

ANELVA Sputtering Chamber

Operator's Manual

Doug Kim, 09/01/2005 Revised 05/15/2006

SAMPLE INSERT

- a. Initially, all the valves are closed and the mechanical pump is running
- b. Open the valve 2 to vent the chamber
- c. Gently lift the top part of the chamber. Do not force it. Middle section of the chamber is not hooked up with top or bottom, so be careful.
- d. Check the temperature of the heater and place the wafer on the setter wafer. The flat of the wafer should face 7 o'clock direction. (This direction can be changed as the geometry of sputtering gun and wafer position. So check the recent position on Anelva log-book.)
- e. Tighten the pins to secure the wafer.
- f. Before closing the chamber, check the marked position of shutter for pre-sputter (close) and target (open). Make sure that the shutter does not bump into the chamber while rotating.
- g. Make sure to close the valve 2.
- h. Press the chamber cover down firmly; use your hands to clamp it down in the backside of the cover. Open up the valve 5.
- i. You may see the smoke coming out of the exhaust of the mechanical pump. That's O.K.
- j. Turn on the cooling water (~ 20 gallons per hour when no bubbles in the water flow meter. Reading is higher when bubbles are present) to cool down the chamber and turbo pump.

TO EVACUTE THE CHAMBER FOR FILM DEPOSITION

- a. If the mechanical pump is already on, go to step e.
- b. Turn on the mechanical pump. There are two switches for the mechanical pump. One is on the front panel and the other is on the pump itself. When the mechanical pump is on and valve 5 is open, notice the pressure drop in the thermocouple gauge on the front

panel. The pressure should drop under 100 mTorr. If not, check the mechanical pump.

When the chamber is not used, every valve should be closed. Especially, rough valve (5) should be closed to prevent any pump oil mist from getting into the chamber.

- c. To evacuate the chamber, open valve 5 (Rough Valve). Notice the pressure change in the Baratron. When thermocouple gauge reads about 1,000 mTorr, the number in the Baratron will start to decrease.
- d. Turn on the cooling water. Flow rate should be about 20 gallons per hour. To prevent flooding of sink, make sure to clear off the sink anything, which might clog the drain.
- e. Wait until chamber pressure drops below approximately 300 mTorr on the Baratron and close valve 5 and open valve 4 (Foreline valve to the turbo pump). Wait about 2 minutes. The thermocouple gauge should read about 500 mTorr and start to decrease down to 300 mTorr.
- f. Turn on turbo pump by pressing 'start' button on the controller and open valve 3 (butterfly valve) slowly. Pump down about 1 hour minimum. Pressure will drop down to at least -0.4 mTorr on the Baratron. Also, check the accurate chamber pressure with ionization gauge (only under high vacuum). Turn on the ionization gauge button on MKS unit. No need to degas the gauge in this pressure region. Just make sure not to use it when oxygen is flowing because it will oxidize the filament.
- g. You can flush out the chamber with argon gas through the leak valve. Open the valve of a T-size argon tank (not the small one). Turn the leak valve counterclockwise two full turns and 24. The leak valve is very sensitive, so be careful not to introduce too much argon. Argon flush is intended to shake off any adsorbents from the chamber wall so that high vacuum can be achieved much quickly. Close the leak valve. Do not tighten the valve. Repeat this step one more time.
- h. To flush out the chamber, turn on the valves of two gas tanks (Ar & O₂). Open the valve
 1. Turn on two solenoid valves and also turn on the mass flow controller. Turn the knob on the mass flow controller of each channel (channel 1 & 2) to 30. At this point, the flow rate for O₂ and Ar gas is 16 and 24 sccm respectively. Two mass flow meters are

calibrated to flow 50 sccm with oxygen at 100 percent capacity. Wait for about 10 minutes and change the set point of channels to Ar 12.5 and O₂ 18.8 for 10 sccm for each gas. When the butterfly valve is fully open, the chamber pressure will be around 3.4 mTorr at the beginning. The chamber pressure will be dwindling down slowly as time goes by (about 2.9 mTorr after 2 hours). Adjust the position of butterfly valve to achieve desired chamber pressure.

- i. Make sure the shutter is in the pre-sputter (close) position and turn on the radio-frequency power supply. Toggle voltage switch up to increase voltage. Put the switch neutral when it reaches 2 kV. When voltage increases current and RF power simultaneously increases. To light the plasma, slowly close the valve 3 to increase gaseous species in the chamber. While the chamber pressure building up, keep an eye on the RF power. Plasma is lit when RF power suddenly drops. It usually happens when the chamber pressure reaches above 150 mTorr. You can see the bluish glow through the glass view port. Once you have plasma ignited, increase the voltage to the target value and open the butterfly valve 3. Adjust tuning knob to minimize the reflected power. Also, adjust impedance knob (smaller effect than tuning) too.
- j. Before using the variac for the substrate heater, make sure the heater and variac power are on. Adjust the variac's power to the targeted substrate temperature. Upon opening the shutter position to the deposition, it may heat up a little bit by sputtering. When you ramp the substrate temperature more than 400 °C, it is necessary to cool off the middle section of chamber with damp paper towels not to damage the o-ring seals.
- k. Start film deposition by turning the shutter position to the target and start the timer for deposition time. Log all the variables such as time, voltage, current, incident power, reflected power, chamber pressure, substrate temperature and variac power. During initial half an hour, all the variables will be stabilized and later be oscillating a little bit.
- l. To finish film deposition, close the shutter and slowly decrease voltage. Plasma will disappear around 0.5 kV. Also, decrease the variac power to the substrate heater. Wait for

a minute or two for RF power to stabilize and turn off its power. (DO NOT turn off AC main switch. It always stays on.) Decrease the variac power all the way to zero and turn it off.

- m. Now close the butterfly valve 3. Wait until chamber builds the pressure up to 300 mTorr (intended to leave the film in Ar/O₂ atmosphere during cooling) and close the valve 1 (gas inlet to the chamber). In order not to build up too much pressure for solenoid valves, quickly close two solenoid valves and also turn off mass flow controller. Don't forget to close the valves for gas tanks.
- n. Wait until the substrate temperature cools down to 150 °C and turn off turbo pump by pressing the stop button on the controller. Wait until it stops (it takes about 15 minutes) then close the valve 4 and turn off the cooling water in 30 minutes.

TO VENT,

- a. Make sure all other valves are closed and open valve 2.
- b. Lift the chamber cover slowly and take out the sample.
- c. Close the chamber cover back and open up the valve 5. Squeeze the back of the chamber firmly to ensure the pumping. When the chamber pressure reached below 300 mTorr, close the valve 5.