

# Denton Discovery-550 Vacuum Sputtering System Users Manual

## Semi-Automatic Operation



**Coral name:** Sputter 1  
**Model:** Discovery 550  
**Location:** CNST NanoFab, Building 215, Room B104  
**Contact:** nanofab\_metaldep@nist.gov  
**Version:** 1.0

## Overview

- In its present configuration, this sputtering system is equipped with four (3-inch diameter) targets, also known as cathodes. Two metal targets for DC sputtering, located at the back of the machine, are labeled 1 and 2; two dielectric (or metal) targets for RF sputtering, located at the front, are labeled 3 and 4.

Cathode #	Location	Type	Material
1	Back left	DC	Metal
2	Back right	DC	Metal
3	Front right	RF	Any
4	Front left	RF	Any

- Two gases are available: Gas #1 is Ar and Gas #2 is O<sub>2</sub>. Ar is the primary gas used to sputter atoms from the targets and O<sub>2</sub> is used for reactive sputtering to adjust stoichiometry of oxides if needed.

Gas #	Gas	MFC range (sccm)
1	Argon	100
2	Oxygen	200

- The color code in all the screens is the following:  
Green: ON or Satisfied  
Red: OFF or Not Satisfied

## Special Notes and Restrictions

- You must be qualified by a NanoFab staff to use this tool
- Introduction of materials other than Si, SiO<sub>2</sub> or SiN<sub>x</sub> into the chamber needs authorization from NanoFab staff
- Sputtering of materials other than those posted on the tool needs authorization from NanoFab staff
- All eleven interlock indicators on the Overview screen should be green once you log in to Coral to enable the tool. If not, notify NanoFab staff member. Do not proceed any further with the machine.

## Step-by-Step Instructions

Refer to the following four figures showing the four screens needed to do a run:

Fig. 1 **Overview** (starting screen; accessed by closing the Auto Control screen)

Fig. 2 **Auto Control** (accessed from Overview)

Fig. 3 **Pre-deposition Configuration** (accessed from Auto Control)

Fig. 4 **Deposition Configuration** (accessed from Auto Control)

### 1. Vent Chamber

- In **Overview** (Fig. 1), press the Auto tab of System Control (at top left) to put the system in Auto mode. The Auto tab turns from red to green.
- Press the light blue Auto Control tab (at bottom right)  
The screen changes to the **Auto Control** screen (Fig. 2)
- Press Auto Vent (at left). The tab turns from red to green and shows “running”. It will take ~2 minutes for the system to reach atmosphere. The FR1 gauge (bottom left of screen) will then read ~600-700 Torr

### 2. Load Wafer

- Open door
- Remove substrate holder from chuck and place it on clean room wipe on table
- Place wafer on substrate holder. Secure wafer with two small pieces of Kapton tape to prevent it from slipping
- Put holder back in chamber
- Close door
- Press Auto pump (left tab, Fig. 2). The tab goes from red to green and shows “running”. NOTE: It will take ~12 minutes to reach 1E-5T.
- Press the Predeposition tab (light blue at right)

### 3. Set Pre-Deposition Configuration (refer to Fig. 3)

- Process Start: 3.0E-6 Torr. Press the square tab, enter number on keypad, press Enter. This is the maximum pressure in Torr at which the sputtering process will be allowed to start.
- Heat: the wafer can be pre-heated using infra-red lamps
  - Toggle between “Selected” and “Not Selected”. If selected,
  - Enter heat set point in °C
  - Enter heat soak time in seconds

- Gas 1 setpoint: enter Ar flow in sccm (typically 50sccm)
- Gas 2 setpoint: enter O<sub>2</sub> flow in sccm if needed. If not, enter 0.
- Etch. Toggle between “Selected” and “Not Selected”. Select this feature to sputter-etch the wafer prior to deposition (for the removal of native oxide for instance). If selected,
  - Etch set point: typically 50W
  - Etch time: typically 30 seconds
- Press “Close” (bottom left)
- Press the Deposition tab (light blue at right)

