**PVD Instructions**

BioMEMS Laboratory Cleanroom

Department of Biomedical Engineering at Rutgers University

­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Things to know prior to start:**

\*Chamber should be under vacuum, with turbo and roughing pumps OFF, when not in use

\* White text in the display interface represents user input dialog (activate by pressing on it)

\* Green text in the display interface represents current machine operating values (not adjustable)

\* Always check which metals are currently loaded (displayed on sputter door) and select accordingly

\* Typical exposure time for Titanium: 8 minutes @ 200 W (power)

\*Typical exposure time for platinum: 10 minutes @ 200 W (power)

\* Typical exposure time for gold: 10 minutes @ 200 W (power)

\* Typical exposure time for Aluminum: 8 minutes @ 200 W (power)

**DO NOT USE NICKEL TARGET IN PVD 75!!!! We do not have the correct sputtering cathodes to use it!**

**Check the thickness of each target before sputtering. If the target is not more than a millimeter thick in the sputter ring, DO NOT USE IT! It will sputter through the cathode of the gun and cause a water leak into the chamber. We have a micrometer to check this!!!!**

**NOTE: Times are liable to change once we get profilometer readings**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Step by Step Procedures:**

1. Turn on Recirculating Chiller (temperature should be ~20 degree C)
2. Open the Air valve on the wall behind the machine (far left valve)
3. Login to computer as Admin if necessary, Start “Cware” software
	1. If you receive an initialization error (red bar), exit and restart program.
	2. Password is Admin.
4. Press “Start PC Vent”
	1. *This allow the air in the room to pressurize the chamber*
	2. *You can open the chamber door once the “PC Vent process Complete” screen appears*
5. Take out platen and load substrate onto it with photo-tape
	1. *Make sure the substrate is facing downward*
	2. *Tape two opposing corners of the substrate to provide a good hold*
	3. *Wafers make ‘tape rolls’ and apply to back*
	4. *Ensure all substrates are secured*
	5. *Final air blow to remove any last minute dust particles*
6. Place platen back into the chamber
7. Close chamber door and press “Start PC pump”
8. Push on the door to avoid error messages
	1. *Machines sometimes senses air leak and will stop operation*
	2. *You can stop pushing after the pressure on the indicator starts to change*
9. Wait by the machine until the “speed%” indicator reaches “95%” and 5 x 10^-5 Torr
10. At this point, the “Filament” box would turn green (on). TURN OFF the filament by press on the OFF button.
	1. *The filament ion gauge should always be OFF except when checking for pressure less than ~1x10^-5 Torr*
	2. *The filament ion gauge is NEVER to be turned on when the chamber is at higher pressures*
11. Then wait until the pressure gets down to ~1x10^-5 Torr & “Pumping complete” screen is on
	1. Often times, the screen won’t come on automatically (due to incorrect reading of pressure), so at ~10^-5 or you’ve waited for >10 mins, turn on the filament momentarily
12. Once the filament is turned off, wait for the pressure to research between 1x10^-6 and 5\*10^-7 Torr
	1. *This usually takes at least 4 hours*
	2. *During the wait, periodically check the screen for error messages, they occasionally appear as a certain level of pressure has been reached and you need to press the “ok” button for the machine to further pressurize the chamber*
	3. *The pressure reading displayed at the bottom of the screen isn’t accurate when operating under low pressure (~1x10^-5 Torr ) to check the true pressure, but remember to turn it OFF right after!*
13. Once the vacuum pressure is reached, go to “vacuum” tab and set “PC Pfeiffer turbo pump speed SP” to 50% by pressing on it
14. Wait until it spins down to 80% or less before further action. This will lengthen the lifetime of the machine.
15. Then open the argon valve (or other necessary gases) on the wall behind the machine (Ar is far Right)
16. On the screen, select “Deposition Tab”, set Velocity Setpoint to 10 RPM and start platen motion (may be next step).
17. Select “Motion” tab turn on motor (platen motion on) and select FWD (should visually be able to see rotations).
18. On the screen, press the “Gas” tab to set the appropriate gas flow, PRESS on the gas valve cartoon ON the screen to open gas
	1. *The mass flow controller for argon is MFC1 and set it to 100 sccm.*
19. Wait until the turbo pump reaches 50% and the pressure is stabilized
	1. *DO NOT TURN ON FILAMENT because the pressure is too high now*
20. Once the pressure is stabilized, on the screen, press “Deposition” tab to set power settings for the sputtering gun
	1. *Set Power Setpoint to 200 W.*
21. Now to turn on the sputter gun:
	1. *Know the source number for your metal of interest (e.g. #1 is titanium, #2 is gold, etc.)*
	2. *(If depositing 1 metal) Press the appropriate “****source switch****” -> press on the appropriate* ***“power switch”*** *-> wait for 30 seconds (When the machine is working, there should be readings on the current.)-> Press on the appropriate* ***“shutter”*** *for \_\_\_\_mins (depend on specification listed above) ->after it is done, press* ***“shutter”*** *first to turn off -> then* ***“power” -****> then* ***“source switch”****.*
	3. *(If depositing 2 metals)Simply repeat part b with the correct source switch, power, and shutter number and depositing time*
22. Close the gas switch on screen (under “gas” tab)
23. Shut off argon valve on the wall behind machine
24. Leave the air valve on
25. Stop platen motion by :
	1. Press “Stop All Motor” tap (in red)
	2. Uncheck the FWD motor tab
	3. Uncheck platen motor’s “on” tab
26. Wait 5 minutes
	1. *To let the process gas get sucked out of the chamber*
27. Press on “PC vent”
28. Once the dialog window shows that the “PC vent” process is complete, then open the chamber door to remove platen
29. Place platen back into the machine
30. Set the Turbo pump speed back to 100 using screen tab
31. Start PC Pump and press on the chamber door
	1. *Stop pushing on the door once the pressure value starts to change*
32. Wait for the Filament to turn on automatically, then turn it off immediately after it turns on
33. This process is complete once the dialog window shows “PC pump” complete message
34. TURN OFF THESE COMPONENTS in order: press on Turbo pump, valve, roughing pump
35. Shut off all the gas valves on the wall behind machine
36. Turn off Recirculating pump
37. Cross your fingers

