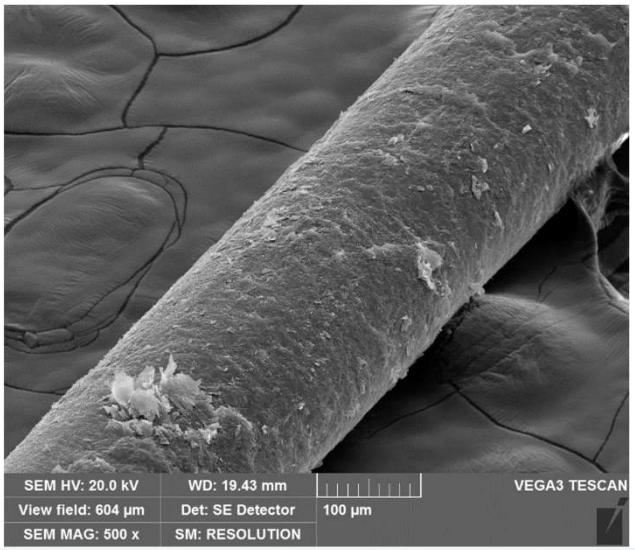
5 kV



10 kV

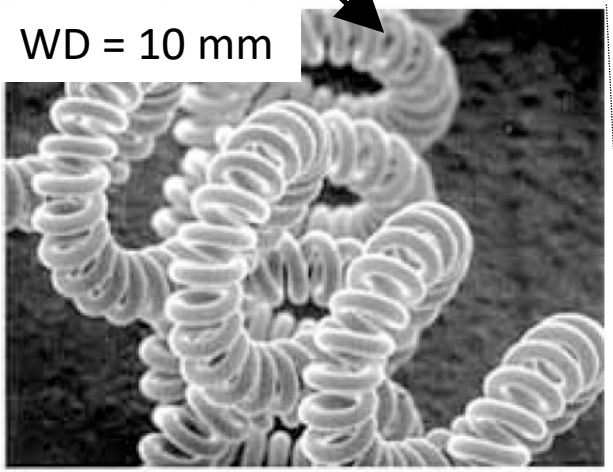


20 kV

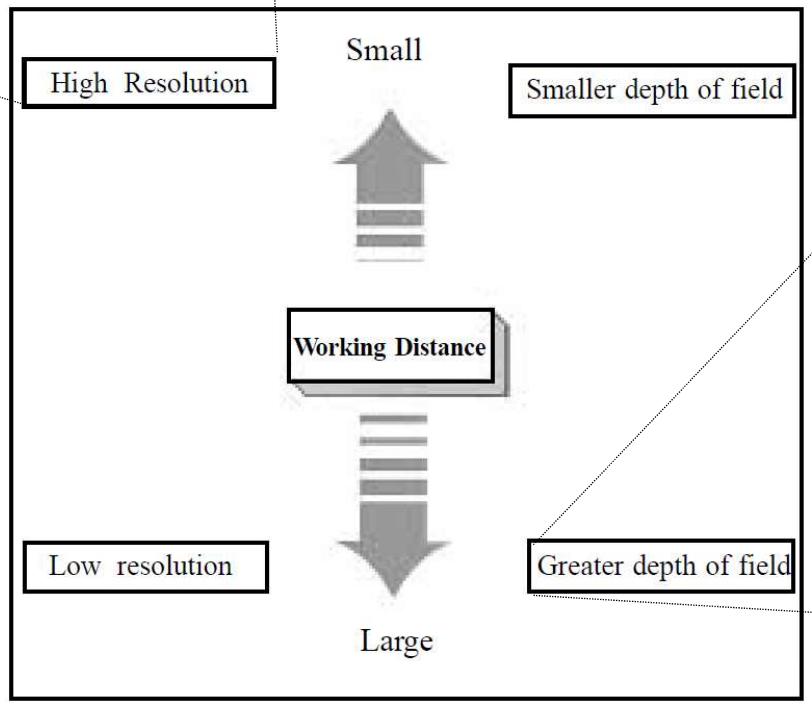


F. Working Distance

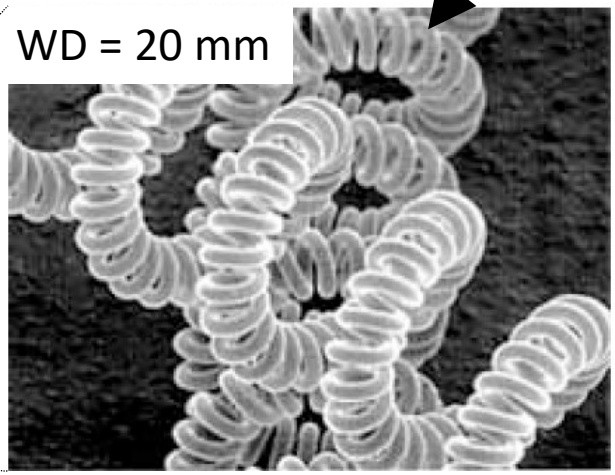
WD = 10 mm



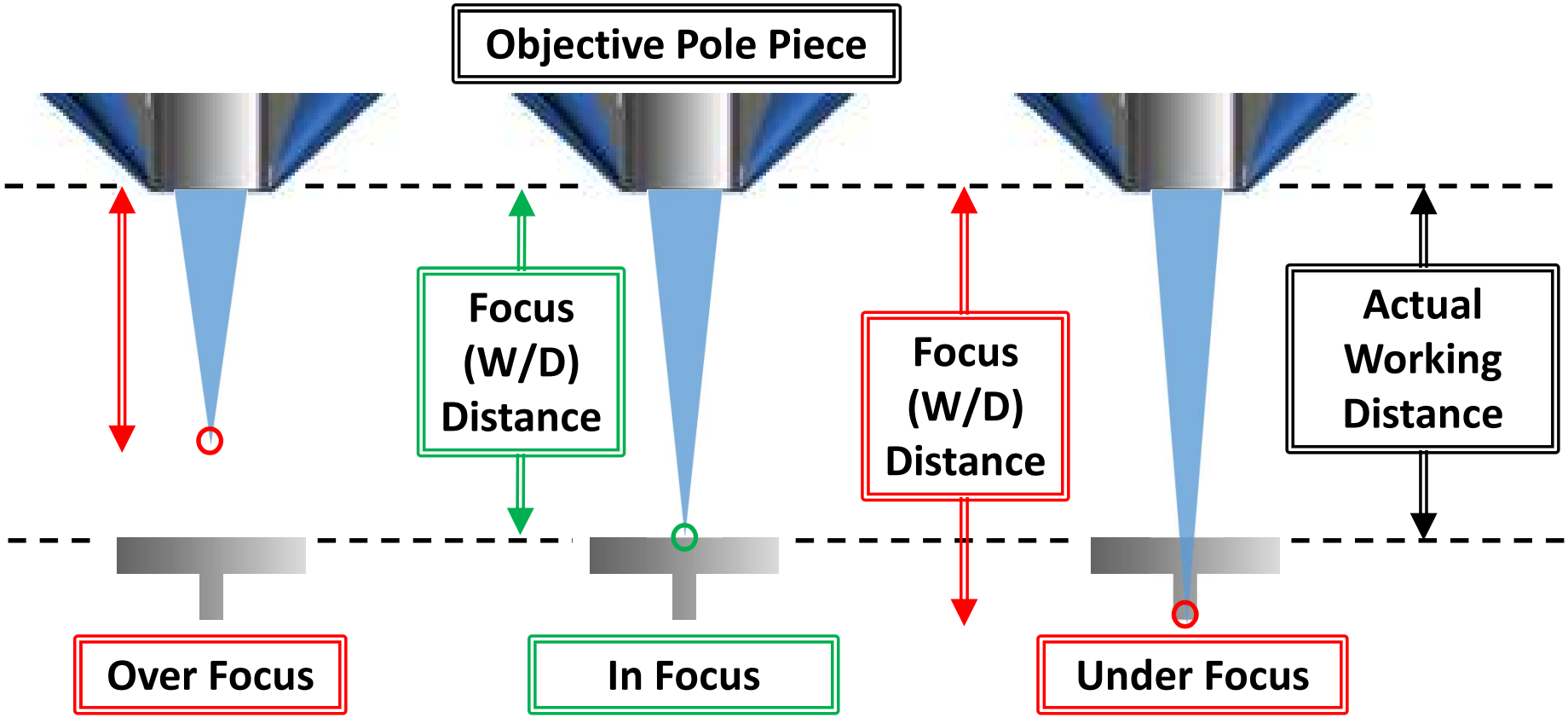
Recommendation: Start at ≈ **10** mm and decrease WD to achieve greater resolution or increase WD to achieve greater depth of field if necessary



WD = 20 mm



G. Working Distance vs Focus (W/D) Distance

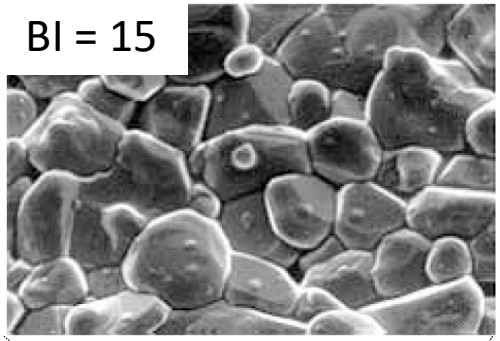


Actual Working Distance = Distance between objective pole piece and sample and can only be controlled manually with the **knob outside the chamber**

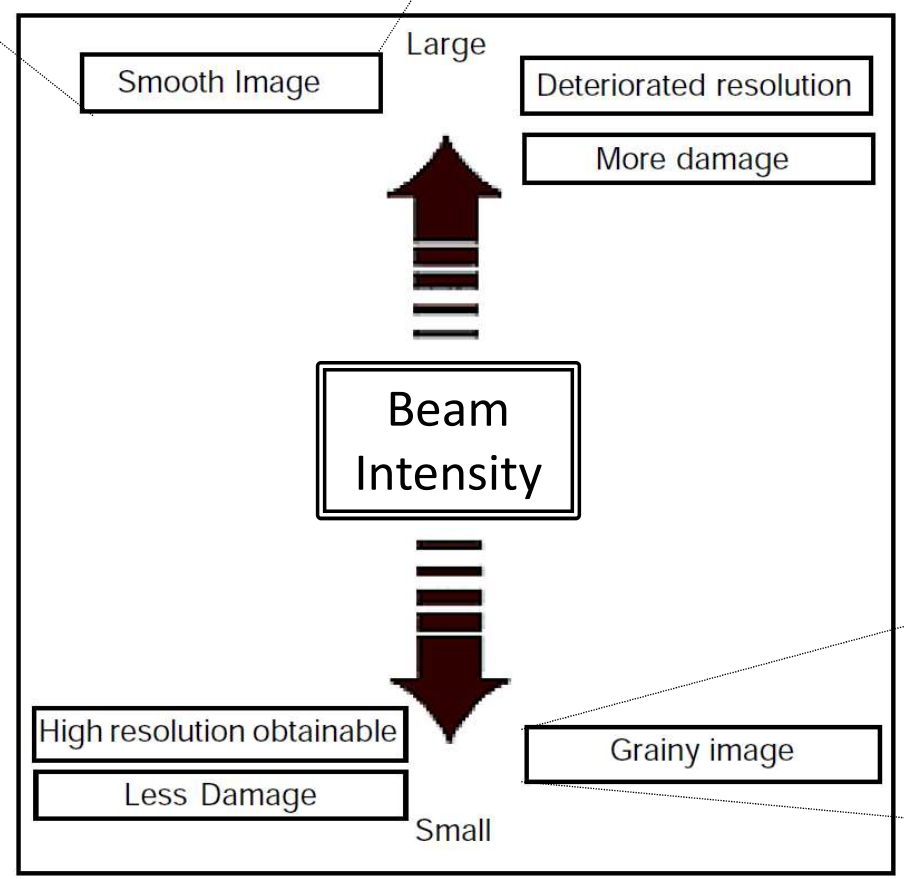
Focus (W/D) Distance = Distance between objective pole piece and focal point and can only be controlled by the **Focus (W/D) button**

H. Beam Intensity – 1/3

BI = 15



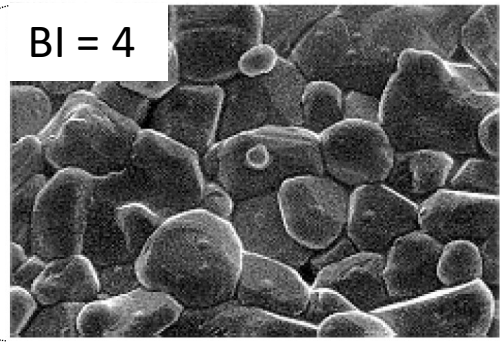
Recommendation: Decrease beam intensity until balance between resolution/grainy image and acquisition time is desired



High BI: Larger spot size for low magnification but poor resolution

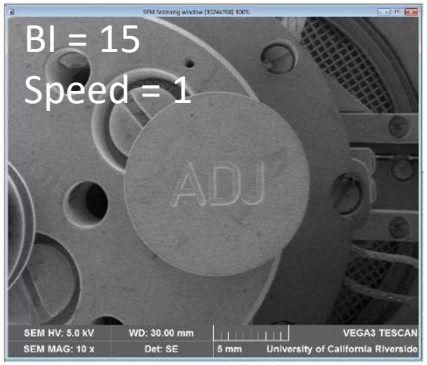
Low BI: Higher resolution but grainier image, need to balance with slower scan ***SPEED***