#### 4. Set Deposition Configuration (refer to Fig. 4)

##### For RF sputtering select the following

- cathode: toggle between 3 and 4 in the red band
- pre-sputter: use to sputter-clean the target prior to opening the shutter
  - RF supply: typ. 300W
  - **DC supply: 0**
  - RF bias: typ. 0
  - Pre-sputter time: typ. 60 seconds
- Sputter
  - RF supply: typ. 300W
  - **DC supply: 0**
  - RF bias : typ. 0
  - Sputter time: enter desired time in seconds

##### For DC sputtering: select the following

- cathode: toggle between 1 and 2 in the blue band
- pre-sputter: use to sputter-clean the target prior to opening the shutter
  - **RF supply: 0**
  - DC supply: typ. 300W
  - RF bias: typ. 0
  - Pre-sputter time: typ. 60 seconds
- Sputter
  - **RF supply: 0**
  - DC supply: typ. 300W
  - RF bias : typ. 0
  - Sputter time: enter desired time in seconds

**NOTES:** It is possible to co-deposit materials from one DC target and one RF target if desired. Simply enter a non-zero value for both DC and RF supplies.

For either **RF** or **DC**, select the following:

Gas #1 set point: Argon flow in sccm

Gas #2 set point: Oxygen flow in sccm

Heat set point: substrate temperature in °C

Ignition pressure: typ. 90mT (pressure for plasma ignition)

When conditions are set, press “Close”. This brings up the Auto Control screen (Fig. 2).

## 5. Rotation

The rotation of the wafer stage is set in Manual mode. Switch from Auto to Manual in System Control. Press any one of the tabs on the right hand side. Set rotation to desired % value (100% corresponds to ~ 2 revolutions per second). Typically the rotation is set at 50%. Press Close. Return System control to Auto.

## 6. Auto Deposition (refer to Fig. 2)

Press “Auto Deposition” at top right.

Once the process start pressure is reached, the tab turns green and shows “Running”.

On the same screen, you can read various parameters of the automatic sputtering process: power, bias, gas flows, deposit time remaining, shutter position, chamber pressure (FR1 reads typ. 6mT).

When the deposition process is complete, the Auto Deposition tab turns from green to white.

## 6. Completion of process

When deposition is complete:

- Vent chamber as described in page 1
- Unload wafer
- Put substrate holder back in chamber
- Close door
- Press Autopump (left)
- Press Close (bottom right) to return to the Overview screen
- **Fill in logbook**

