Chapter 6.8

Gartek – Superconducting Materials Sputtering

(gartek - 582)

1.0 Title
gartek – Superconducting Materials Sputtering

2.0 Purpose
The gartek system sputters Nb and Al from targets with shaped, rotating backing magnets. The system also contains a sputter etch for improving film adhesion to substrate material.

3.0 Scope
System contains two sputter targets – Nb and Al. These are driven by DC power supplies. The load/lock chamber also has RF sputter etch capability. Argon gas flows into the chamber and is ignited into plasma by relevant power supplies.

4.0 Applicable Documents

5.0 Definitions & Process Terminology
5.1 Sputter: A process in which gases in the chamber are ionized and driven into a target by an electromagnetic field. Ion collision with the target surface releases ions of the target material into the plasma which then deposit onto surfaces via line of sight to their ejection point.

5.2 Target: An 8” diameter high purity disc of material used as a source for PVD deposition material.

5.3 DC power Supply: Sources power for Nb and Al targets during sputtering.

5.4 RF Power Supply: Sources power for RF sputter etch.

5.5 Roughing Pump: Mechanical Pump used to take system from atmosphere to crossover pressure.

5.6 Turbo Pump: Turbine based turbo molecular pump used to obtain high vacuum in Load/Lock.

5.7 Cryo Pump: Cryogenic gas trap used to obtain high vacuum in sputter chamber.

5.8 Load/Lock: Chamber which vents to atmosphere during normal operation for the purpose of loading and unloading substrates.

5.9 Door Valve: Separating valves between load/lock, sputter chamber, and XPS chamber. Maintains high vacuum in sputter chamber during substrate loading steps.

5.10 Ion Gauge: Gauge used to measure high vacuum pressure. Controller known to read as unstable during first 30 minutes of vacuum pump down.

5.11 Shuttle: Carrier arm to transport substrates from load/lock to chamber.

5.12 Gas Controller:
6.0 Safety

6.1 Shuttle Movement

6.1.1 Always drop all tables before moving a shuttle with a wafer on it! Failing to do so will damage the shuttle arm.

6.2 Reflected Power

6.2.1 If reflected power increases beyond 15W during sputter etch, load a dummy and try again. If problem persists report a problem on Mercury.

7.0 Statistical/Process Data

None available at this time.

8.0 Available Processes, Gases, Process Notes

8.1 Nb Sputtering

8.1.1 High purity Niobium sputtering is available. The process is designed to deposit Nb layers suitable for superconducting devices.

8.1.2 Process recipe is: 4mT Ar, 1.8kW (set for 2.8 on power supply).

8.1.3 Deposition Rate: ~20 Å/sec

8.2 Al Sputtering

8.2.1 High purity aluminum sputtering is available. The process is designed to deposit Al layers above Nb without breaking vacuum.

8.2.2 Process recipe is: 4mT Ar, 0.1kW.

8.2.3 Deposition Rate: To Be Determined.

8.3 Sputter Etch

8.3.1 Sputter Etch is available. Process operates at 100W RF. Pressure control unavailable.

8.3.2 Etch Rate: To be Determined.

9.0 Equipment Operation

9.1 Setup

9.1.1 Close vacuum valve on vacuum oven to right of system.

9.1.2 Check base pressure of system.

9.1.3 Enable gartek on Mercury.

9.2 Vent & Load

9.2.1 Close left Door Valve. Wait 20+ seconds.

9.2.2 Ensure Entry Table is up.

9.2.3 Turn off L/L Ion Gauge

9.2.4 Close the Hi Vac Valve. Wait 15 seconds to ensure valve is closed.

9.2.5 Ensure Rough Valve is closed. Wait 15 seconds to ensure valve is closed.

9.2.6 Open the Vent N2 valve and allow L/L to come to atmosphere.

9.2.7 Put on Clear Poly Gloves
9.2.8 Open L/L cover and remove wafer shuttle.
9.2.9 Turn off Vent N2.
9.2.10 Unscrew lid of wafer holder, load wafer, and screw wafer holder lid down.
9.2.11 Wipe L/L cover O-ring off with technicloth.
9.2.12 Close L/L cover, close Vent N2.
9.2.13 Open Rough Valve.
9.2.14 When pressure reaches 25 mTorr, close Rough Valve.
9.2.15 Open Hi Vac Valve.
9.2.16 Turn on L/L Ion Gauge.
9.2.17 Pump for 1+ hours.