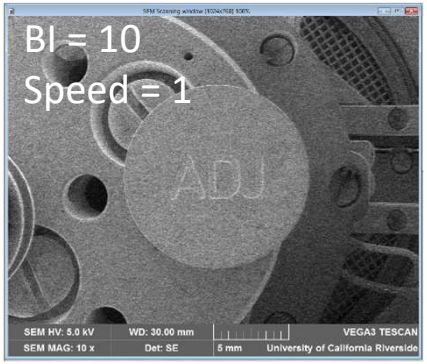
BI = 4

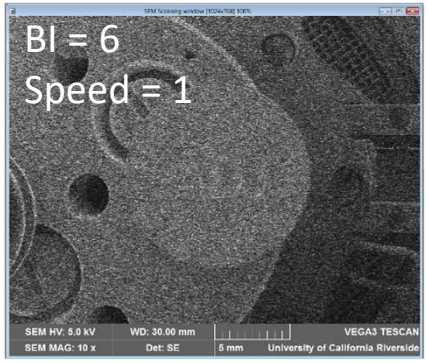


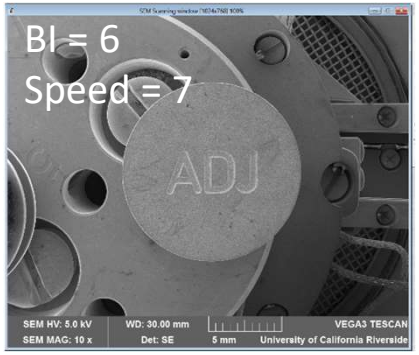
H. Beam Intensity – 2/3

Low Magnification (Minimum < Mag < 10 kX)



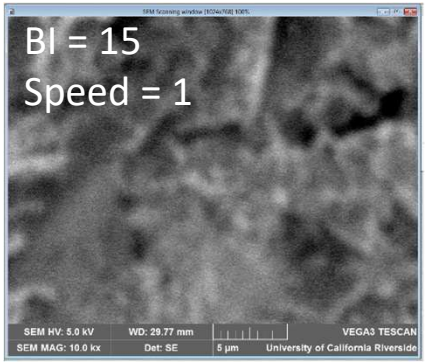


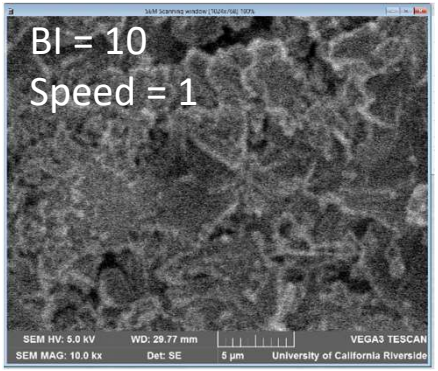


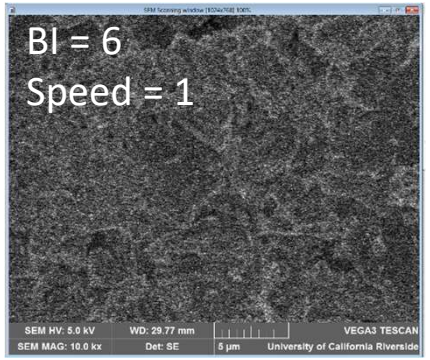


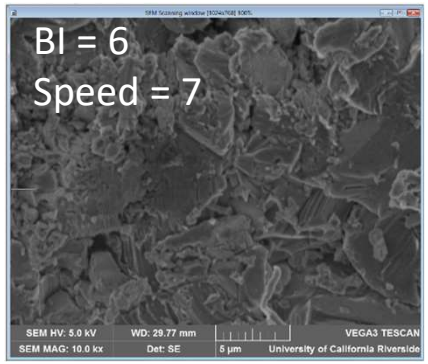
At Low Mag, lowering BI doesn't have a dramatic affect on the quality of image…

High Magnification (10 kX < Mag < Maximum)





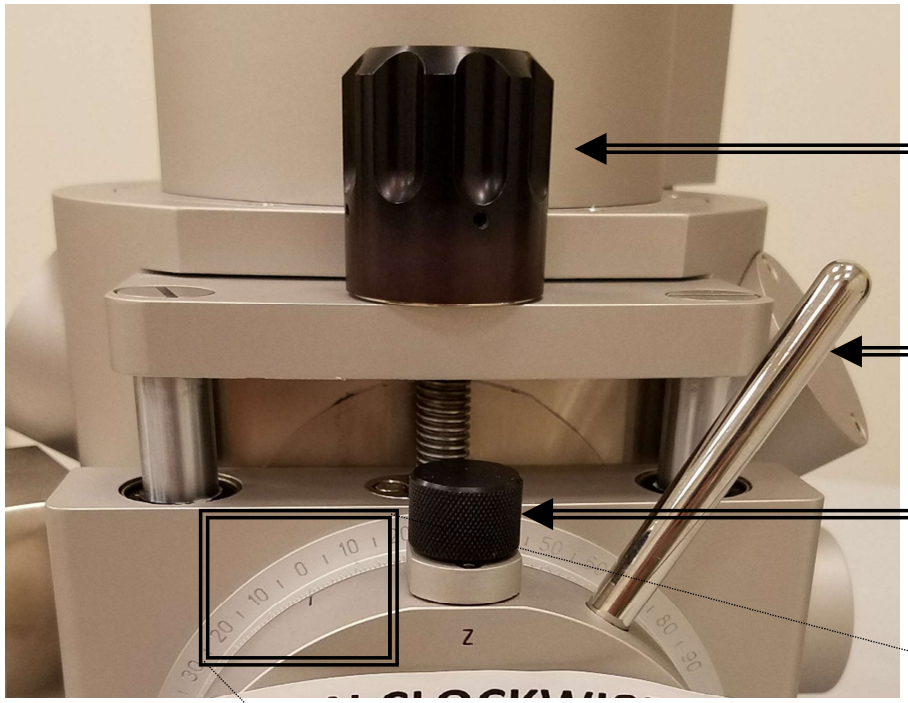




At High Mag, the BI MUST be chosen correctly!

A grainy image will ALWAYS accompany a reduction in BI, but is easily removed with a drop in scan SPEED!

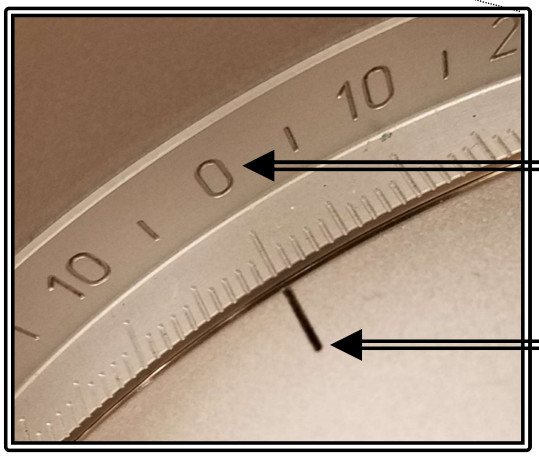
I. SEM Chamber



Z-dir Stage Movement Knob – Coarse Control

Stage Tilt Handle

Z-dir Stage Movement Knob – Fine Control



0° Tilt Position

Tilt Position Marker

J. Tilt (Advanced Users) - 1/2

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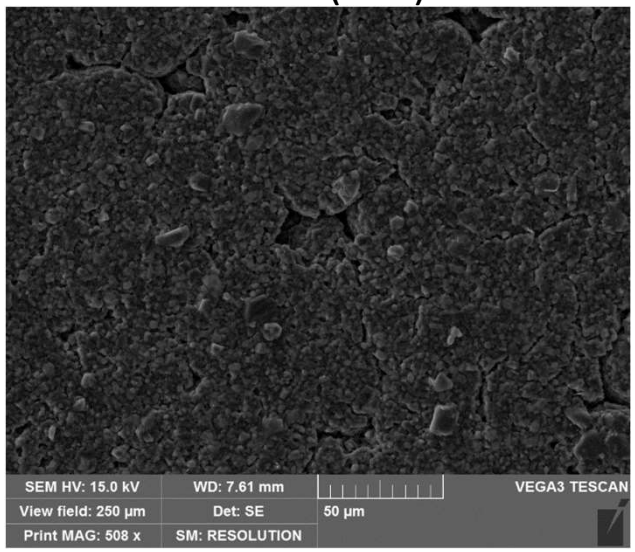
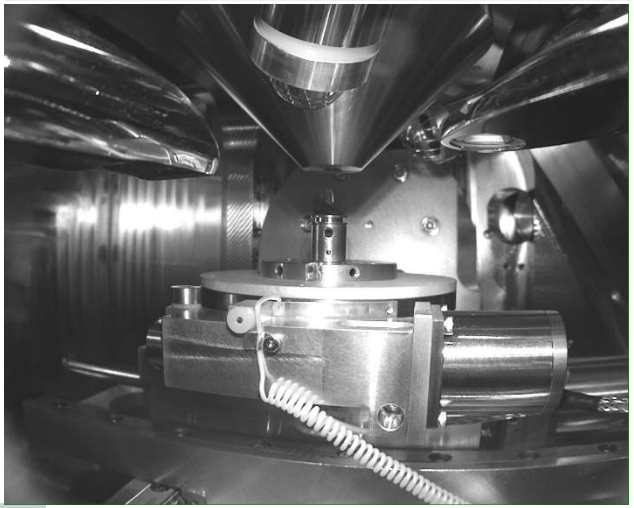
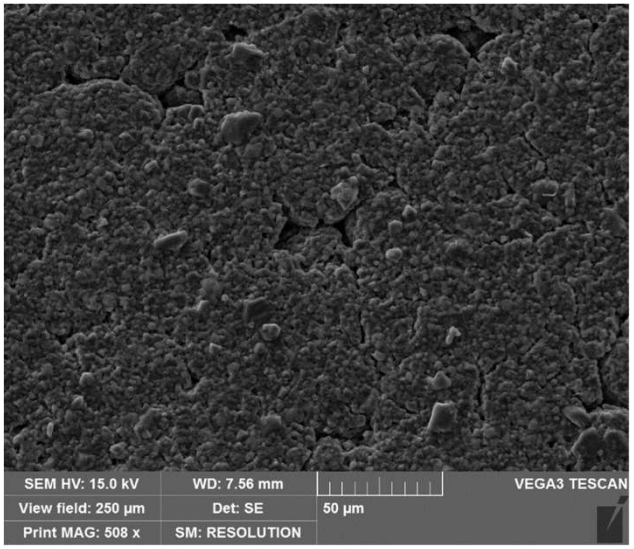
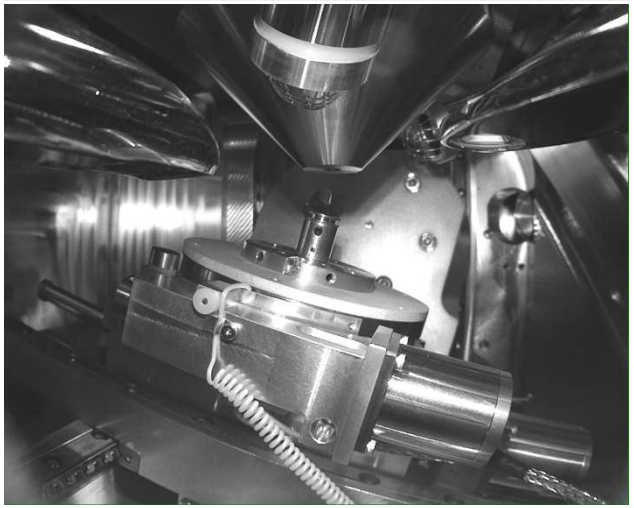
0° Tilt (Flat)



