

University of Minnesota Nano Fabrication Center

Standard Operating Procedure

Equipment Name: PE2400 DC sputterer

Badger Name: K3 Sputterer 2400
PE

Revision 3
Number: Kevin Roberts

Location: Keller Bay 3

Date: 3/27/2020

1 Description

The sputtering system is used to deposit Aluminum, Platinum or Titanium films onto substrates. This occurs when high voltage is passed into the vacuum chamber and ionizes the Argon gas within. These positively charged Argon atoms strike the metal target at the top of the chamber and the “newly freed” metal particle deposit on the substrate resting below.

2 Safety

- a Keep the area clear between the chamber and the cover when the user is closing the system.

3 Restrictions/Requirements

- a Must be a qualified user on DC Sputter System.
- b Wafers must be clean with no organic material on them.
- c Fill out the logbook

4 Required Facilities

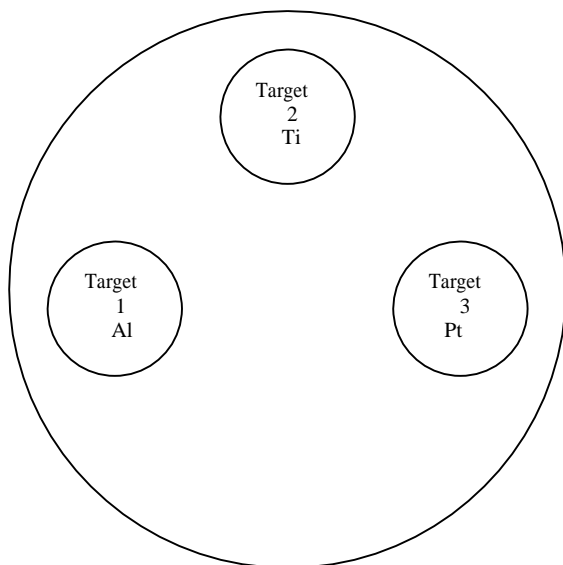
- a Process chilled water

5 Definitions

- a gph. Gallons per Hour
- b sccm. Standard Cubic Centimeters per Minute
- c mT. Milli Torr, measures pressure

6 Setup

- a To vent the system, use the Microsoft mouse to select **VENT** to bring the chamber up to atmosphere for sample loading. This will take approximately five minutes. When atmosphere has been reached, select the **OK** message box that appears.



Target Type and Location

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- b Visually check the targets prior to loading your substrates into the system. The targets should look clean with out any discoloration. Please notify the Process and/or Maintenance staff member if this has occurred and do not continue processing.

7 Operating Instructions

Loading samples into the chamber

- a Press the **Hoist** switch to raise the cover on the chamber.
- b Make note of the table position prior to loading. The table is divided into four equal spaces numbered Position 1, 2, 3 and 4 on the corresponding dial located on the panel beneath the chamber.
- c Place your samples onto the rotation table inside the chamber and opposite of the desired target metal.
- d Route the power to the appropriate target using the **target selector switch** found on the top-right of the front panel.
- e Keeping the area clear between the cover and the chamber, use the **Hoist** switch to slowly lower the cover, keeping it centered over the bottom chamber until closed. The sensor, which also needs to be aligned, is on the left side of the chamber. The system will not pump down if the sensor is not aligned properly.

Pumping the System down

- a Click **PUMPDOWN** to reduce the chamber pressure. The system will automatically initiate the roughing cycle. When the pressure on the computerized roughing gauge reaches 80mT (about 5 minutes), the system will automatically initiate the Hi-Vacuum cycle and switch on the ion gauge controller (Granville Phillips black box). It will take roughly 2 hours to reach a sufficient base pressure of 2×10^{-6} Torr.
- b After a few minutes, a message box will appear indicating that the system is pumping down to a base pressure. Select **OK** in the message box.