9.3 Sputter Etch
9.3.1 Turn off Ion Gauge.
9.3.2 Turn on L/L PC Ar.
9.3.3 Turn on L/L Ar.
9.3.4 Turn on RF Etch. Note Reflected Power.
9.3.5 Etch for desired time.
9.3.6 Turn off RF Etch.
9.3.7 Turn off L/L Ar.
9.3.8 Turn off L/L PC Ar.
9.3.9 Turn on Ion Gauge.

9.4 Wafer Transfer Procedure – L/L to Table 1 (Niobium)
9.4.1 Note pressure in Left Load Lock.
9.4.2 Open left Door Valve. Wait 20+secs to see pressure fluctuation on L/L Ion Gauge to make sure door valve is open.
9.4.3 Ensure Table 1 and Table 2 are in the down position and the right Door Valve is open.
9.4.4 Hold Shuttle Left until shuttle moves all the way to the left.
9.4.5 Move the Entry Table down. Confirm it drops with flag. Wafer is now on Shuttle.
9.4.6 Hold Shuttle Right until shuttle moves all the way to the right.
9.4.7 Move Table 1 up. Wafer is now on Table 1 in the up position.
9.4.8 Close the left Door Valve.
9.4.9 Toggle Shuttle Left once. Shuttle should move halfway between targets.
9.4.10 Lower Table 1 down. Confirm it drops with flag. Wafer is now on Table 1 in the down position.
9.4.11 Close the right Door Valve. Write down pressure (note the small rise).
9.5 **Wafer Transfer Procedure – Table 1 to Table 2 (Aluminum)**

9.5.1 Complete **Wafer Transfer Procedure – L/L to Table 1**. This procedure should begin with the wafer on **Table 1** in the down position.

9.5.2 Open left **Door Valve**. Wait 20+secs to see pressure fluctuation on L/L Ion Gauge to make sure door valve is open.

9.5.3 Open right **Door Valve**. Wait 20+secs to see pressure fluctuation on L/L Ion Gauge to make sure door valve is open.

