

# GENERAL PROCESS AND OPERATION SPECIFICATION

## Nordson March CS-1701 RIE

### I. SCOPE

1. The purpose of this document is to describe the requirements and basic operating instructions for the March RIE. The March is a reactive ion etching (RIE) system for the dry etching of silicon, oxide, nitride, and photoresist.

### II. SAFETY

1. You must be trained and signed off to use this equipment.
2. Use carefully when operating around high voltage, RF energy, or hot temperatures.
3. High-pressure gas cylinders for this tool are stored in the service corridor. Ask a staff member for assistance in changing process gas.
4. When the chamber is open, do not touch the platen (low electrode) of the chamber or the gas showerhead (top electrode).
5. Beware of residual process gases when opening the chamber. Do not skip the purge step. This tool does not automatically purge its chamber like other tools.
6. If you are unsure about any procedure or indication while operating this equipment, contact a staff member or trainer for assistance.

### III. APPLICABLE DOCUMENTS, MATERIALS AND REQUIREMENTS

1. For more information on the tool and its processes, AggieFab staff can provide an equipment manual upon request.
2. This tool is configured to run with Ar, O<sub>2</sub>, and CF<sub>4</sub>. Nitrogen is only used to vent the chamber.
3. Gases are stored in the service corridor but are available via manual controls by the tool.

## IV. OPERATION

1. Load sample:
  - A. The tool should be at atmosphere with nothing else running or on.
  - B. Open the chamber and center sample inside.
    - i. Samples must be smaller than 6" in diameter. Small pieces are acceptable.
    - ii. Use a small piece of single-sided kapton tape to mount your small samples onto a carrier wafer.
    - iii. Carrier wafer is 4-inch Si substrate covered by thick film of SiO<sub>2</sub> or Si<sub>3</sub>N<sub>4</sub>.
    - iv. No sharpie is allowed in the chamber. If you need to mark your samples, do it with a diamond scribe.
2. Pump down the process chamber:
  - A. To close the chamber, you must lift the lid vertically while closing it.
  - B. Make sure the lid is centered and settled down.
  - C. Press red "POWER" button on the March. (Note: March unit only functions as RF matching network, everything else is manually controlled)
  - D. Ensure the black AUTO/MAN switch is set to "Auto!" (up)
  - E. Turn on the pump and the roughing valve.
    - i. The pump is below the table. To turn it on, flip the black switch near the top.
    - ii. The roughing valve is on the left side of the tool. To open the valve, align the handle with the pipe.
  - F. Wait for the tool to reach base pressure which is about 8.00E-2 torr (~ 80 millitorr)
3. Process Setup:
  - A. Flow process gases:
    - i. Open any needed gas main valves to allow gas flow.
    - ii. Adjust the needle valves to achieve desired flow rate.
  - B. Set up RF power supply:
    - i. Flip the ON switch on the back of the RF power source.
    - ii. Set the power using the up and down buttons.
      - a. Do not go above 400W!
4. Double check everything is ready to go:
  - A. Ensure each part of the process is ready. (It may help to start at the vacuum pump and move **Checking Clockwise** every piece as you go)
    - i. The pump is on.
    - ii. The tool is on (The red "POWER" button is lit).
    - iii. Roughing valve is open.
    - iv. Vent valve is closed.
    - v. Chamber is closed properly.
    - vi. Pressure is acceptable.
      - a. The pressure does not have to be below base pressure since the process gases are already flowing.
    - vii. Every used gas on and flowing at the correct rate.
    - viii. RF power set correctly.

5. Run process:
  - A. Prepare a timer.
  - B. On the RF power source, press the “ON/OFF” button and start the timer at the same time.
    - i. Make sure the plasma is lit before continuing.
  - C. Wait for timer to expire.
  - D. Press the “ON/OFF” button on the ENI RF power generator to turn off the plasma.
  - E. Flip the switch to “OFF” on the back of the RF power supply. (This is a safety precaution)
  - F. Close all gas line main valves.
  - G. Let the system pump down to base pressure.
6. Purge the chamber: (This step is crucial! Gas byproducts can be dangerous)
  - A. Wait for the chamber to pump to the original base pressure.
  - B. Purge Chamber:
    - i. Open argon, set the flow rate to 50 sccm for 30 seconds.
    - ii. Close Argon.
    - iii. Wait until the pressure stabilizes at a lower pressure (lower than  $8.00E-2$  torr).
    - iv. Do another chamber purge (Go back to step 6.B.)
7. Remove sample and turn off tool:
  - A. Close roughing valve.
  - B. Press the red “POWER” button on the March to turn off it.
  - C. Turn off pump.
  - D. Open vent valve slowly.
  - E. Wait for the chamber to reach atmosphere. (This will happen quickly since the chamber is small)
  - F. Close vent valve and remove sample.
  - G. Close the chamber and leave it at atmosphere.
  - H. Double check everything is closed/turned off.

V. SIGNATURES AND REVISION HISTORY

Revision History:

Revision	Author	Date	Change
Original Issue	Elijah Colter	September 17 <sup>th</sup> , 2021	
Rev A	Elijah Colter	May 5 <sup>th</sup> , 2022	Added appendix A & B. Minor corrections to operation procedure
Rev B	Yaguang Lian	March 7 <sup>th</sup> , 2024	Updated appendix A. Minor corrections to operation procedure

Approvals:

Technical Manager Signature:     *Sandra G. Malhotra*    

Date:     May 3, 2024

## **Appendix A: Suggested Recipes**

Etch Material	Base Pressure (mTorr)	RF Power (W)	Process Pressure (mTorr)	Etch Rate (nm/min) *	Flow Rate (sccms)		
					CF4	O2	Ar
LTO SiO2	<80	200	160	~76	10	-	-
LPCVD Si3N4	<80	200	160	~154	10	-	-
Silicon	<80	200	160	~102	10	-	-
Photoresist	<80	200	160	~186	10	-	-

\*Etch rates are rough estimates

Notes:

1. “-” Denotes 0 sccms
2. Power can be lowered if desired, power and etch rate are approximately linearly related.
3. Short Etch times are recommended, due to the tool only having water cooling. Tool and substrates will both heat up during longer etch times. For longer etches, several repeated shorter steps are recommended. Same idea for temperature-sensitive substrates or films.