Deposition

- a Start the cooling water by turning the handle on the right side of the chamber labeled H₂O. The gauge in the rear should read 85 - 90 gph.
- b Flip the **off** switch found on the lower front of the black Granville Phillips ion gauge.
- c Flip the **throttle** switch into the up position for power.
- d Push the **close** button, which isolates the cryopump from the chamber with the baffle. The **setpoint dial**, located next to the close button, should be set at 2.2. After waiting a few seconds for the throttle valve to close properly, make sure the Argon regulator counter (above the chamber) is set at 88. To turn on the Argon flow, flip up the **toggle** switch on the shutoff valve.
- g Increase the Argon flow by turning the **leak valve knob** until the counter reads. The pressure rise is displayed on the Piranha gauge and the argon flow is displayed on the flow meter digital readout. Standard pressure/flow ranges are 7-20 mT and 7- 10 sccm respectively. Adjust flow as desired.
- h Turn the key on the MDX power supply from **off** to **program**. This will cause the off button to flash so push the **off** button to confirm and you should hear a

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beep. If the beeping does not stop, check to be sure that the cooling water is flowing.

- i Set the ramp time by holding in the **ramp** button and moving the shuttle control. Set the **power level** in the same way. {Nominal: 2-minute ramp)

| Target | Maximum Power |
|--------|---------------|
| Pt | 500 watts |
| Al | 5 kwatts |
| Ti | 1000 watts |

- j Press the **on** button found on the MDX power supply to start the deposition cycle. The power supply will ramp up in the programmed time and stabilize when the power level is attained, causing the system to beep.
- k Look in the chamber window to see if a blue light exists; this is the Argon plasma and if you cannot see it, check to make sure the chamber pressure is in the 10^{-6} range. Or check the display on the power supply. Let the target warm up for five minutes after the power has reached the maximum power before actually depositing metal on your samples. Doing this will enhance your film quality.
- l If you are going to rotate the table during the deposition, flip the Table Rotation up. Deposition rates have been done at a set point of 80.
- k When the run is complete, press the **off** button on the MDX power supply.
- l Turn OFF the table rotation if needed.
- m If you are going to sputter deposit from another target within the same deposition,, follow steps h – l.

Shutdown

- a Turn the Argon **leak valve knob** back down to 88, which brings the chamber to original base pressure.
- b Close the shutoff valve to the Argon line by flipping down the **toggle switch**.
- c When the pressure reads 0 mT (gas pressure of zero), push the **open button** for the throttle valve.
- d Flip the Throttle Valve Power toggle switch DOWN (off).
- e Wait 15 minutes for the source and table to cool down and then **shut off** the cooling water.
- f Return the controller key to the **off** position on the MDX power supply.
- g Click **VENT** on the computer monitor to bring the chamber to atmosphere and wait roughly five minutes to click the **OK** message box.
- h Open the chamber cover using the **hoist switch**.
- i Remove your samples.
- j Keeping the area clear between the cover and the chamber, use the **Hoist** switch to slowly lower the cover, keeping it centered over the bottom chamber until closed. The sensor, which also needs to be aligned, is on the left side of the chamber. The system will not pump down if the sensor is not aligned properly.
- k Click **PUMPDOWN** to reduce the chamber pressure. The system will automatically initiate the roughing cycle. When the pressure on the computerized roughing gauge reaches 80mT (about 5 minutes), the system will automatically

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initiate the Hi-Vacuum cycle and switch on the ion gauge controller (Granville Phillips black box).

- b After a few minutes, a message box will appear indicating that the system is pumping down to a base pressure. Select **OK** in the message box.

8 Problems/Troubleshooting

- a While trying to pump down the system, it is possible that one of two error codes could appear on the display:

- 1 80 mT not reached in time
- 2 Leakcheck failure

If this happens select the OK message box and then click the PUMPDOWN button again and the system should return to normal. If the system still refuses to pumpdown or another error code appears on the screen, then abort your run and contact the Process personnel.

- b If a plasma is not visible, check the following:

- 1 The Throttle valve should be closed.
- 2 The chamber pressure is in the 10^{-6} range.
- 3 The check the display on the power supply, it should read the current power.