PVD 75 DC and RF SPUTTERING SYSTEM SOP

May 2013

System Start Up

1. The sputterer and utilities should be on and the chamber should be under vacuum.
2. Simply touch the screen or mouse pad and the computer will awake.
3. If the computer or entire system is off contact cleanroom staff.

Chamber Vent

1. Select the “VACUUM” page at the top left of the screen
2. Note the current vacuum found at the bottom of the screen in Torr. See Figure 1. If the vacuum is greater than 1 x 10-5 Torr there may be a problem.
3. To open the chamber press “START PC VENT” located at the middle right of the screen.

Target Loading

1. Once vented, select the “DEPOSITION” button to allow one to open the target and substrate
shutters. See Figure 2.

2. Press the “SOURCE SHUTTER” button (near the top left corner of the screen) corresponding to the source you would like to use. Observe that the shutter within the vacuum chamber corresponding to your selection has opened. Source 1 and 2 are 3” sputter heads and source 3 is for 4” sputter targets.

3. Change the material listed in the “Source Configuration” section of the deposition screen to reflect the target you are loading. Click (or press) in the “Material” name box that corresponds to your source number, and then enter the correct abbreviation for the material you are loading.

![Deposition window](image)

Figure 2 Deposition window

4. Remove the gas inlet tube from the dark space shroud if it is connected. Note: it may be helpful to have the tube connected to the shroud when one is doing low pressure depositions (< 5 mTorr). See Figure 3.

5. Remove the dark space shroud around the sputter head by loosening the 3 screws around the periphery of the sputter head.

6. Remove the ring(s) holding the target in place (remove 4 screws)

7. Remove old target and replace with the new target. **CAUTION:** The magnets in the sputter head, a.k.a. cathode, are strong and can snap magnetic targets to the head with substantial force. Watch your fingers when inserting new targets.
8. Replace target holder ring (3 screws). For 1/4 “ targets use 2 additional spacer rings, 1/8” use 1 ring and for 1/16” targets use no rings.

9. Replace dark space shroud. For thicker targets use the shallow set of notches on the shroud and for thin use the deeper set of notches. The screws should be tightened so that the shroud does not move at all.

10. Check for continuity (using the digital multi-meter hanging outside the sputterer) between the target and shroud. These should be electrically isolated from one another. If there is continuity re-seat the dark space shroud or increase the height of the shroud by placing it on a shallower set of notches. For dielectric targets, it is impossible to perform the continuity check. Users are advised that it is common for a short to occur between the dark space shroud and the target holder rings therefore it is important to leave ample space between these electrodes. For RF dielectric depositions a short may not be discovered until one has failed to light the plasma.

11. Close the source shutter. Press the “SOURCE SHUTTER” button (near the top left corner of the screen) corresponding to the source you would like to use.

12. Pump the system down if finished or proceed to substrate loading below. Press the “START PC PUMP” button located at the right center of screen.
Substrate Loading

1. With the system vented and the deposition screen selected, press the “SUBSTRATE SHUTTER” button located at the top left of the screen.
2. Remove the substrate access panel above the substrate holder and shutter.
3. Remove the 4” substrate fixture by pushing it out from the shutter side.
4. Load your substrate into the fixture and replace the substrate access panel.
5. Pump down the chamber. Press the “START PC PUMP” button located at the right center of screen.

DC and RF Deposition

1. Verify that both the targets and substrate have been loaded and the system is at least 5 x 10^-5 Torr.
2. Select the “VACUUM” page at the top left of the screen.
3. Turn on the “PC HIGH VAC THROTTLE” valve near the center of the screen. See Figure 1.
4. Select the “PLATEN MOTION” screen at the top right.
5. Start platen rotation by pressing the “FWD” button under “DRIVE MOTOR CONTINUOUS”.
6. Select the “GAS” page from the top center (roughly) of the screen.
7. Start argon flow. Argon flow may be controlled via constant flow rate or via constant pressure. For most applications constant pressure is the preferred method of gas introduction.
   a. To set Ar flow subject to a target pressure:
      i. Open the source valve for gas flow, for example “SOURCE 1 GAS” for sputtering off of source 1
      ii. Enter 4 in the mode window of MFC1
      iii. Enter a target pressure in mTorr in the widow below “CAPMAN PRESSURE SP” in the upper left of the screen. Argon flow should begin and the pressure displayed in “CAPMAN PRESSURE” should approach the set point.
   b. To set Ar flow for constant flow:
      i. Open the source valve for gas flow, e.g. “SOURCE 1 GAS” for sputtering off of Source 1
      ii. Enter a target flow rate in the box below “SETPOINT SCCM” for MFC 1 in the lower left of the screen.
8. Return to the deposition window. Press the “DEPOSITION” button at the top left of the screen.

