 <p style="text-align: center;"><b>Center for Functional Nanomaterials</b> Brookhaven National Laboratory</p>	<b>NUMBER</b>
	<b>REVISION</b>  1.1
<b>Subject: Kurt Lesker PVD-75 Sputterer -- operating procedure</b>	<b>DATE 3/5/2013</b>
	<b>PAGE 1 OF 5</b>

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**1. Important reminders before you get started:**

- a. This document is not a substitute for system training. No one should use the instrument without proper training and authorization from Aaron Stein.
- b. Remember to work safe.
- c. Do not attempt to make any changes to any other systems or touch the tool in any way unless authorized to do so by a CFN Staff member.

**2. Tool booking rules**

- a. We will use the Google Calendar for sign-ups.
- b. At this time, there are no limitations on how often and how long your session can be.

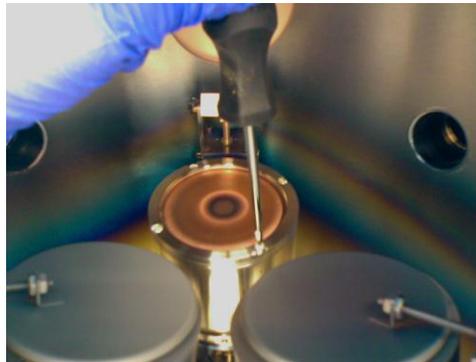
**3. Loading sample(s)**

- a. If you ever need to start the software, the user name and password are both "user".
- b. You should find the machine under vacuum. Hit "Start PC Vent" to vent the machine ("PC" stands for "process chamber"). It will take ~10+ minutes to vent.
- c. To remove the sample platen, first open the sample shutter. You can do this on the "deposition" tab on the software display.
- d. An Allen key is on a hook on the machine which can be used to loosen the screws on the platen.
- e. Samples can be mounted anywhere on the holder with clips or tape (Kapton tape only). Feel free to move the clips as necessary. An Allen key that works with these screws is located on the side of the system. Return the wrench to its box when you are finished.
- f. Be mindful that the shutter does not cover the entire platen – keep samples as close to the center as possible.
- g. Once samples are mounted, check to make sure that they are secure and won't fall off when the platen is upside down.

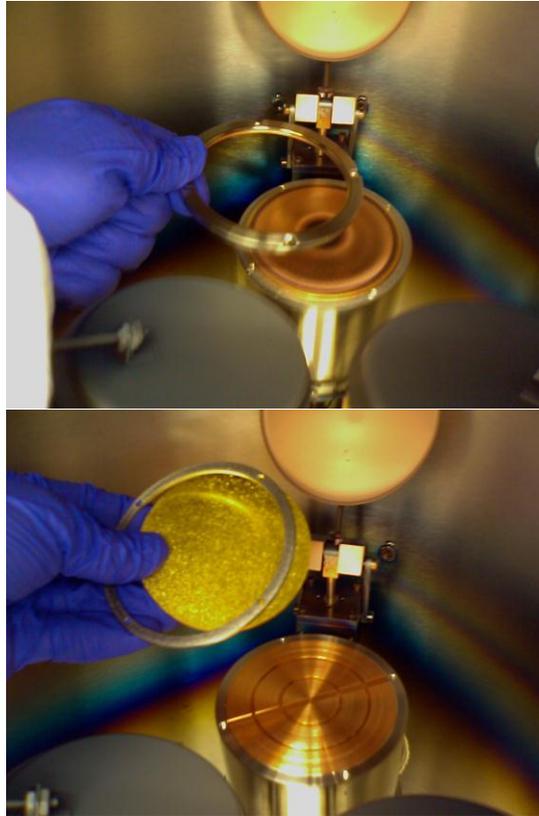
- h. If you are satisfied that the samples are mounted securely, place the platen back in place and screw tight with the Allen wrench. Do not overtighten.
  - i. Check the sample shutter for correct operation. Leave it closed.
4. Loading sputter target
- a. If necessary and if you are authorized, change or refill the materials you want to evaporate. Otherwise, have a staff member (Aaron, Don, Gwen or Fernando) do it for you.
    - i. Please note that precious metal targets (i.e. gold, silver, platinum) are stored in a safe. You must ask a staff member to get these for you.
  - b. There is a material list in the back of the log book for the sputterer which shows the current materials in each position. Be sure to write the new arrangement down if you make any changes to the materials in the chamber.
  - c. Go to Deposition Page
  - d. Hit source shutter button for the sputter target you wish to replace.
  - e. Hand loosen the three screws located around the base of the source cover.



- f. Remove cover by sliding it up.
- g. Remove the four screws around the target retainer ring (flat head).



- h. Remove retainer ring, metal ring, and metal target. Place removed metal target in appropriate storage container.