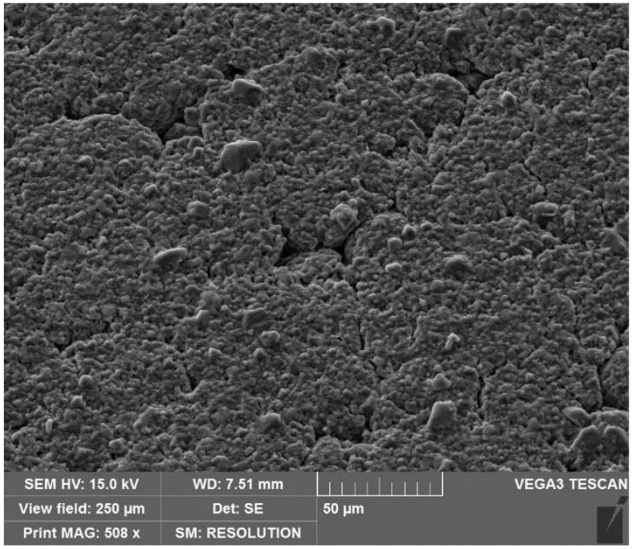


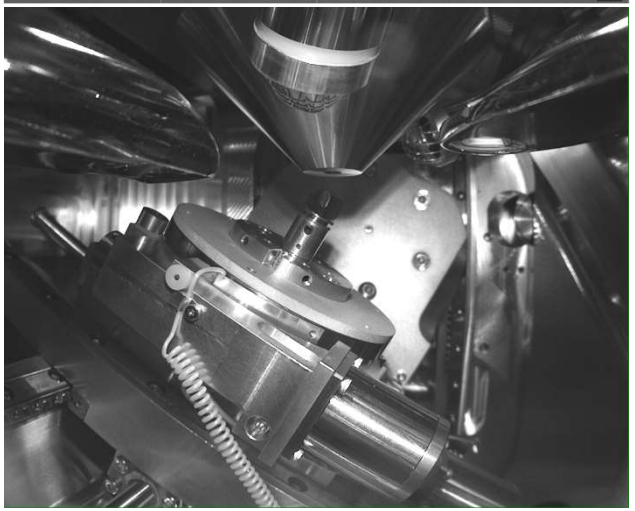
15° Tilt





30° Tilt





J. Tilt (Advanced Users) - 2/2

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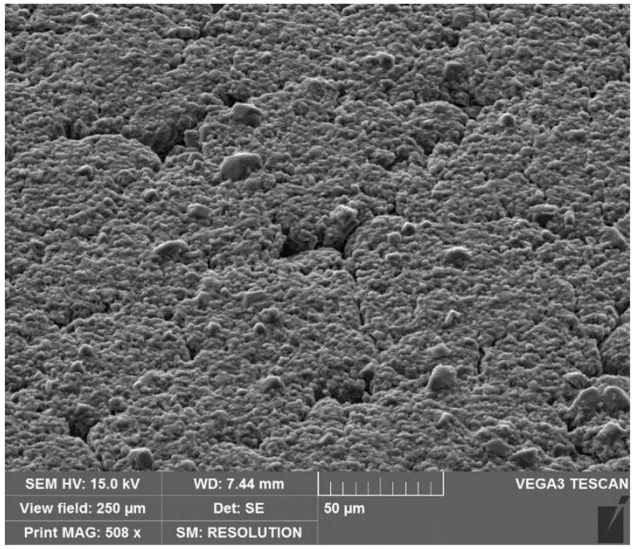
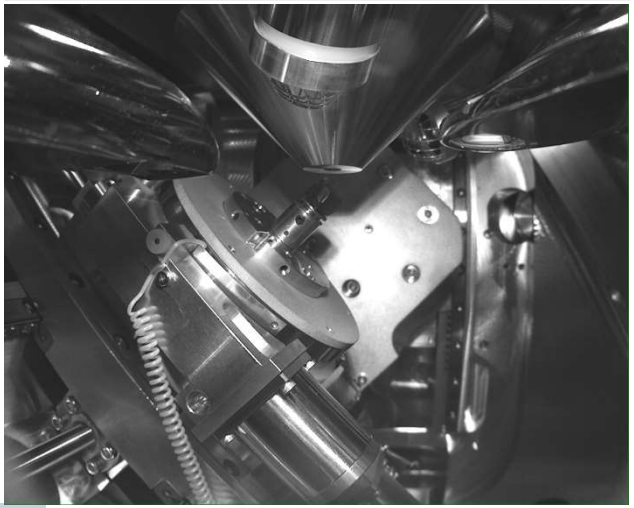
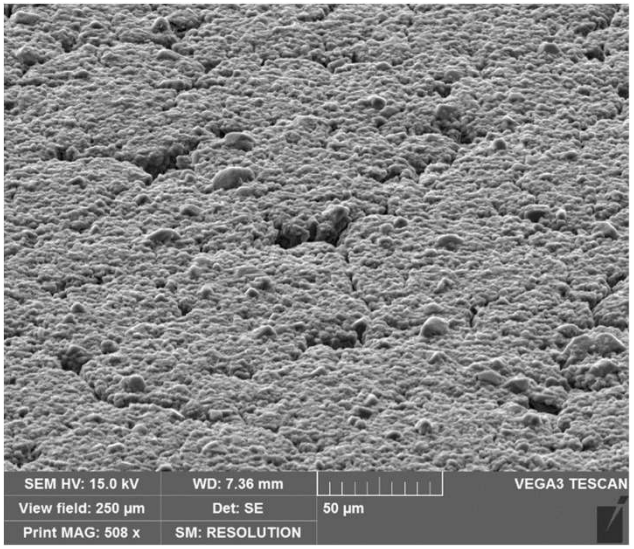
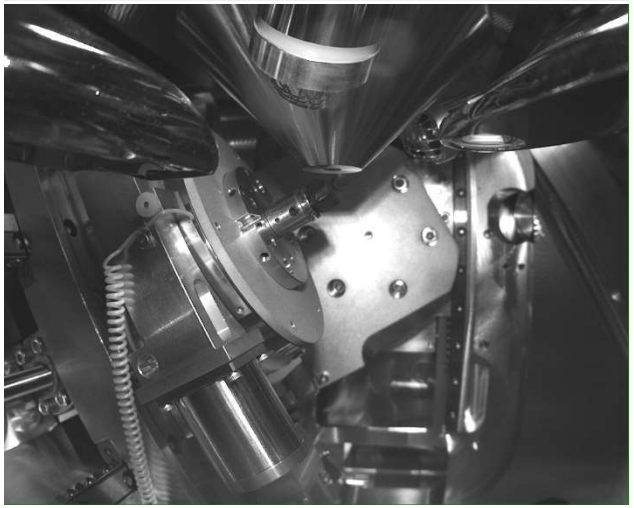
45° Tilt



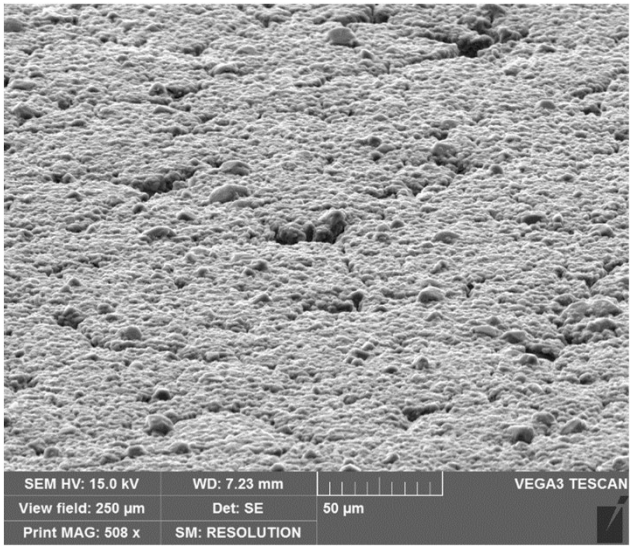


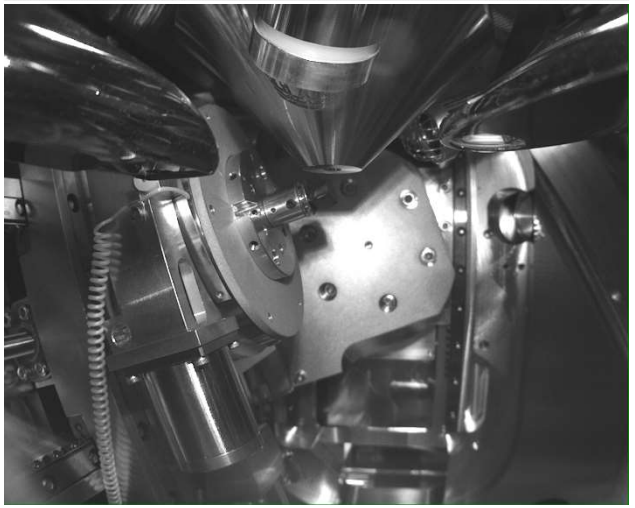
60° Tilt





70° Tilt





K. High Resolution Imaging Process Tree

#	Description	Stage	Mag	Focus	Z Knob	BI	Speed	Auto B/C
1	Center **tallest part** of **tallest sample** in window	Yes	Yes	Yes		Yes	Yes	Yes
2	Achieve desired **working distance**			Yes	Yes	Yes	Yes	Yes
3	Center **desired sample image** in window with **desired Mag**	Yes	Yes	Yes		Yes	Yes	Yes
4	Increase Mag to ≥ **2X desired Mag**		Yes	Yes		Yes	Yes	Yes
5	Beam optimization (if desired Mag ≥ 10 kX)			Yes		Yes	Yes	Yes
6	Achieve **best focus**			Yes		Yes	Yes	Yes
7	Reduce Mag back to **desired Mag**		Yes			Yes	Yes	Yes
8	Determine optimal image conditions for **BI** and **Speed** and acquire					Yes	Yes	Yes
9	Reduce Mag and acquire image		Yes			Yes	Yes	Yes
10	Move to new sample location -> Repeat #3 to #9							

SEM Operation

I. Initiate Software
II. Sample Preparation
III. Sample Loading
IV. Turning on HV
V. Mode
VI. Beam Intensity
VII. Brightness and Contrast
VIII. Mag
IX. Focusing
X. Speed
XI. Working Distance
XII. Image Preparation
XIII. Column Centering
XIV. Stigmation Correction
XV. Image Acquisition
XVI. Saving
XVII. Sample Unloading
XVIII. Cleanup

I. Initiate Software – 1/1

1. **Record** your time-in on the **sign-in sheet** located on preparation table

2. Sign into Windows using provided **Username** and **Password** located on **monitor** if necessary

3. Double-click on VegaTC icon to load software

4. Sign into your user account with your **Username** and **Password**

II. Sample Preparation – 1/1

1. **Always wear gloves** when dealing with anything that will be placed into or in contact with the SEM

2. The specimen should be conductively fixed or glued to a specimen stub (12.5 mm specimen pin-stubs)

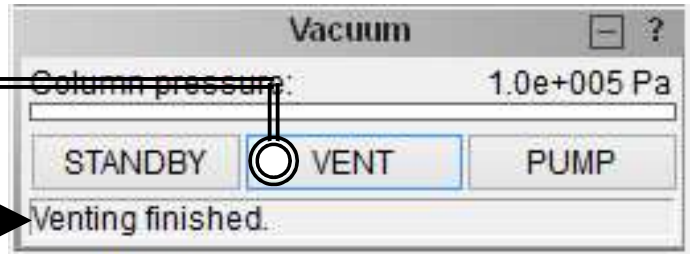
3. Non-conductive samples need to be coated by a conductive layer using either a carbon coater or sputter coater (coming soon to MSE)

4. Magnetic samples will need to be fixed well by screw holder (provided by user)

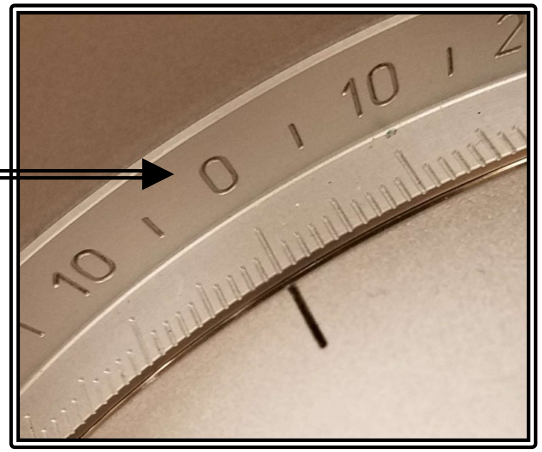
5. Items located in the cabinet are available for SEM users to help prepare their samples

III. Sample Loading – 1/3

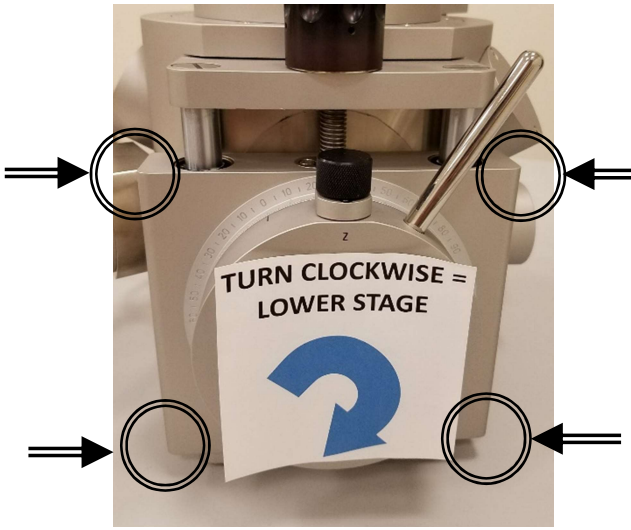
1. Click ***VENT*** to vent the microscope
2. Click ***Yes*** to confirm venting



3. Wait until *"**Venting finished**"* appears
4. Set the tilt of the specimen stage to 0° if not already set to 0° (**Advanced Users only**)



5. Gently pull the chamber corners toward you to open the chamber



III. Sample Loading – 2/3

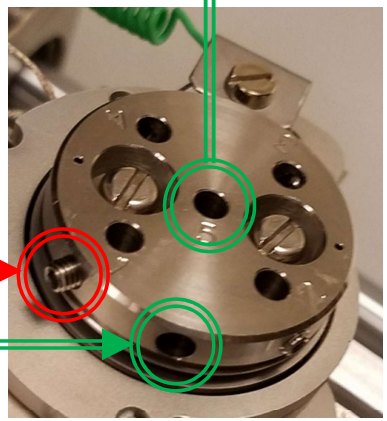
6. Rotate stage if necessary to access screw port

7. Using provided tweezers, clamp onto the specimen stub and **blow a stream of air** over the **entire specimen stub** AWAY from the chamber using Airgun

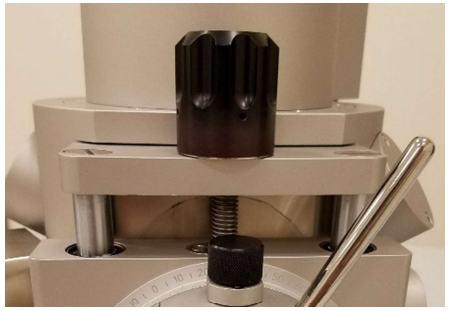
8. Loosen the screw first (see example)

9. Carefully insert the specimen stub into the specimen stage

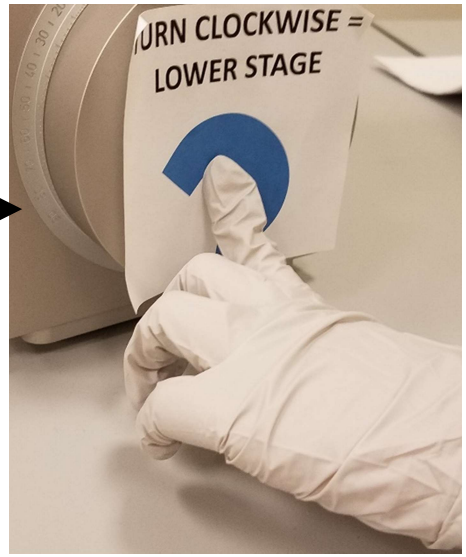
10. Tighten the screw holding the specimen stub

