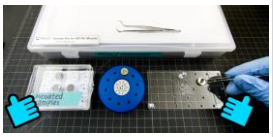
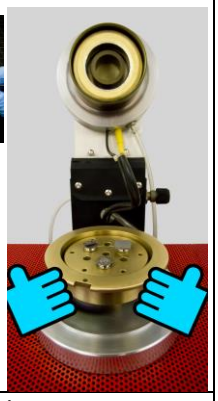
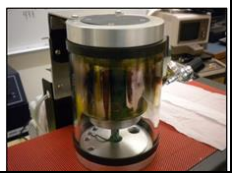
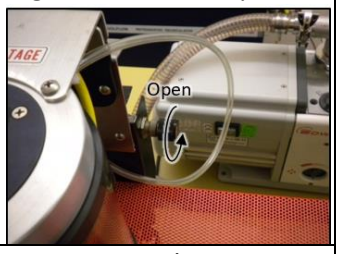
Number: 04

WORK INSTRUCTION BREAKDOWN SHEET

Operation: Sputter Coater Operations
Instrument: Technics Hummer VI Sputter Coater

IMPORTANT STEPS	KEY POINTS	REASONS WHY
A logical segment of the operation when something happens to advance the work.	**Anything in a step that might:** 1. **Make or break the job** 2. **Injure the worker** 3. **Be a Cultural Consideration** 4. **Make the work easier to do (i.e., "knack", "trick", special timing, or bit of special information).**	**Reasons for each key point**
Sample Stub Placement		
Lift ***Top Plate***.	• Gently lift the ***Top Plate*** with two hands. • Make sure ***Top Plate*** is resting **securely** in upright position.	
Remove glass ***Chamber***.	Place glass ***Chamber*** on top of clean tissue wipers.	Minimizes accumulation of debris and other contaminants on top and bottom gaskets of glass ***Chamber***. 
Transfer previously-prepared SEM specimen mount(s) to anode pedestal.	Use SEM specimen mount tweezers to place in appropriate-sized hole(s) on the anode pedestal.	 
Replace glass ***Chamber*** onto ***Bottom Plate*** and then lower ***Top Plate***.	• Gently lower the ***Top Plate*** with two hands. • Align/Center the glass ***Chamber*** with both the ***Top*** and ***Bottom Plates***.	It takes some trial and error to achieve the goal of a good seal prior to turning on vacuum pump. 

[1] Adapted from Graupp, P. & Wrona, R. (2006) The TWI Workbook: Essential Skills for Supervisors. New York, NY. Productivity Press.

Chamber Vacuum Pump-Down		
While applying **gentle** downward pressure on ***Top Plate*** with left hand, flip main ***Power Switch*** (lower right corner) to "On" with right hand.	• Power light will illuminate. • Operator should hear the vacuum pump turn on.	Pressing down on ***Top Plate*** with hand facilitates a good seal. 
Vacuum Gauge (upper left corner) should indicate a slow decrease in pressure as the gauge needle moves from right to left to ~50-60 millitorr.	• When the gauge begins to move to the left, remove hand from ***Top Plate***. • It should take no longer than 3 minutes to achieve ~50-60 millitorr. • If a "hiss" is audible, there is no seal. • If the gauge does not move to left, turn off main ***Power Switch***, adjust the ***Top Plate***/glass ***Chamber*** /***Bottom Plate*** assembly, and repeat previous step.	Purges atmospheric gases from sample chamber. 
Open the ***Fine Gas Control Valve*** by repeatedly turning the knob towards the Operator; counter-clockwise.	• Operator should observe the ***Vacuum Gauge*** needle moving slowly to the right as the pressure increases. • Continue to quickly open the valve until the gauge needle moves right past at least 500 millitorr.	Allows argon gas to fill the sample chamber. 
Completely close the ***Fine Gas Control Valve*** by repeatedly turning the knob clockwise away from the Operator.	• Note: **do not overtighten** the ***Fine Gas Control Valve.*** • Operator should observe the ***Vacuum Gauge*** needle moving slowly to the left as the pressure decreases.	Purges remaining atmospheric gases and some introduced argon gas from sample chamber. 
Repeat previous two steps until the pressure descends to ~30-40 millitorr.		Goal is to have only a minimal amount of argon gas in sample chamber.

[1] Adapted from Graupp, P. & Wrona, R. (2006) The TWI Workbook: Essential Skills for Supervisors. New York, NY. Productivity Press.