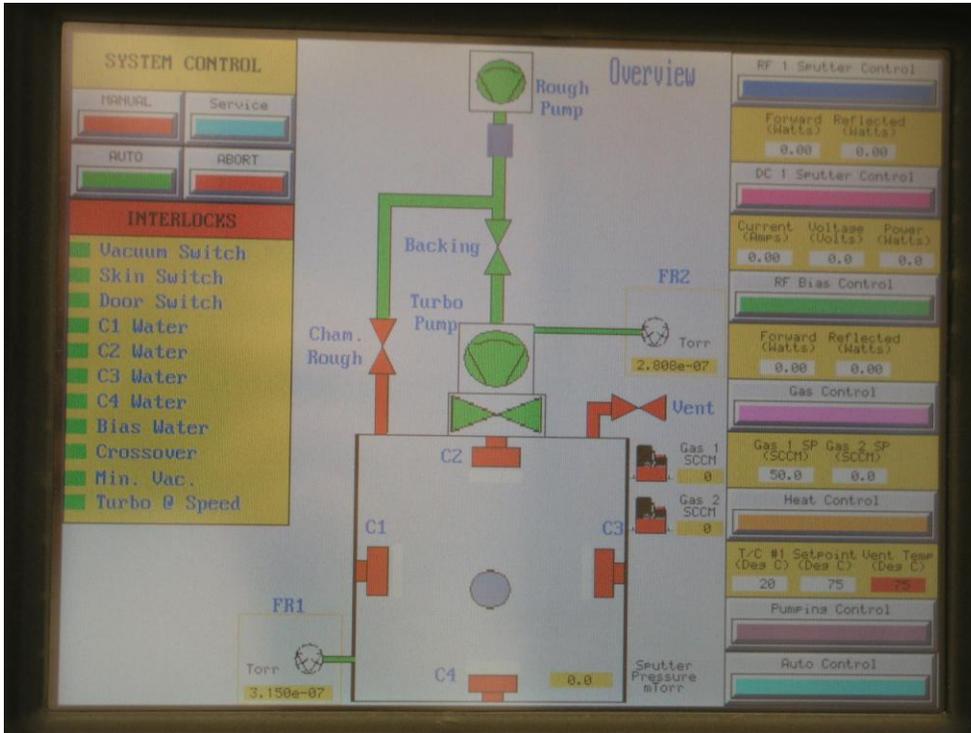


Figure 1 Overview screen

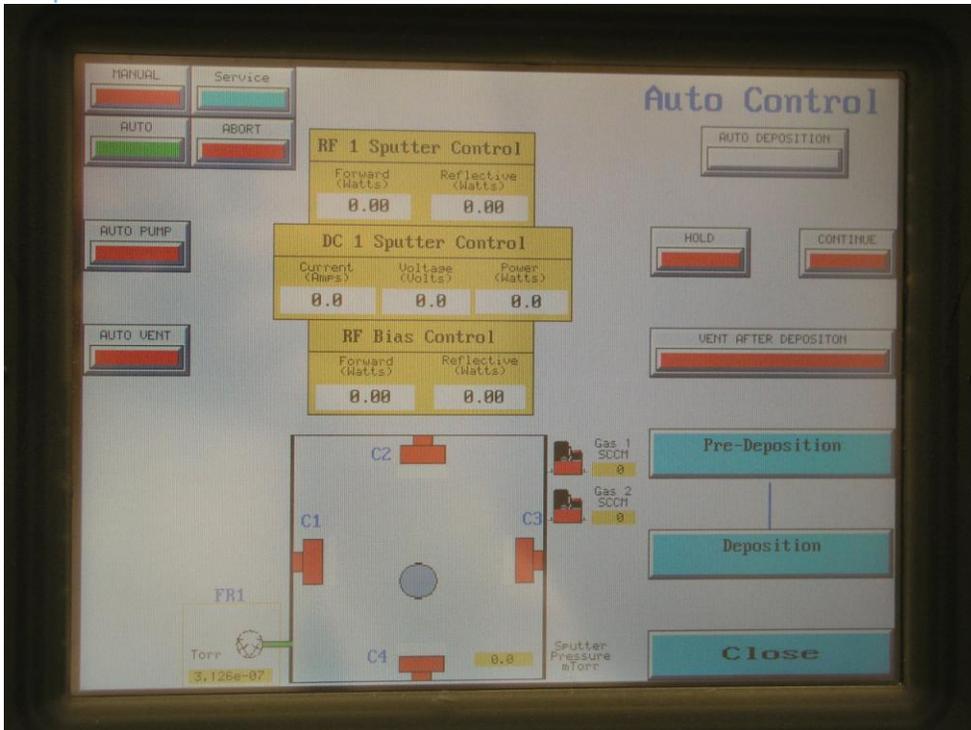


Figure 2 Auto Control screen