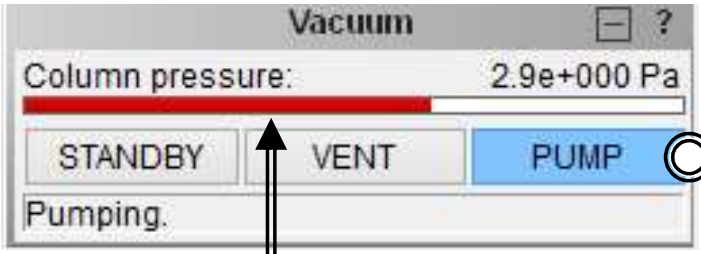


III. Sample Loading – 3/3

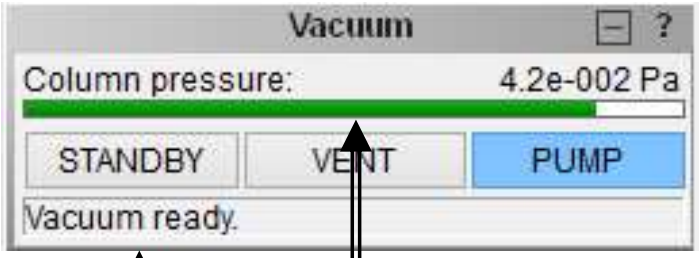


11. Ensure that the sample stage is at the lowest position using Z-knob (clockwise)
12. Carefully close the chamber door by pushing it towards the chamber
    CHECKING THAT THE SAMPLE DOES NOT TOUCH ANYTHING INSIDE CHAMBER
13. Place finger against chamber door
14. Click ***PUMP*** to start pumping down chamber



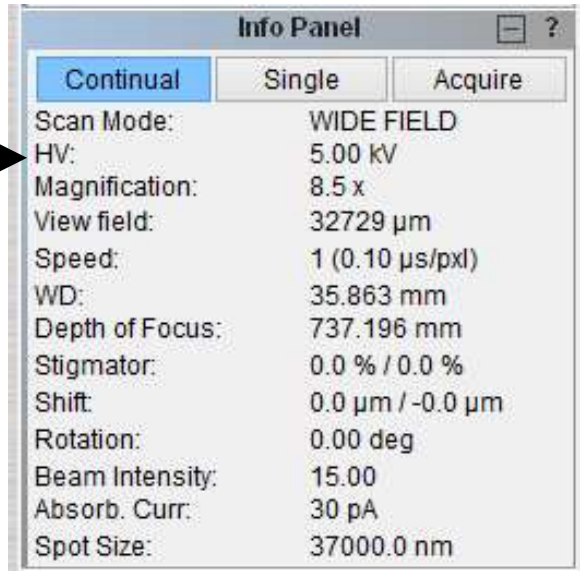


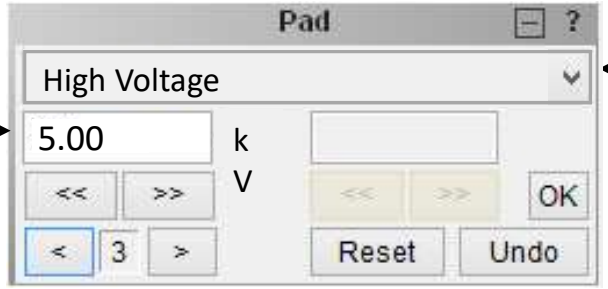
15. Wait until bar graph shows red to release finger
16. Wait until the bar graph turns green or *"**Vacuum ready**"* appears (~ 3 min)



IV. Turning on HV – 1/2

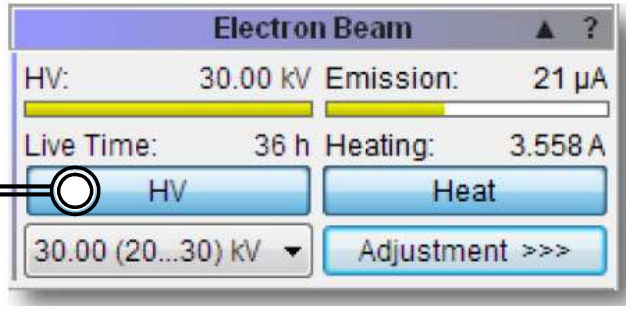
1. Click on ***HV*** on the Info Panel
   or select ***HV*** in Pad Drop Down



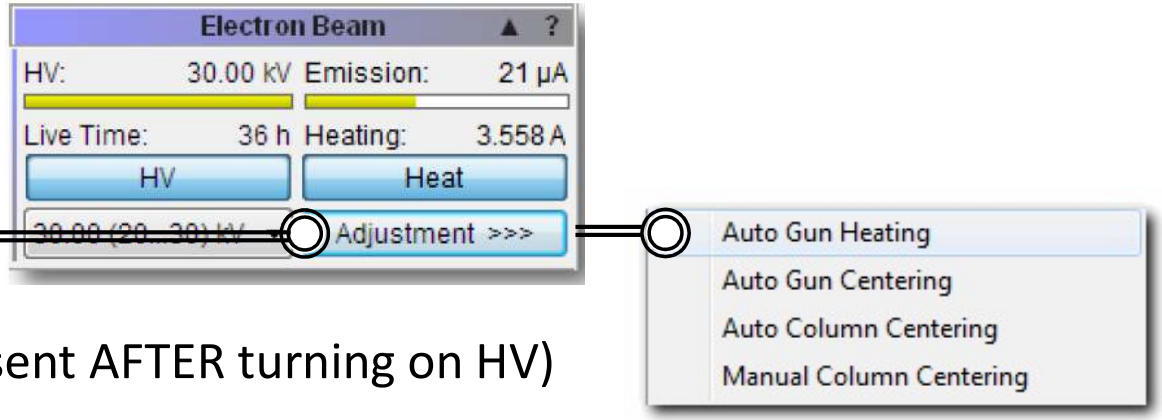


2. Set a specific ***High Voltage*** in the ***Pad*** panel
   (set 5 kV as starting voltage)

3. Click ***HV*** to turn on the high voltage

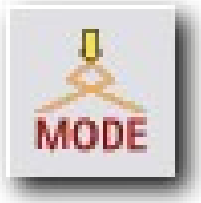


4. Click ***Adjustment >>>***
   and select
   Auto Gun Heating



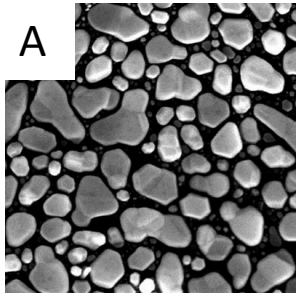
(required if black screen present AFTER turning on HV)

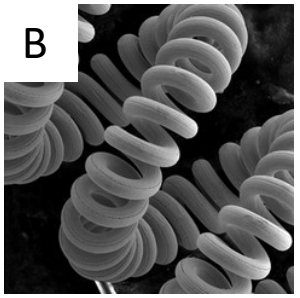
V. Mode – 1/1

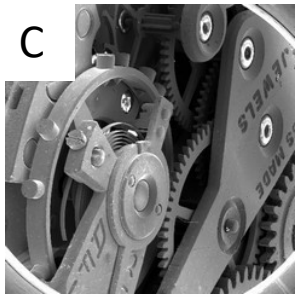


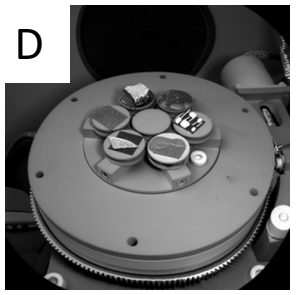
1. Click ***MODE***
2. Confirm ***Continual Wide Field*** option is checked ✓
3. Choose desired scanning mode (**default = Resolution**)

	Mode	Characteristics
A	Resolution	High resolution Lower depth of focus
B	Depth	Good resolution Increased depth of focus
C	Field	Lower resolution Large field of view High depth of focus
D	Wide Field	Extra large field of view

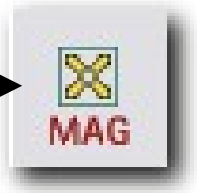


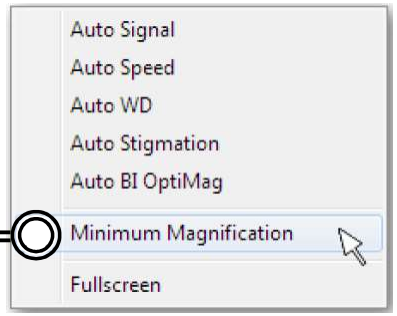






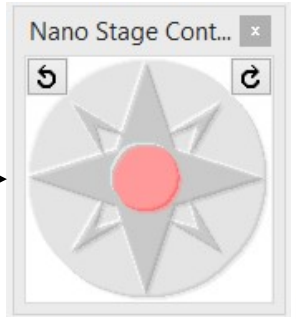
4. Right-click on ***MAG*** and select ***Minimum Magnification***





VI. Beam Intensity – 1/1

1. Center the SEM window onto your desired sample using the stage control



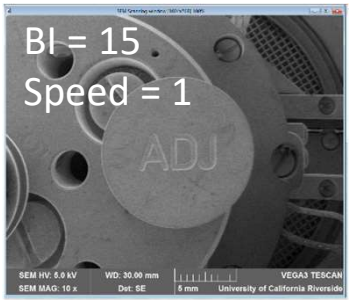
2. Click ***BI*** to adjust beam intensity using the **<<** and **>>**

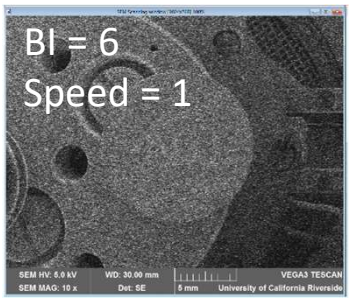
Recommended Initial ***BI*** values

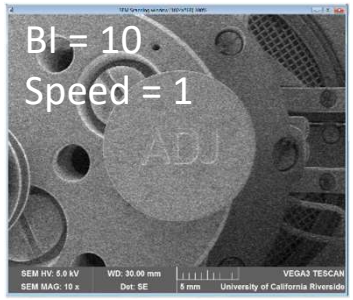
Magnification	Beam Intensity
Min – 200	13 – 18
200 – 2000	8 – 12
2000 – 10k	7 – 10
>10k	4 – 7

3. Recommend ***BI*** of ***15*** to start at low mag
4. Change the sensitivity if necessary

Recommended Value = 3



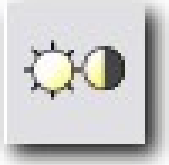




VII. Brightness and Contrast – 1/1

1. Click ***Auto*** to auto adjust the brightness and contrast if too bright or dark as necessary

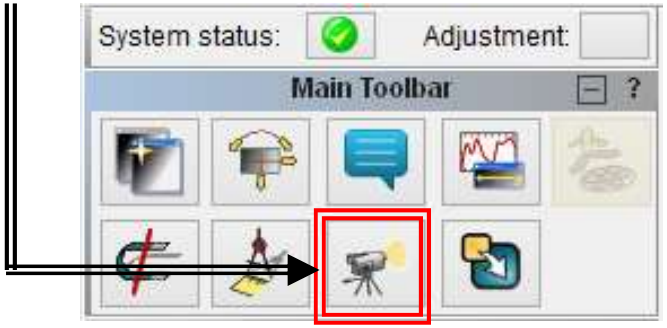
2. Click ***Brightness*** to manually adjust the brightness and contrast

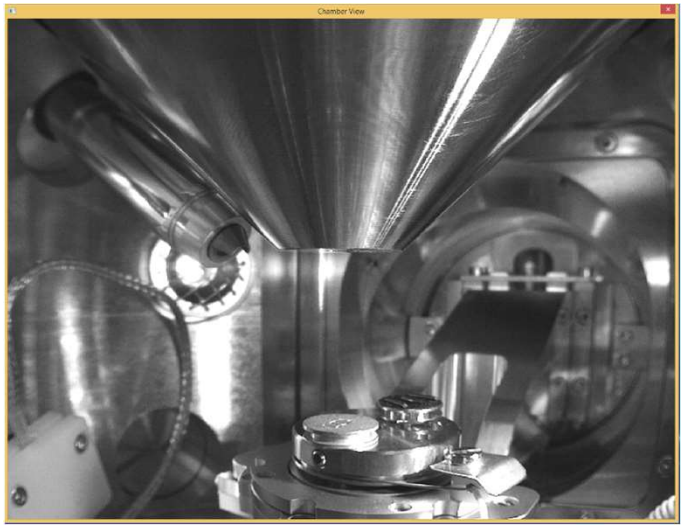


Contrast: **Hold F12 +** ⟷ **trackball** = Change only Contrast

Brightness: **Hold F11 +** ↕ **trackball** = Change only Brightness

3. Click on the ***IR Camera*** button to open up the view of the chamber (if you haven't already)

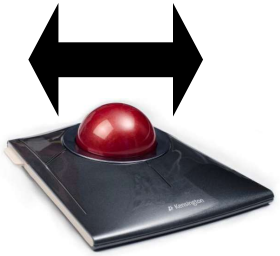




VIII. Mag – 1/1

1. Click ***MAG*** to change the magnification

2. Turn the trackball from left to right

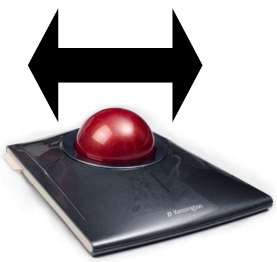


3. Or enter a value directly in ***Pad*** panel

4. Change the sensitivity if necessary

Recommended Value = 5

IX. Focusing – 1/1

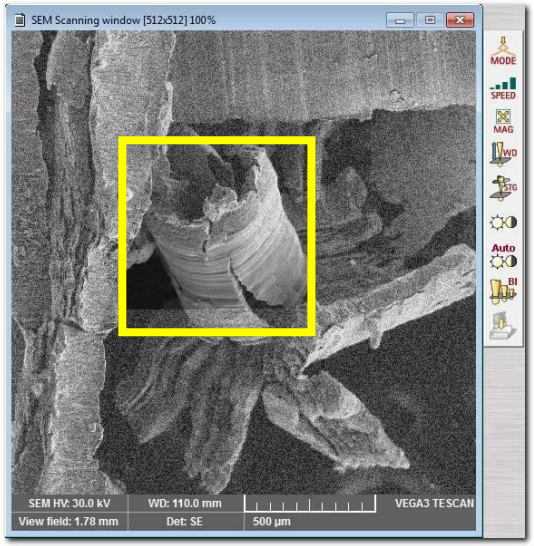


1. Click ***WD*** to adjust **focus distance**
2. Turn the Trackball from left to right to adjust focus
3. A **focused image** shows the **actual working distance** via **WD value**
4. Change the sensitivity if necessary