9. Start the deposition. In the Power Supply section of the deposition window the user can choose “POWER SUPPLY 1” or “POWER SUPPLY 2” for RF or “POWER SUPPLY 3” for DC depositions. Typically DC sputtering is used for conductive materials and RF is used to deposit dielectrics.

   a. RF Deposition – “POWER SUPPLY 1” is used for source 1 and source 3, while “POWER SUPPLY 2” is used for source 2. Using independent supplies allows the user to perform co-depositions of two materials at the same time. Co-depositions are not covered in this SOP. For purposes of this document we assume the user has loaded a target into either source 1 or 3.

      i. In the row corresponding to “POWER SUPPLY 1” select the desired target by pressing the button above the source number, e.g. “SOURCE SW1 (SRC 1)” for source 1

      ii. Set the target power in Watts by clicking in the box adjacent to the Power Supply 1 ON/OFF button. If a ceramic or other dielectric target is used it is wise to start the plasma at some low power, e.g. 50 W, then slowly ramp the power up to avoid cracking the target due to thermal expansion.

      iii. Turn on the power. Click on the ON/OFF button next to “POWER SUPPLY 1” label near the center of the screen. Verify that the plasma is lit by looking in the vacuum chamber window. Note the reflected power in the box labeled “RFL POWER W” in the row corresponding to the power supply being used. Caution: If the reflected power is above 10% of the set point, stop the deposition as this can damage the power supply and there is likely a problem with the sputter cathode.

      iv. Set ramp rate for reaching the final power (optional). Enter a ramp rate in the box below the label “RAMP RATE U/S” found in the “POWER SUPPLY 1” row. Typical values are 0.5 to 0.15.

      v. Set the final power (optional). Enter the final value for the power in Watts by clicking in the box adjacent to the Power Supply 1 ON/OFF button. The set point should slowly rise to the set point value.

      vi. Note the plasma electrical properties. After the power has reached the set point and plasma is lit, note the reflected power (number below “RFL POWER W”) and the DC bias (number below “DC BIAS V” at the right side of the screen) associated with the plasma in the displays at the center right of the screen. If the reflected power is above 10% of the set point, there may be a problem. The DC bias is an indicator of the plasma’s impedance, the energy of arriving Argon ions and is a useful diagnostic for the
deposition.

vii. Open the substrate shutter. Press the “SUBSTRATE SHUTTER” button at the top left of the deposition screen.

viii. Open the source shutter. Press the “SOURCE SHUTTER #” button associated with the source at the top left of the screen.

ix. Begin timing the deposition.

x. Turn off plasma. Turn off the plasma by pressing the Power Supply 1 ON/OFF button.

xi. Vent the system. Press the “START PC VENT” button. This will close all shutters, turn off the gas flow, and switch off all power supplies before actually venting.

xii. After unloading the substrate pump the system back down and leave it at vacuum.

b. DC Deposition

i. Select the source number corresponding to the desired target by pressing the button above the source number, e.g. “SOURCE SW3 (SRC 1)” for source 1.

ii. Set the target power in Watts by clicking in the box adjacent to the Power Supply 3 ON/OFF button.

iii. Turn on the power. Click on the ON/OFF button next to “POWER SUPPLY 3” label near the center of the screen. Verify that the plasma is lit by looking in the vacuum chamber window and note the voltage and current associated with the plasma in the displays at the center right of the screen. This current and voltage is an indicator of the plasma’s impedance and is a useful diagnostic for the deposition.

iv. Open the substrate shutter. Press the “SUBSTRATE SHUTTER” button at the top left of the deposition screen.

v. Open the source shutter. Press the “SOURCE SHUTTER #” button associated with the source at the top left of the screen.

vi. Begin timing the deposition.

vii. Stop deposition. Close the source shutter and turn off the plasma. Turn off the plasma by pressing the Power Supply 3 ON/OFF button.

viii. Vent the system. Press the “START PC VENT” button. This will close all shutters, turn off the gas flow, and switch off all power supplies before actually venting.

ix. After unloading the substrate pump the system back down and leave it at vacuum.