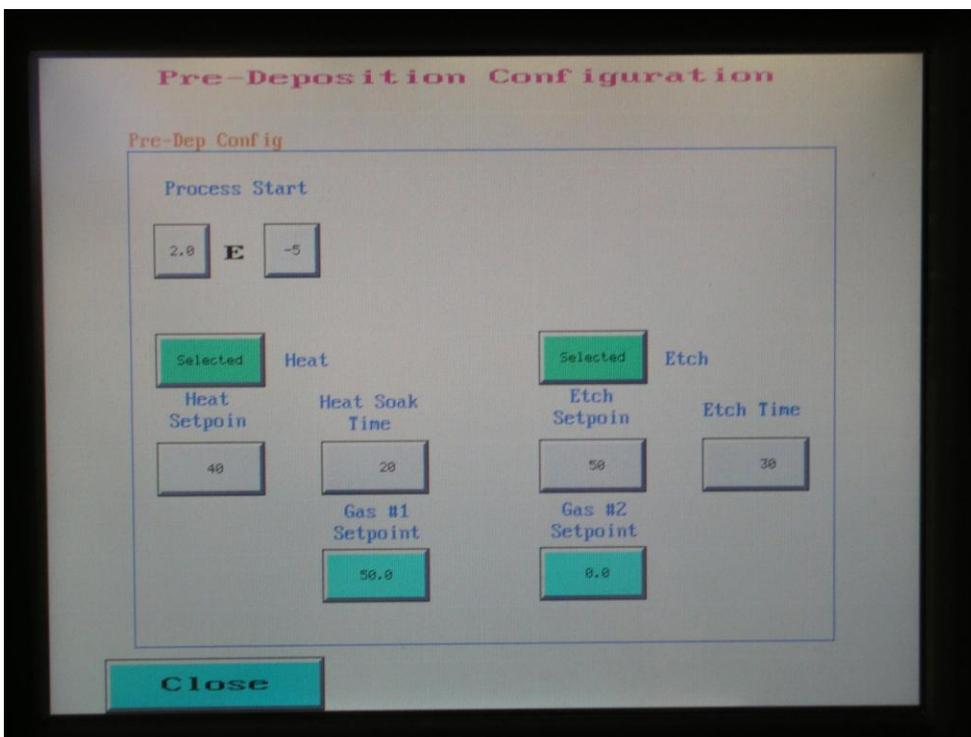


Figure 3 Pre Deposition Configuration screen

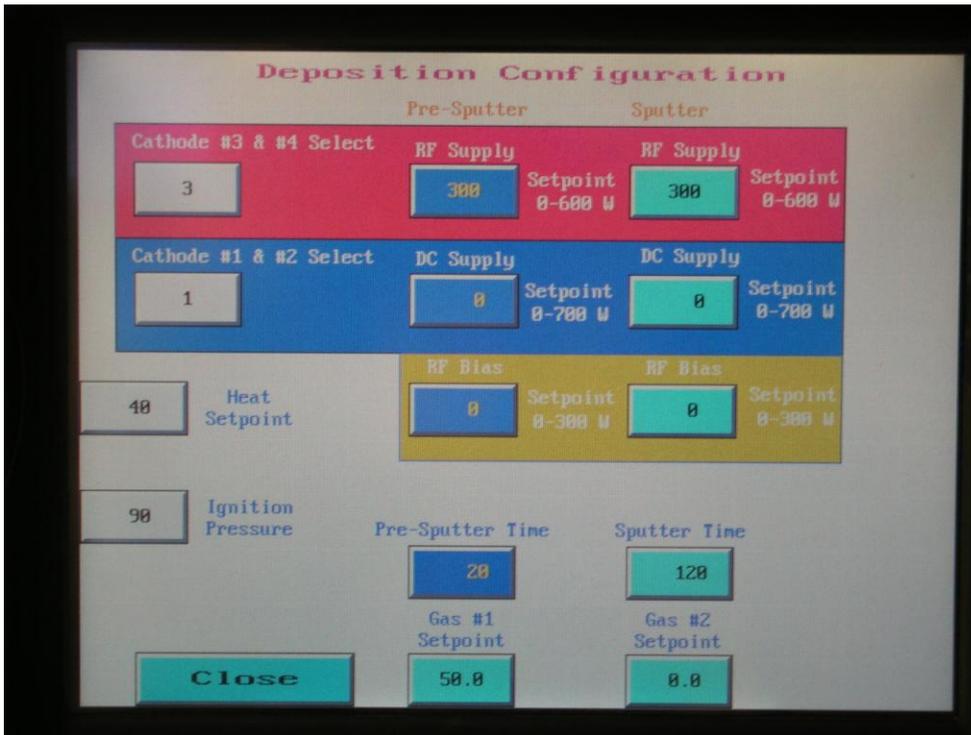


Figure 4 Deposition Configuration screen