- i. Place new metal target in place.
  - j. Different targets have different thicknesses
    - i. if there is a large gap between the sputter gun and the ring, you can add “spacer” rings.
    - ii. These rings serve to prevent plasma forming on the sides of the target and sputtering at the sides.
    - iii. The whole space does not need to be filled.
  - k. Screw down top ring with four screws.
  - l. Replace the cover.
    - i. There should be a gap between the target and the cover.
    - ii. There is a copper gasket which should fit between the target and the cover.
    - iii. There are three different height positions available. Choose the correct height to ensure this gap.
    - iv. Also – make sure there are no metal flakes causing a short between the cover and the target. If there is a short, you will not be able to sputter.
  - m. When you are done loading the target(s), hit source shutter # to close shutter.
  - n. Change the target for the correct position in the software and the log book.
- 5. Chamber inspection and pump down**
- a. It is important that you can see through the window during deposition. Make sure the mylar window is transparent (and be aware that more metal will be deposited on the window during your deposition).

- b. If a new mylar window liner is needed, change it by cutting an appropriately sized piece from the roll on the table.
  - c. Always assume the old window has some toxic metal (e.g. chromium) deposited on it and treat the mylar as hazardous waste. Place in the satellite accumulation area under the table (white can).
  - d. Inspect sealing surface and chamber door O-ring for pieces or lint, thread, etc. Call a staff member if you see any problem. It is best practice to wipe the O-ring with a wipe before pumping down.
  - e. In addition, the chamber must be kept clean – if there are many flakes of metal in the chamber vacuum them out with the vacuum cleaner.
  - f. Inspect thickness monitor for cleanliness. If too many flakes are around crystal, please inform a staff member.
  - g. One last thing is to check the life on the crystals in the monitors to make sure that they are sufficient.
    - i. Open the sigma software and check the lifetime on the crystals you will use.
    - ii. If it is above 80%, you are good to go.
    - iii. If any of the crystals you need to use are below 80%, you should probably change it.
    - iv. If you do not know how to change the crystal, or are uncomfortable doing so, ask a staff member to show you/do it for you.
  - h. Now you are ready to pump the chamber. Press “Start PC Pump”.
  - i. The entire pumping process is automated. If after ~15 min the chamber is not in the  $10^{-4}$  Torr range or better, there might be a problem. Please inform a staff member. It will take less than an hour to get into the mid  $10^{-6}$  Torr range and will get into the  $10^{-7}$  Torr range after a couple of hours. Overnight pumpdowns should be well into the low  $10^{-7}$  range.
- 6. Sputtering**
- a. Reduce turbo pump speed to approximately 50%.
    - i. It will take about 30 minutes for the turbo pump to reduce speed
    - ii. Click on number to change percentage
  - b. If you want to use the crystal monitor, you may. Please note that the best way to measure sputtering thicknesses is to determine a rate for a given power and then use time instead of the monitor – this is much more accurate. The sputtering rates should be very consistent once you establish them.
    - i. Open up the Sigma software and load the settings for the metal you will deposit.
      1. File>OPEN and find the metal.
      2. Then you must hit VIEW>Setup and then OK in the window that pops up.
      3. Make sure the numbers have changed.
      4. Please note that the tooling factors have been calibrated, but may not be entirely accurate. You may want to calibrate the thickness if you are concerned about deposition accuracy.
  - c. Go to Deposition Page. Hit the Source switch if necessary. If your target is in source 2 or source 3 you will have to select the appropriate source switch

- d. Set appropriate Power source to desired wattage
    - i. Remember for Source 1 would set the wattage for Power Source 1 and for Sources 2 & 3 you use Power Source 2
  - e. Flow the argon gas:
    - i. go to Gas Page
    - ii. Set Capman Pressure SP to desired pressure setpoint, typically 5mT
    - iii. Set MFC1 to mode 4. This sets the computer to regulate the pressure of the injected gas so that the chamber pressure is maintained at the desired Capman Pressure setpoint
    - iv. Once the turbo pump has reached a 50% speed hit the Gas Inject button
    - v. Allow the pressure to stabilize in the chamber
  - f. Under the Deposition page, hit Power Supply "ON." You should see a plasma on the metal target source
  - g. Open the Source shutter
  - h. Adjust wattage to reach desired deposition rate
  - i. Open substrate shutter and start timer (or zero crystal monitor).
  - j. Close Substrate shutter once desired thickness is reached
  - k. Turn off Power Supply (#) and close Source Shutter. Stop the gas flow.
- 7. Unloading Sample**
- a. To vent the system, simply hit "PC Vent" in the software. This will vent the chamber and make sure the system is in a proper state. It will take a few min to vent the chamber after a sputter.
  - b. After venting, remove the platen and your sample. Put the platen back into the chamber when you are done and pump the chamber back down.
  - c. Be sure to mark the log book with your name, proposal number, material(s) deposited, chamber pressure, power and deposition rate as well as the total material deposited.
  - d. Make sure you are leaving the workbench clean and all tools clean and in order.