Recommended Value = 2 for Fine (Mag ≥ 10kX)
and 5 for Coarse (Mag ≤ 10kX)

5. Double-left-click in the SEM scanning window to create a ***Focus Window***

- Left mouse button inside = move ***Focus Window***
- Right mouse button inside = resize ***Focus Window***
- Double-left-click = remove ***Focus Window***



6. WD ≈ 30 mm when sample is at lowest position

X. Speed – 1/1

1. Click ***SPEED*** to adjust scan speed

2. Use Focus Window to determine the effect of ***SPEED*** and ***BI*** has on your image quality

Recommendation:

SPEED of 1 – 4 for **initial focusing**

BI setting should be appropriate to ***MAG*** value

SPEED of higher values looks better but takes longer to focus!

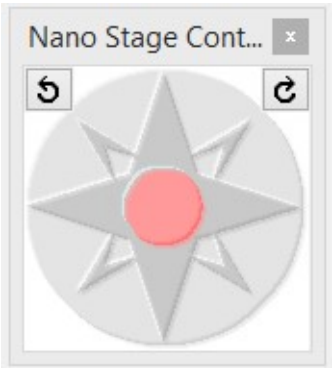
Use higher ***SPEED*** values of 5 – 8 when **ready to save images**

SPEED	Acquisition Time
1	0.12 sec
2	0.30 sec
3	0.87 sec
4	3 sec
5	16 sec
6	32 sec
7	1 min 36 sec
8	4 min 34 sec
9	13 min 58 sec
10	44 min 4 sec

Recommended Initial ***BI*** values

Magnification	Beam Intensity
Min – 200	13 – 18
200 – 2000	8 – 12
2000 – 10k	7 – 10
>10k	4 – 7

XI. Working Distance – 1/3



Use combination of ***MAG***, ***Stage Control***, and focusing (***WD***)

a. Identify and bring the **tallest position** of your **tallest sample** to the **center** of SEM scanning window

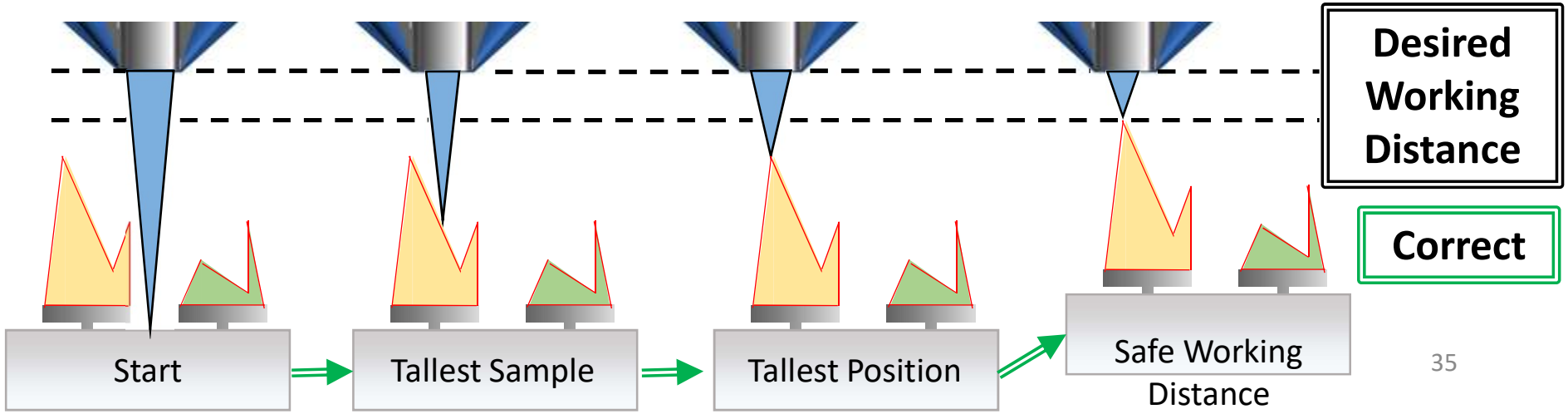
b. Increase *MAG* until **distinct features** make up **majority** of window

c. Check if mode = ***Resolution*** or ***Depth*** (if not, keep increasing ***MAG***)

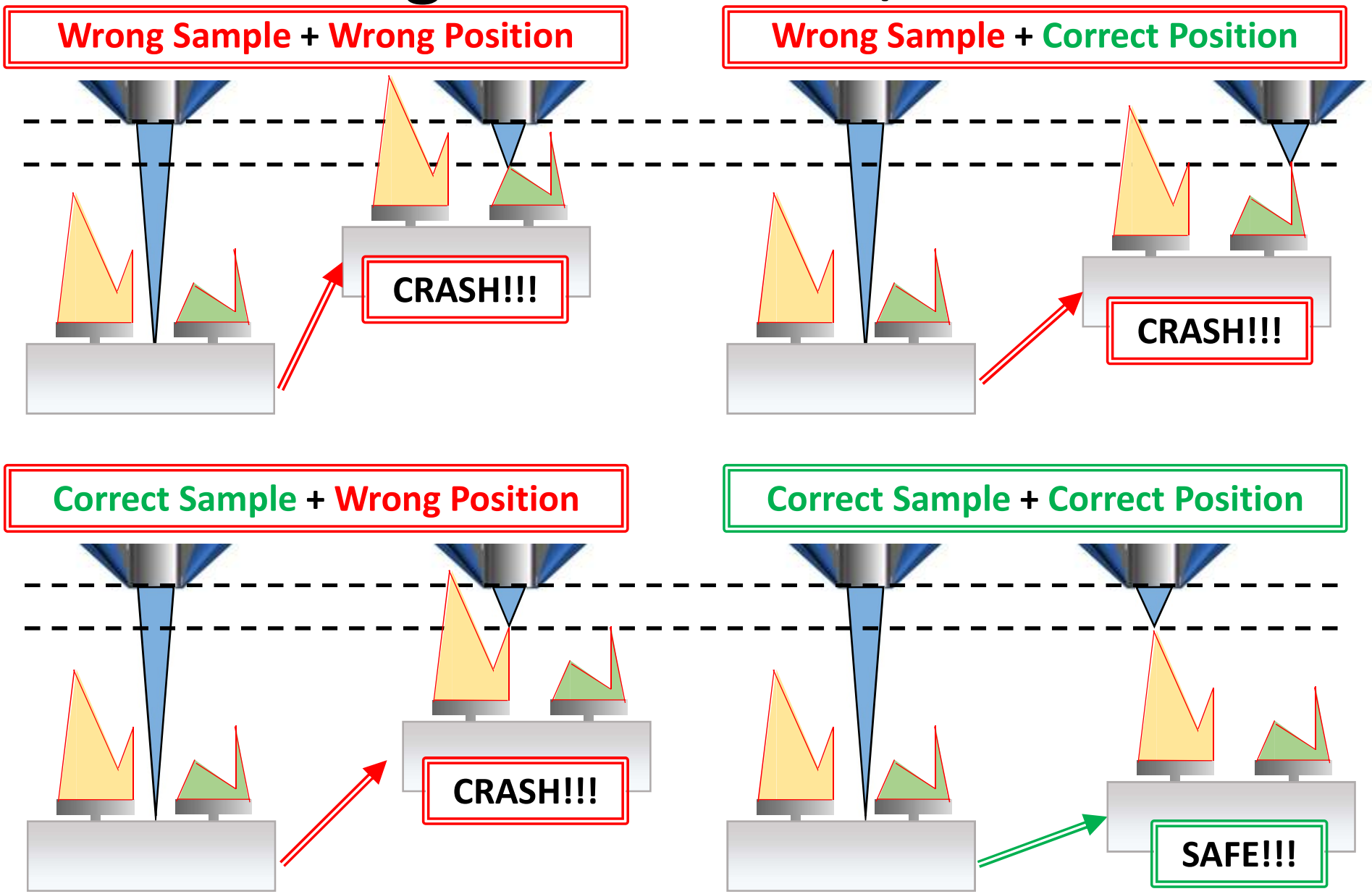
d. If you can't see transition between focus & out-of-focus with ***WD***, **you skipped a step!**

NOTE: The tallest portion of the tallest sample should be focused since this will crash into the pole-piece first as you raise the stage in the next step.

This DOES NOT have to be the desired position or sample for your images, it is ONLY for setting the safe working distance value!



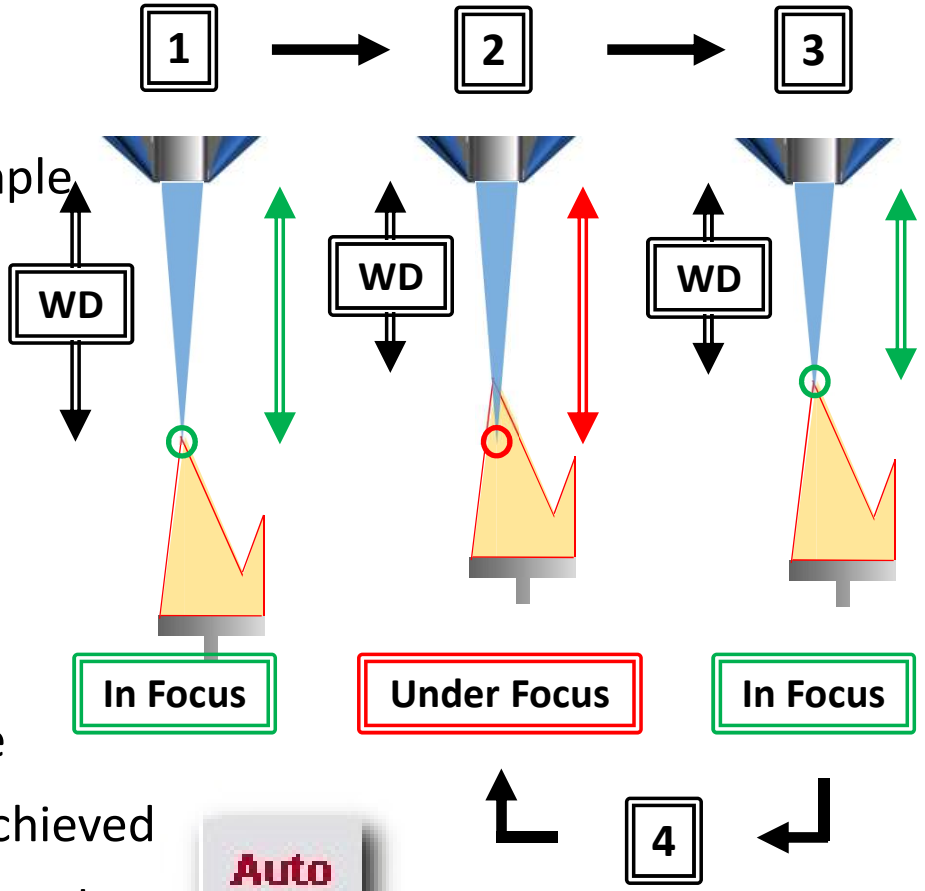
XI. Working Distance – 2/3



XI. Working Distance – 3/3

PROCEED WITH CAUTION AS CHANGING THE WORKING DISTANCE CAN RESULT IN DAMAGE TO THE SEM!