9.5.4 Move **Table 1** to the up position and ensure **Table 2** is in the down position.

9.5.5 Hold **Shuttle Left** until shuttle moves all the way to the left.

9.5.6 Move **Table 1** down. Confirm it drops with flag. *Wafer is now on Shuttle.*

9.5.7 Hold **Shuttle Right** until shuttle moves all the way to the right.

9.5.8 Move **Table 2** up. *Wafer is now on Table 2 in the up position.*

9.5.9 Close the left **Door Valve**.

9.5.10 Toggle **Shuttle Left** once. Shuttle should move halfway between targets.

9.5.11 Lower **Table 2** down. Confirm it drops with flag. *Wafer is now on Table 2 in the down position.*

9.5.12 Close the right **Door Valve**. Write down pressure (note the small rise).

9.6 **Sputter Procedure (Target 1)**

9.6.1 Complete **Wafer Transfer Procedure – L/L to Table 1**.

9.6.2 Turn off the chamber **Ion Gauge**.

9.6.3 Turn on **Target 1 Gas** and **LL/PC AR**. Write down the process pressures.

9.6.4 Turn on the Cooling Water by pressing the **green power button** on the Cooling Unit in the service chase.

9.6.5 Set **DC Pwr Switch** to Nb.

9.6.6 Check the **power setting dial** is at 2.8 for Nb. (Real power delivery = 1.8kW)

9.6.7 Set a timer with sputter duration.

9.6.8 Turn on **Target 1**.

9.6.9 Sputter Nb for selected duration.

9.6.10 Turn off **Target 1**.

9.6.11 Turn off **Target 1 Gas** and **LL/PC AR Gas**.

9.6.12 Turn the chamber **Ion Gauge** On.

9.7 **Sputter Procedure (Target 2)**

9.7.1 Complete **Wafer Transfer Procedure – Table 1 to Table 2**.

9.7.2 Turn off the chamber **Ion Gauge**.

9.7.3 Turn on **Target 2 Gas** and **LL/PC AR**. Write down the process pressures.

9.7.4 Turn on the Cooling Water by pressing the **green power button** on the Cooling Unit in the service chase.

9.7.5 Set **DC Pwr Switch** to Al.
9.7.6 Check the power setting dial is at 0.1 for Al.
9.7.7 Set a timer with sputter duration.
9.7.8 Turn on Target 2.
9.7.9 Sputter Nb for selected duration.
9.7.10 Turn off Target 2.
9.7.11 Turn off Target 2 Gas and LL/PC AR Gas.
9.7.12 Turn the chamber Ion Gauge On.

9.8 Wafer Transfer Procedure – Table 2 to Table 1
9.8.1 This procedure should begin with the wafer on Table 2 in the down position.
9.8.2 Open left Door Valve. Wait 20+secs to see pressure fluctuation on L/L Ion Gauge to make sure door valve is open.
9.8.3 Open right Door Valve. Wait 20+secs to see pressure fluctuation on L/L Ion Gauge to make sure door valve is open.
9.8.4 Move Table 2 to the up position and ensure Table 1 is in the down position.
9.8.5 Hold Shuttle Right until shuttle moves all the way to the right.
9.8.6 Move Table 2 down. Confirm it drops with flag. Wafer is now on Shuttle.
9.8.7 Hold Shuttle Left until shuttle moves all the way to the left.
9.8.8 Move Table 1 up. Wafer is now on Table 1 in the up position.
9.8.9 Hold Shuttle Right until shuttle moves all the way to the right.
9.8.10 Close the left Door Valve.
9.8.11 Toggle Shuttle Left once. Shuttle should move halfway between targets.
9.8.12 Lower Table 1 down. Confirm it drops with flag. Wafer is now on Table 1 in the down position.

9.9 Wafer Transfer Procedure – Table 1 to L/L
9.9.1 Open the right Door Valve.
9.9.2 Move Table 1 up. Wafer is now on Table 1 in the up position.
9.9.3 Open the left Door Valve.
9.9.4 Hold Shuttle Right until shuttle moves all the way to the right.
9.9.5 Lower Table 1 down. Confirm it drops with flag. Wafer is now on Shuttle.
9.9.6 Hold Shuttle Left until shuttle moves all the way to the left.
9.9.7 Move the Entry Table up. Wafer is now in Left L/L in the up position.
9.9.8 Hold Shuttle Right until shuttle moves all the way to the right.
9.9.9 Close the left Door Valve.

9.10 Vent & Unload
9.10.1 Close left Door Valve. Wait 20+ seconds.
9.10.2 Ensure Entry Table is up.
9.10.3 Turn off L/L Ion Gauge.
9.10.4 Close the Hi Vac Valve. Wait 15 seconds to ensure valve is closed.
9.10.5 Ensure Rough Valve is closed. Wait 15 seconds to ensure valve is closed.
9.10.6 Open the Vent N2 valve and allow L/L to come to atmosphere.
9.10.7 Put on Clear Poly Gloves
9.10.8 Open L/L cover and remove wafer shuttle.
9.10.9 Turn off Vent N2.
9.10.10 Unscrew lid of wafer holder, unload wafer, and screw wafer holder lid down.
9.10.11 Wipe L/L cover O-ring off with technicloth.
9.10.12 Close L/L cover, close Vent N2.
9.10.13 Open Rough Valve.
9.10.14 When pressure reaches 25 mTorr, close Rough Valve.
9.10.15 Open Hi Vac Valve.
9.10.16 Turn on L/L Ion Gauge.
9.10.17 Turn off the Cooling Water by pressing the red power button on the Cooling Unit in the service chase.
9.10.18 Disable gartek on Mercury.

10.0 Troubleshooting Guidelines

10.1 Shuttle Sticking

10.1.1 Cause: If the shuttle makes contact with a door valve it will get stuck. Additionally, in rare cases the shuttle may stop responding when moving to the right.

10.1.2 Solution: Hold toggle switch to move shuttle in the desired direction and use hand to assist the shuttle mechanism the first few inches. This should free the shuttle.
11.0 Figures & Schematics