Changing the targets:

1. If the machine is not running, turn on the chiller and open the air on the wall.
2. Log into CWare using admin, password admin, press enter twice.
3. Wait for the screen to come up to full mode, it will probably show a partial screen with vacuum errors on it. Once the program becomes full screen, the error message should go away. If it doesn’t, get one of the senior grad students to assist with troubleshooting.
4. On the Deposition tab, press the source shutter of interest to open the shutter
5. Using your fingers, loosen, but do not remove the top screws holding the dark space shield in place.
6. Remove the dark space shield from the sputtering cathode, place on the side or in front of the open chamber.
7. Using the smallest diameter Allen wrench, loosen the screws on top of the target holding ring ring. When they are partially loosened, you should be able to twist the ring clockwise and remove it without removing the screws.
8. Take off the target and place it back in its correct holding box on top of the PVD.
9. Place the new target in the center of the sputtering cathode.
10. Check to ensure the correct number of spacing rings is in place. There should be one thin ring for spacing for the 0.125” thick targets such as Au, Pt, but no rings are needed for the thick targets such as Al, Ti.
11. Replace the target holding ring and tighten screws in a cross pattern – farthest 1-2 turns, closest 1-2 turns, left side 1-2 turns, right side 1-2 turns. Continue tightening evenly until all screws are tight, but not impossible to loosen. You don’t want to break either the screws or the Allen wrench.
12. Replace the dark space shield and make sure the first notch (shallowest one) is the one which is touching the screw. We’ve had issues with the cathodes appearing to be shorted out when other notches are used.
13. Tighten the screws holding the dark space shields in place by turning them clockwise.
14. Press the source shutter again to close the cathode.
15. Close the door and press PC pump to vacuum down the chamber.
16. Follow instructions for using sputtering as above.

­­­­­­­­­­­­­­­­­­­