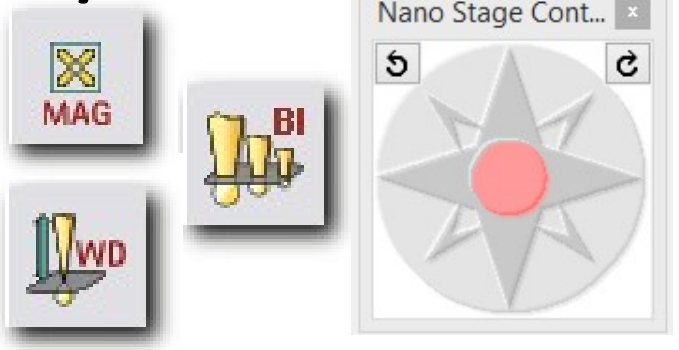
1. **Identify current WD** by focusing on sample
2. **Raise the specimen stage** by SLOWLY turning the Z-knob counter-clockwise



3. **Identify new WD** by focusing on sample
4. **Repeat steps 2 - 3** until desired WD is achieved
5. Click ***Auto*** to auto adjust the brightness and contrast if too dark when necessary

6. SLOW DOWN WHEN YOU REACH ~ 10 mm AND DO NOT GET LESS THAN 5 mm

XII. Image Preparation – 1/2

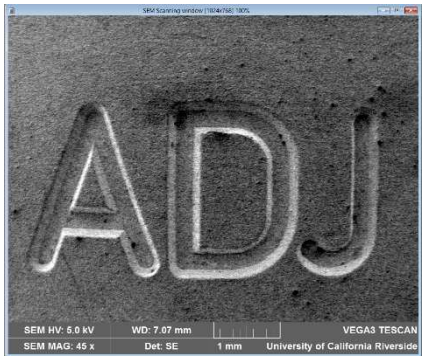


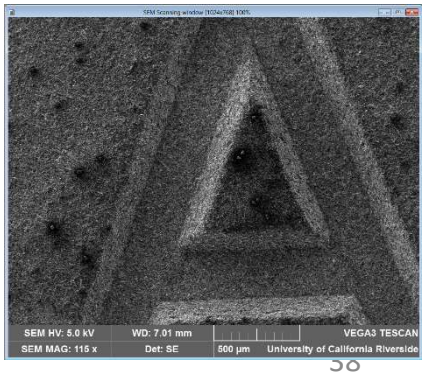
Imaging at ***MAG*** ≥ 10 kX requires optimization steps **XIII. Column Centering** and **XIV. Stigmation Correction** after completion of **XII. Image Preparation**, else skip and proceed next to **XV. Image Acquisition** directly

1. Right-click on ***MAG*** and select ***Minimum Magnification*** to see your whole sample again

2. Identify an area of interest on your sample to image by using a combination of ***MAG***, ***Stage Control***, focusing (***WD***), and ***BI***

Example





XII. Image Preparation – 2/2

3. Bring the area of interest to the **center** of SEM scanning window and to the **highest desired** magnification (e.g. Desired Mag = 10 kX)

   You will **NOT** use the ***Stage Control*** after this step, so **ENSURE** that the image at the Desired Mag is the one you wish to take before continuing

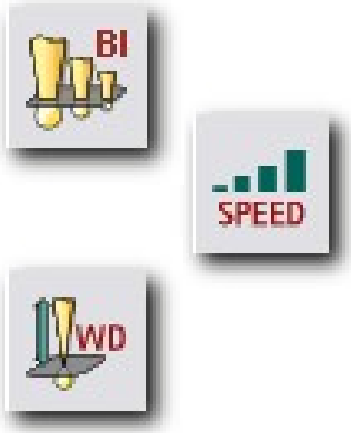
4. Increase ***MAG*** by ≥ 2X the desired Mag using the Pad (e.g. New Mag = 20 kX, 30 kX, etc…)

   Higher ***MAG*** yields better results but gets more difficult to optimize

5. Reduce ***BI*** if necessary to increase resolution

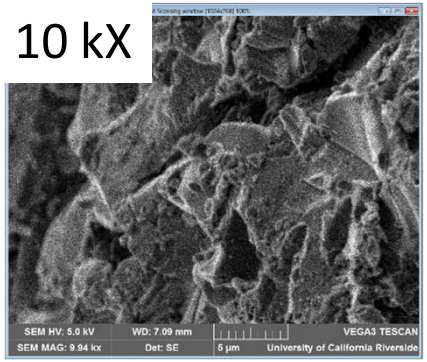
6. Change scan ***SPEED*** to 3 or 4 to remove graininess

7. Focus (***WD***) your sample again

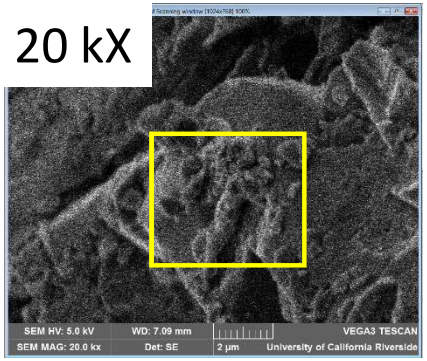


Example

10 kX



20 kX

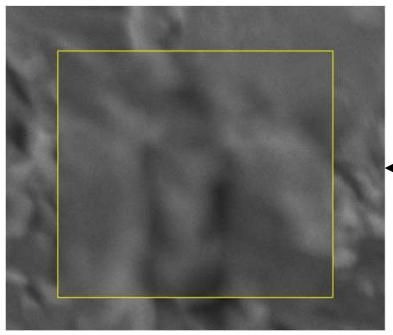


Recommended Initial ***BI*** values

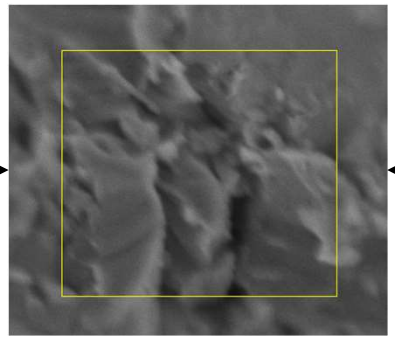
Magnification	Beam Intensity
Min – 200	13 – 18
200 – 2000	8 – 12
2000 – 10k	7 – 10
>10k	4 – 7

XIII. Column Centering – 1/3

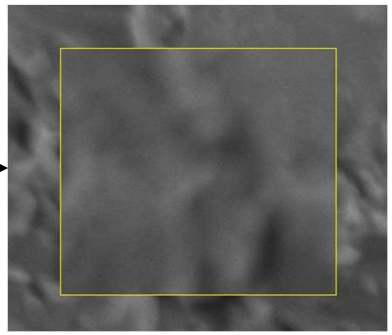
1. Create a ***Focus Window*** around a feature of interest
2. Click ***WD*** and bring the feature into focus
3. If image moves or shifts as you focus, then column centering needs to be completed and continue to **Step 5**
4. If image does not move or shift, proceed to **XIV. Stigmation Correction**



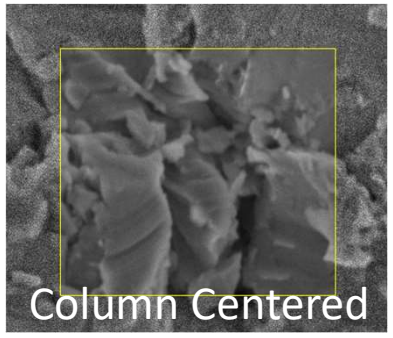
Under-focused



Focused



Over-focused

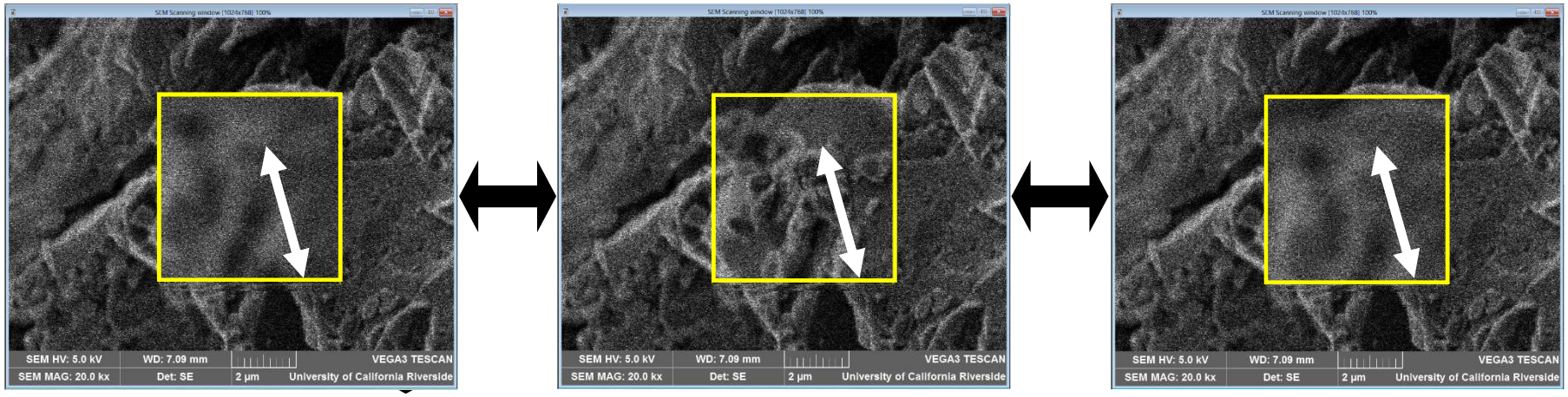


5. Click ***Manual Column Centering*** button
6. The Manual Centering Wizard will appear
7. Click ***Next>>***

XIII. Column Centering – 2/3

8. Your image will now “wobble” in and out of focus

   If image has any X or Y translation as it wobbles, you will need to remove it



9. Minimize image movement by adjusting the OBJ Centering using the trackball

X: **Hold F12 +** ⟷ **trackball**

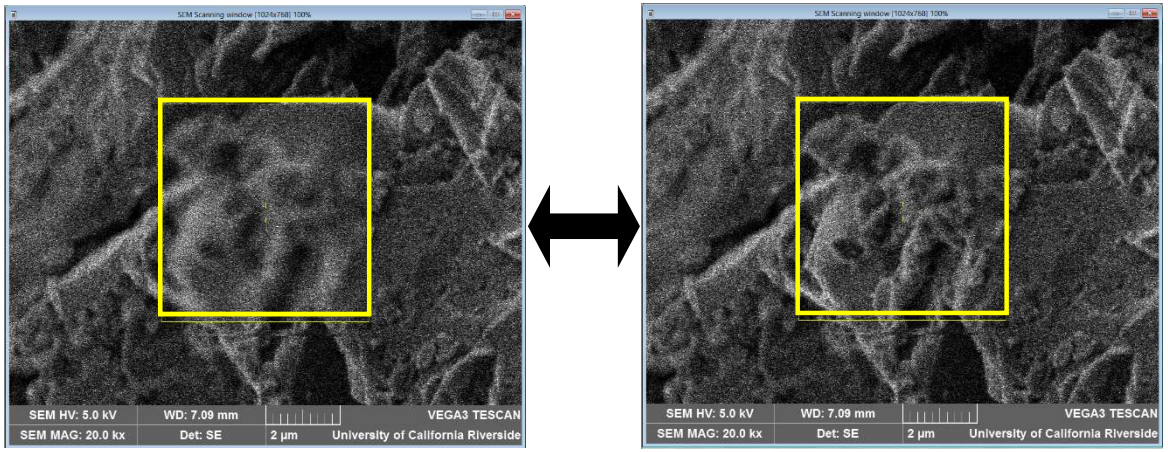
= Change only X-movement

Y: **Hold F11 +** ↕ **trackball**

= Change only Y-movement

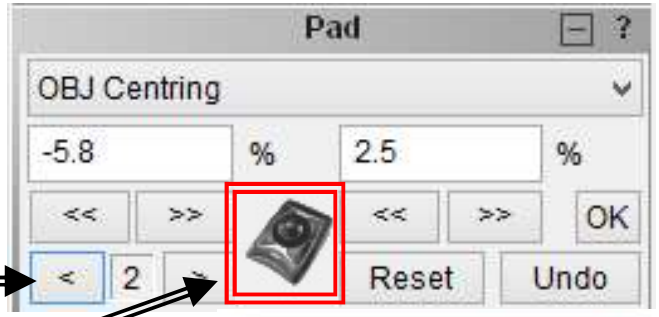
XIII. Column Centering – 3/3

8. The image should remain stationary with no X or Y translation but only oscillate in/out of focus



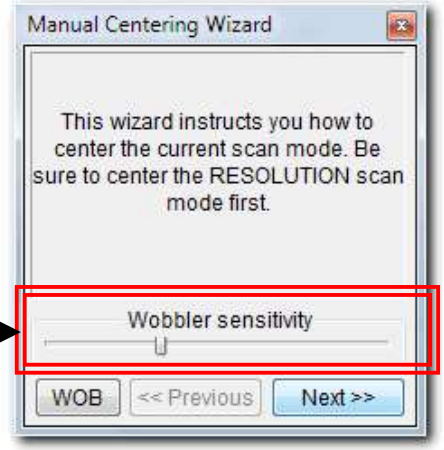
9. Adjust the sensitivity to finely control the ***OBJ Centering*** if necessary