<table>
<tr><th colspan="3">Coating/Deposition/Plating</th></tr>
<tr><td>Once a pressure of ~30-40 millitorr is achieved, slowly open the Fine Gas Control Valve until the Vacuum Gauge needle stabilizes on 75 millitorr.</td><td><u>Slowly/Gradually</u> open valve counter-clockwise so as not to pass 75 millitorr.</td><td>Slow/Gradual opening of valve avoids surpassing target pressure of 75 millitorr and then having to repeat the time-consuming open/close process to achieve target pressure.</td></tr>
<tr><td colspan="2">• In the Timer region (located in lower left corner), turn the dial clockwise to at least 12 minutes.
• Set a handheld digital timer to 11 minutes as well.</td><td>• No voltage will occur during the next step if the mechanical timer dial is not set to greater than zero minutes.
• The instrument’s mechanical timer is not accurate; if it reaches zero before the digital timer, the coating process will stop too soon.
• Thickness of metal deposition is a function of time.</td></tr>
<tr><td>• Flip the High Voltage Switch to “On”.
• <u>Slowly</u> turn the High Voltage Control dial clockwise until the Plasma Discharge Current Meter reads 10 milliamperes.
• Immediately start digital timer countdown.</td><td>• High voltage light will illuminate when High Voltage Switch is flipped to “On”.
• A purple glow will occur inside the glass Chamber as the voltage is increased.
• During operation, monitor the vacuum gauge, plasma discharge current, and argon regulator pressure and gently/slowly adjust accordingly if values stray from:
○ Vacuum gauge: 75 millitorr (± 5 millitorr).
○ Plasma discharge current: 10 mA (± 1 mA).
○ Argon pressure regulator: 10 psi (± 2 psi).</td><td>Electric current ionizes argon gas resulting in purple glow.
 
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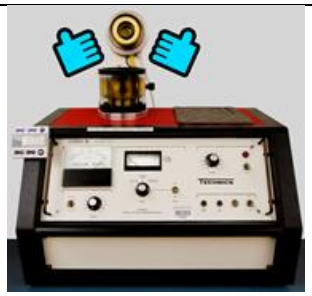
<tr><td colspan="2">• When the <u>digital</u> timer reaches zero minutes, turn the instrument timer dial counter-clockwise to zero minutes.
• Turn the High Voltage Control dial counter-clockwise to zero.
○ Do not turn instrument timer dial past zero minutes, or instrument will start again.
• Flip the High Voltage Switch to “Off”.</td><td></td></tr>
<tr><td colspan="2">Flip the main Power Switch to “Off”.</td><td></td></tr>
<tr><td>Lift Top Plate.</td><td>• Gently lift the Top Plate with two hands.
• Make sure Top Plate is resting <u>securely</u> in upright position.
• If the Top Plate does not easily lift, wait a few minutes and/or open the Fine Gas Control Valve a little to equalize the pressure and try again.
• Once pressure has equalized, Operator may need to use hands to gently separate glass Chamber from Top or Bottom Plate.</td><td>  </td></tr>
</table>

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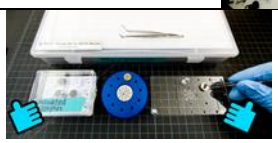
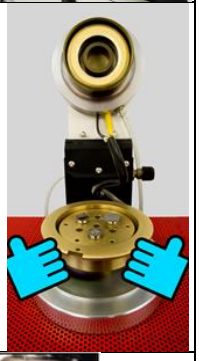
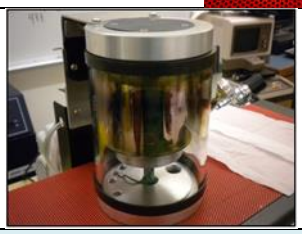
Remove glass ***Chamber***.	Place glass ***Chamber*** on top of clean tissue wipers.	Minimizes accumulation of debris and other contaminants on top and bottom gaskets of glass ***Chamber***. 
Use SEM specimen mount tweezers to transfer coated SEM specimen mount(s) from anode pedestal to storage box or to temporary transfer stages.		 
Reassemble vacuum chamber.	• Return glass ***Chamber*** onto ***Bottom Plate***. • Gently lower the ***Top Plate*** with two hands.	
Proceed to "Sputter Coater Shutdown" Work Instructions (See Number: ___)		

[1] Adapted from Graupp, P. & Wrona, R. (2006) The TWI Workbook: Essential Skills for Supervisors. New York, NY. Productivity Press.