Recommended Value = 5 first then 2



10. If flashing trackpad is present, click ***<< Previous*** and ***Next >>*** to reset

11. Adjust the ***Wobbler sensitivity*** to change the extent of "wobble" if necessary at very high magnifications

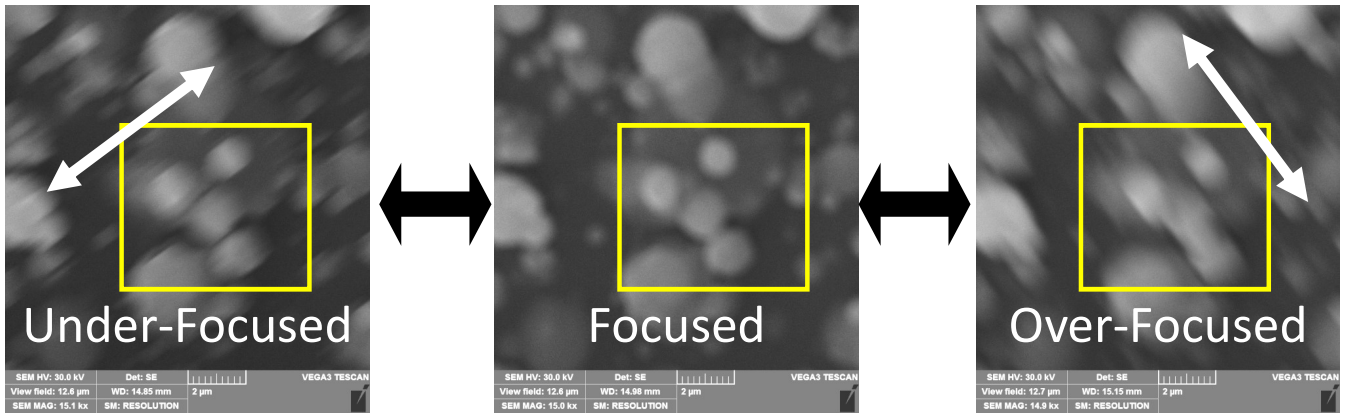


12. Click ***Finish*** when done

XIV. Stigmation Correction – 1/4

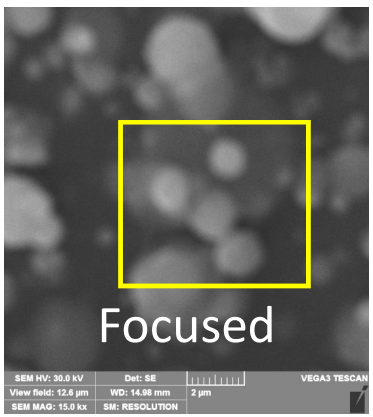
1. Create a ***Focus Window*** on a feature of interest
2. Click ***WD*** and bring the feature **in and out-of-focus** (both sides) to check if any **streaking** occurs on **non-straight features**

Stigmation Not Corrected

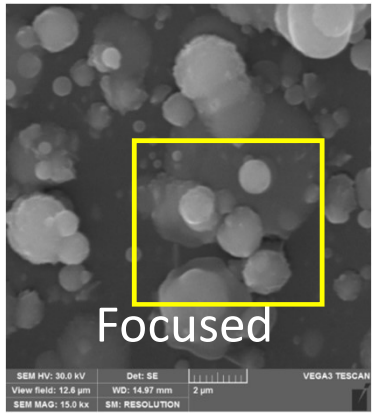


3. Any streaks are evidence that ***Stigmation Correction*** is necessary
4. When Stigmation corrected, a focused image will become **significantly sharper**

Stigmation Not Corrected



Stigmation Corrected



XIV. Stigmation Correction – 2/4

5. Set ***SPEED = 4*** + appropriate ***BI*** (see table)
6. Click ***WD*** and create a ***Focus Window***
7. Focus on a feature (***WD*** Sensitivity = 2) as BEST AS YOU CAN

8. Click the ***STG*** to set as active function

Recommended Initial ***BI*** values

Magnification	Beam Intensity
Min – 200	13 – 18
200 – 2000	8 – 12
2000 – 10k	7 – 10
>10k	4 – 7

9. Set ***STG*** **Sensitivity = 6** (slow down trackball for accuracy near "sweet spot")
10. Achieve a sharper image by adjusting the Stigmators one at a time (X and Y)

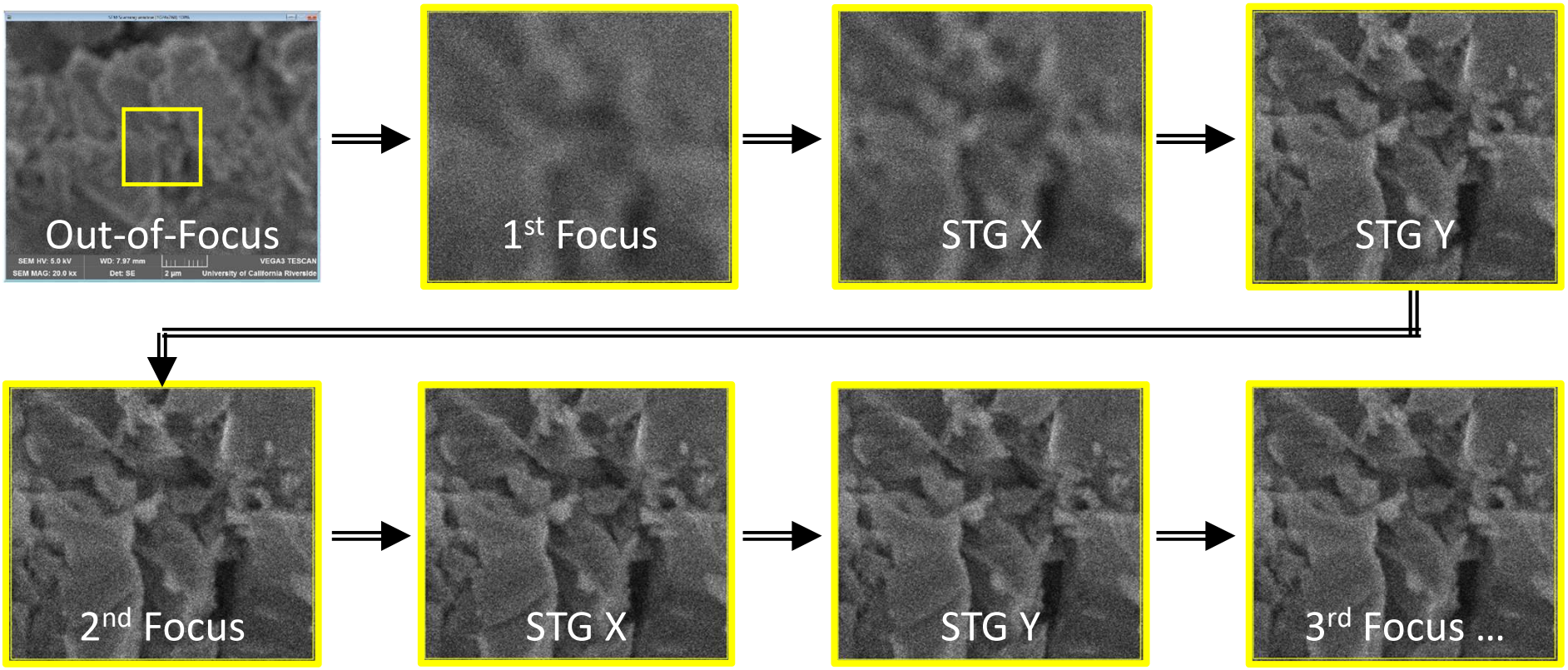
X: **Hold F12 +** ⟷ **trackball** = Change the X-component

Y: **Hold F11 +** ↕ **trackball** = Change only Y-component

11. **CAREFULLY AND SLOWLY** adjust each Stigmator component (X and Y) until you can identify the "*perfect*" or setting with the sharpest image
12. **REPEAT Steps 6 – 11** until you no longer see any improvement in sharpness

XIV. Stigmation Correction – 3/4

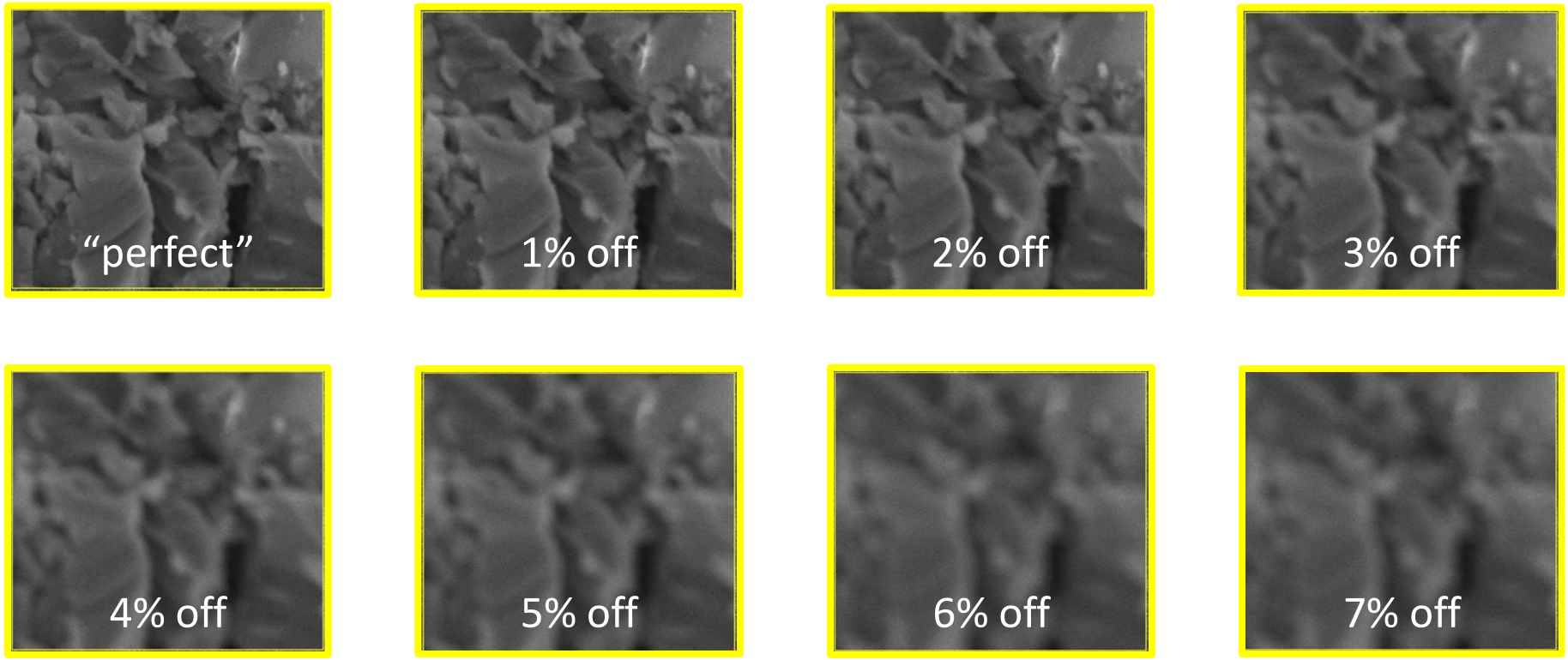
13. If your image still doesn't look "good", 99% it's because of poor ***STG Correction***
14. The sequence of ***STG Correction*** should resemble the following:



15. Repeat the sequence as necessary until the image looks "good"

XIV. Stigmation Correction – 3/4

16. Proper ***STG Correction*** is **EXTREMELY** sensitive
17. A few % values off from “perfect” setting, and your image will look very blurry!



18. If this is the case, **GO BACK AND RE-DO** the ***STG Correction***!

XV. Image Acquisition – 1/3

1. Create ***Focus Window*** and achieve the **BEST** focus (Recommend Sensitivity = 2)

(Do **NOT** focus again **AFTER** this step!)

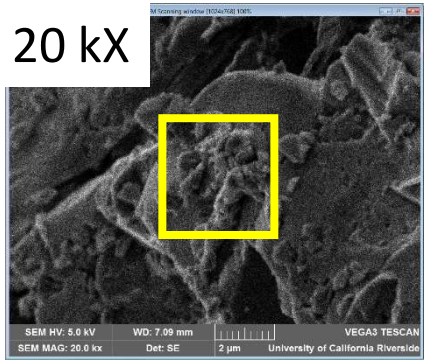
2. Click ***MAG*** and set back to desired magnification
(e.g. Desired Mag = 10 kX)

3. Activate the ***Focus Window*** over a desired feature

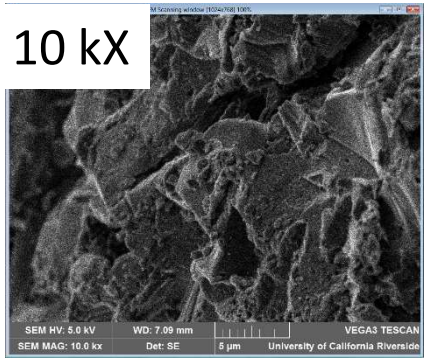
Smaller window = requires less time to refresh

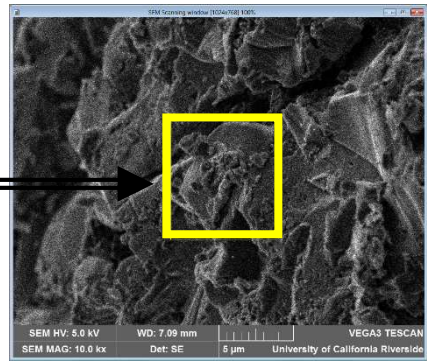
Example

20 kX



10 kX





XV. Image Acquisition – 2/3

4. Identify maximum **Acquisition Time** for your image (e.g. 2 min) and select corresponding ***Speed*** (e.g. ***SPEED*** = 7)

5. Adjust the ***BI*** until a balance between resolution is matched with graininess

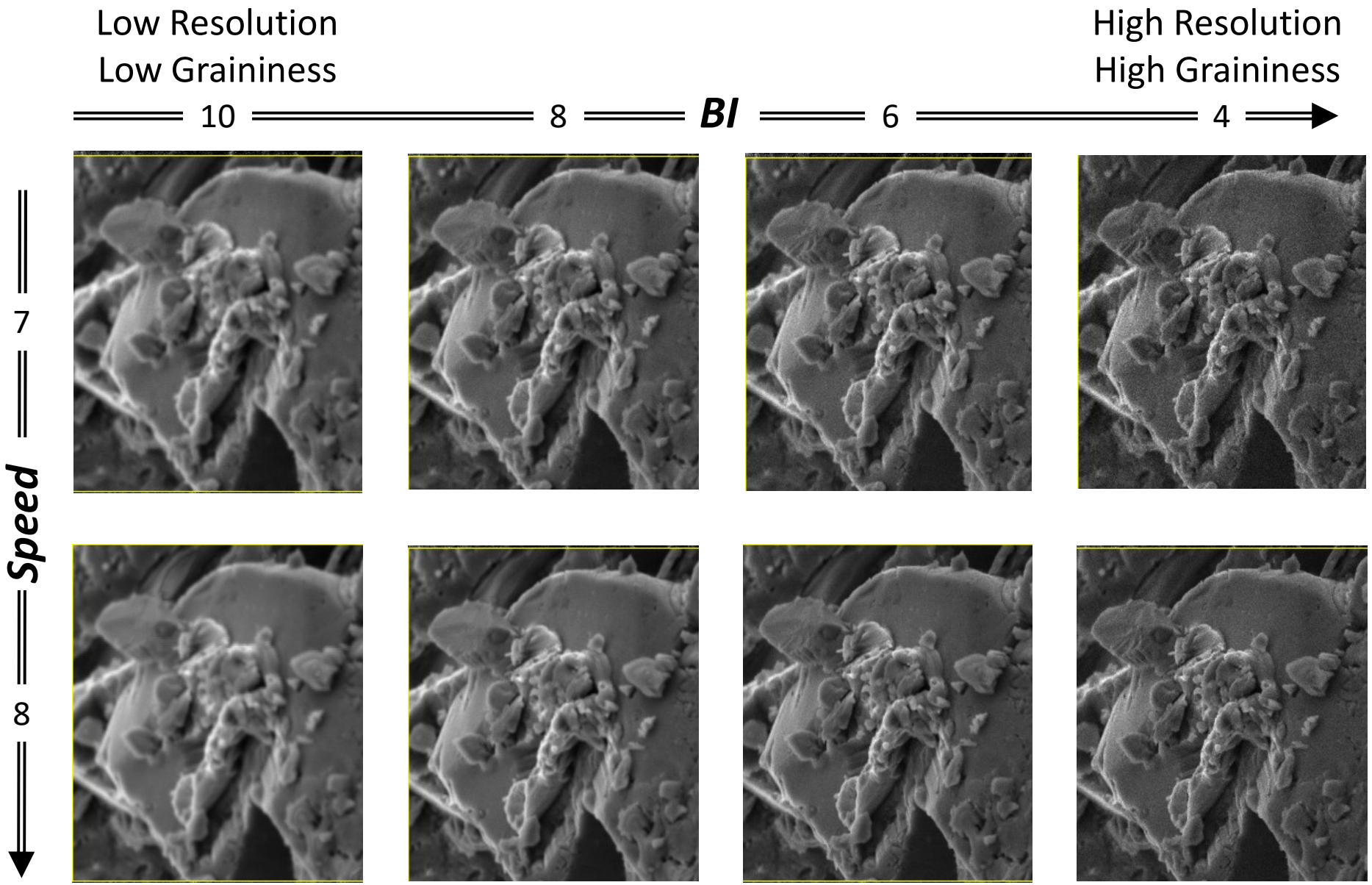
6. Click ***Auto*** to auto adjust the brightness and contrast as you change the ***BI***

SPEED	Acquisition Time
1	0.12 sec
2	0.30 sec
3	0.87 sec
4	3 sec
5	16 sec
6	32 sec
7	1 min 36 sec
8	4 min 34 sec
9	13 min 58 sec
10	44 min 4 sec

NOTE: **Remove focus window first** else it will only adjust pixels found within focus window + **change speed back to 1** for faster auto correction

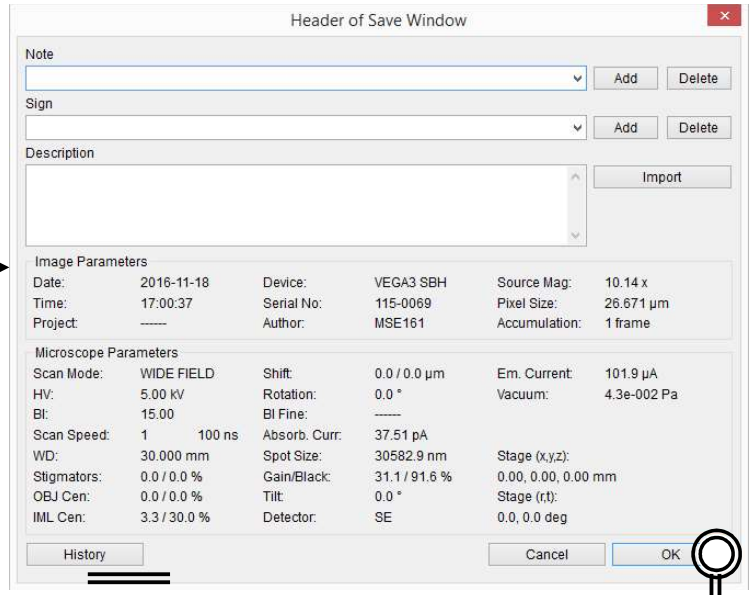
7. If high resolution is desired but excessive graininess is present, increase the **Acquisition Time** (e.g. ***SPEED*** = 7 -> 8)
8. Repeat Steps 5 – 6 until desired balance between resolution and graininess and is achieved (e.g. see next slide for examples)

XV. Image Acquisition – 3/3



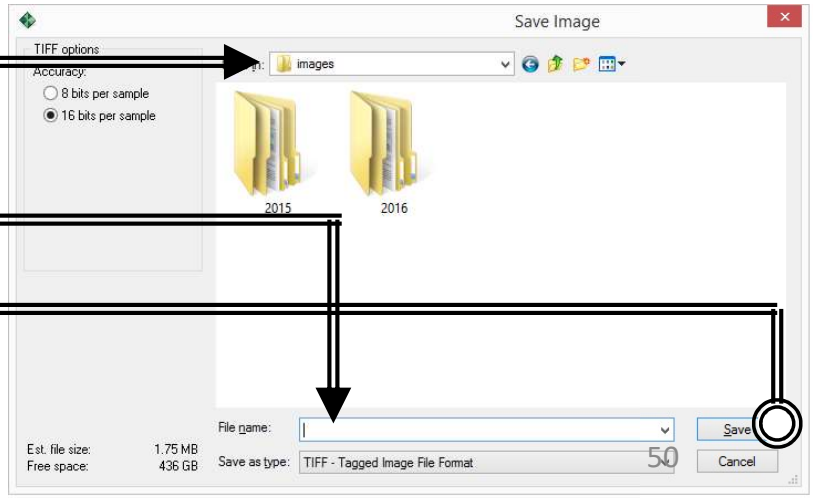
XVI. Saving – 1/1

1. Click ***Acquire*** to capture image
2. If desired, you may save information to the image file



Note = the basic description
Sign = the enlarged description
Description = the detailed information
Add = saves the Note or Sign in the list
Delete = deletes the Note or Sign from the list

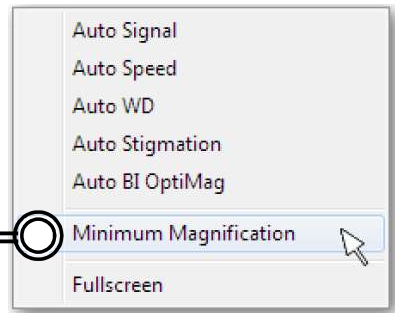
3. If you choose not to include any Header information, click **OK**
4. Choose the folder location for your images



5. Enter your file name
6. Click **Save**

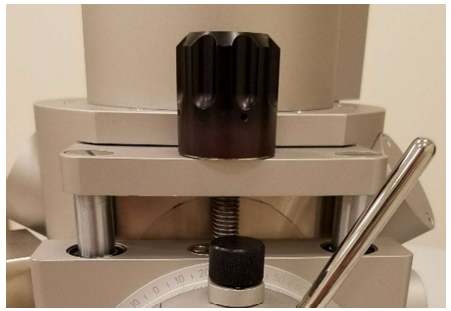
XVII. Sample Unloading – 1/3

1. Right-click on ***MAG*** and select ***Minimum Magnification***



2. Click ***SPEED*** and select **SPEED 1**

3. Carefully lower the sample stage to the lowest position by turning the Z-knob clockwise

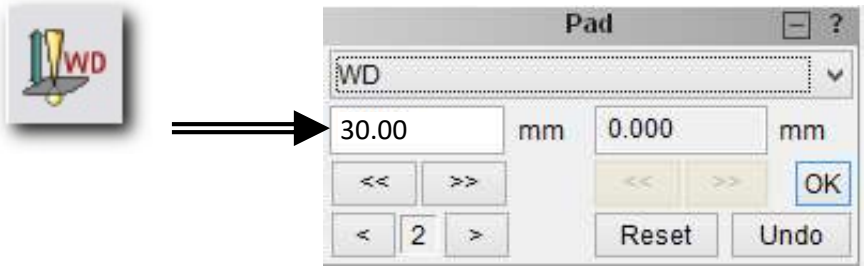


4. Set ***BI*** to **15**

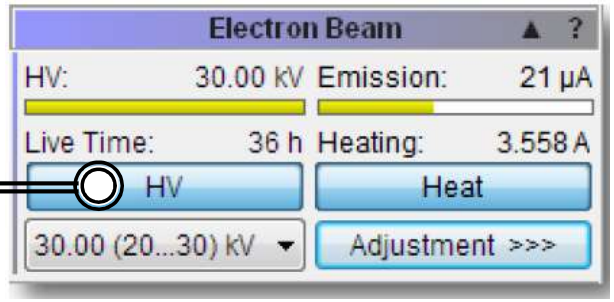
5. Click ***Auto***

XVII. Sample Unloading – 2/3

6. Set ***WD*** to 30 mm

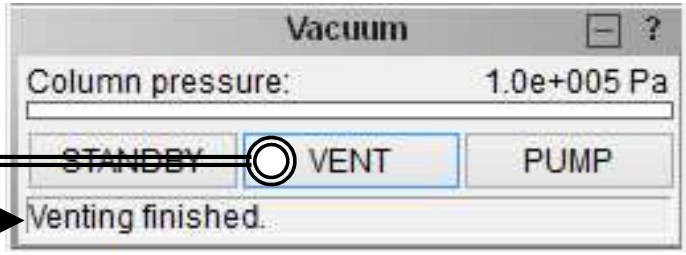


7. Click ***HV*** to turn off the high voltage



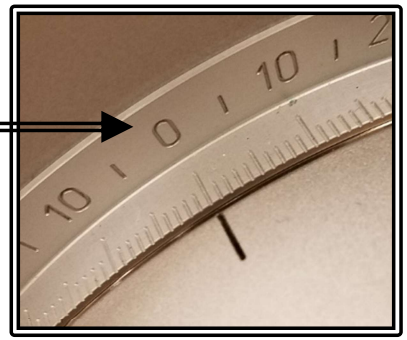
8. Click ***VENT*** to vent the microscope

9. Click ***Yes*** to confirm venting



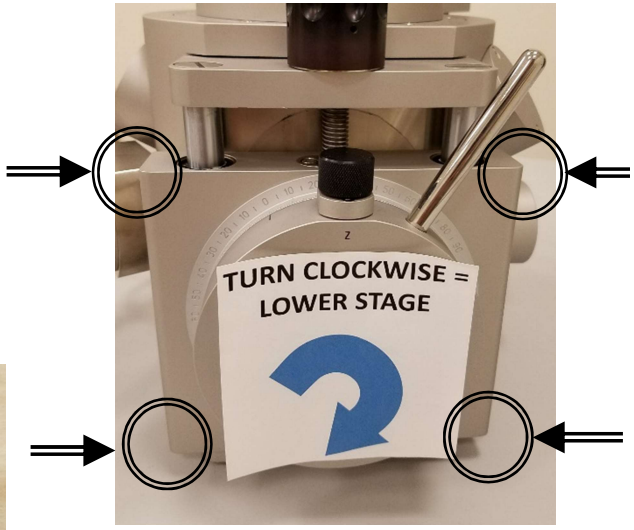
10. Wait until *"**Venting finished**"* appears

11. Set the tilt of the specimen stage back to 0° if not already set to 0° (**Advanced Users only**)



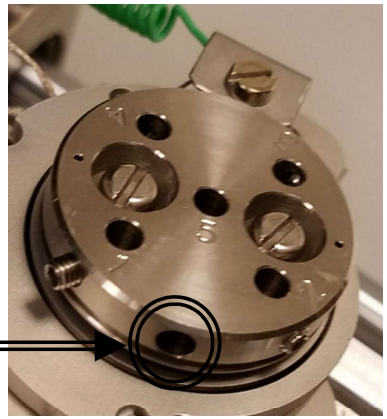
XVII. Sample Unloading – 3/3

12. Gently pull the chamber corners toward you to open the chamber



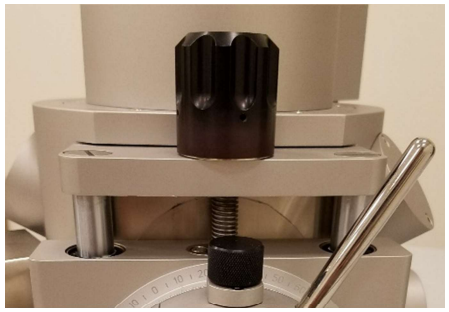
13. Loosen the screw holding the specimen stub on the specimen stage

14. Rotate the stage if necessary to access screw port



15. Using the provided tweezers, carefully remove the specimen stub out of the specimen stage

XVIII. Cleanup – 1/1



1. Ensure that the sample stage is at the lowest position by full clockwise turns
2. Carefully close the chamber door by pushing it towards the chamber
3. Place finger against chamber door
4. Click ***PUMP*** to start pumping down chamber
5. Wait until bar graph shows red to release finger
6. Wait until the bar graph turns green or *"**Vacuum ready**"* appears (~ 3 min)
7. Open the **File** menu and select **Logoff**, click ***Yes***
8. **Record** your total time used in the **Sign-in sheet**