Lam490b

STANDARD OPERATING PROCEDURE

CORAL Name: *LAM490B*

Model Number: LAM490B

Location: ICL

What it does: Nitride, polysilicon and shallow silicon etch

Introduction: The Lam 490B is a 6" etcher designed to etch silicon nitride, silicon and polysilicon. There are two basic chemistries associated with this tool: SF_6 and oxygen (available 24 hours), and chlorine and helium (normal hours only). C_2F_6 is also available.

Safety: **CAUTION**: This tool uses Chlorine gas, which is very toxic. Do NOT open the gasbox or remove any machine covers under any circumstances!!!

NOTE: There is an EMO button to the right of the monitor to be used in case of emergency.

NOTE: Use the arrows (v, ^, >, <) to navigate the screen, and then push FIELD SELECT to toggle through the various choices.

If you have any etch/process problems please send e-mail to LAM490B@mtl.mit.edu

Procedure: NOTE: Use the "Engage Machine" command in CORAL. The CORAL switchbox should indicate "ON" in order to enable the SEND cassette elevator.

1. Select the proper recipe module. These modules are kept at the etcher. There is a poly recipe (end-pointed) and a nitride recipe (timed). The module labeled TECH is for the daily conditioning by the Technicians.
2. Plug the selected module into the module receptacle located on the lower left side of the control panel.
3. Press the LOAD button located to the right of the module receptacle. CAUTION: Use Extreme Care! DO NOT PRESS THE SAVE BUTTON!
4. Load 3 blank wafers into the SEND cassette. Blank wafers are kept in a box labeled 490B Dummies. If wafers are not available then contact the staff.
5. Place the SEND cassette with the wafers on the flat-finder. Orient all wafer flats in the upward position.
6. Place the SEND cassette on the send elevator located on the left side of the etcher.
7. Place the RECEIVE cassette on the receive elevator located on the right side of the etcher.
8. Press the START button located on the right side of the process control panel. This procedure seasons the chamber and ensures the system is in proper working order before etching your wafers.
9. After the dummy wafers have been etched, remove them from the RECEIVE cassette and return them to the wafer box labeled 490B Dummies.
10. Replace the RECEIVE cassette on the receive elevator
11. Load your process monitor into the SEND cassette and orient the flat in the upward position.
12. Place the SEND cassette on the send elevator. Press the START button. After this wafer is etched you should measure the underlying material to ensure that the process is working properly. A visual inspection should also be done.
13. If everything is okay, then load the remainder of your wafers into the SEND cassette. Orient the wafer flats in an upward position and press START.
14. Remove your wafers from the RECEIVE cassette when the process is complete. Replace the RECEIVE cassette on the receive elevator.

ALARMS

The etcher will alarm for the following malfunctions.

Low water flow
RF mismatch (high reflected RF power)
Gap spacing unstable
Wafer arm malfunction
Endpoint detection fail
Pump down fail

Please report any alarms by sending e-mailing to LAM490B@mtl.mit.edu

SYSTEM FUNCTIONS:

Status Page

This page is completely controlled by the computer.

Monitors gas flow in sccm
Gap spacing in cm
RF forward power in Watts
RF reflected power in Watts (must be stabilized within 20 seconds)
Movement of wafers (simulated)
Etch chamber pressure in Torr
Etcher temperature in degrees C (monitored in cooling water return)
Verification of set points
Manually stop step in recipe (if desired)
Viewing set points during processing

Recipe Page

The following variables are programmable.

Step #
Pressure
RF power
Gap
C2F6 Hexafluoroethane
O2 Oxygen
He Helium
Cl2 Chlorine
SF6 Sulfur Hexafluoride
Stability
Time + Endpoint
Recipe
Overetch
Time‹Max 00:00 Min:Sec
Copy‹Step #00 to #00

Parameter Page:

This page is used in conjunction with the Recipe page. There are 3 choices at the Parameter prompt: Machine, Endpoint, and LamLink.

Machine:
Resetting of alarms is from this page

Silencing Alarms
RF alarm reset

Endpoint:
Selection of the endpoint (etch finished)
Triggering of the endpoint
Time for delaying the endpoint start time
Time for normalizing the sampling of the endpoint reference
Setting of the channel for the endpoint detector

LamLink:

Primarily a page for a production environment.

Options Page

This page is primarily used by the staff to diagnose problems with the system and to reset it if a malfunction occurs. This page also monitors the read out of all the digital and analog inputs and outputs of the system. There is also a manual operation subset to this page that enables manual control of the system. This subset is restricted to staff use only. However, the operator can monitor the actual endpoint of the etch by looking at channel 12 or channel 13 (depending on the recipe used)

NOTE:
Remember to enter any details and comments in CORAL, and to "Disengage" the machine.

Recipes

This tool employs either Fluorine or Chlorine to etch nitride and Silicon. If the previous user has used the same etch species that you wish to use, than you should run one or two dummies to test the system mechanically. However, if you wish to change the etch species, then you must run several dummies (~ 20min of RF time) to ensure the chamber is conditioned properly. Dummy wafers are provided for your use.

It is imperative that you condition the chamber prior to doing work on real wafers. There are a finite number of ionized particles available in a given process to do the etching. The ratio between the volumes of the film and the photoresist (if any), effect the etch rate significantly. This phenomenon is generally referred to as the “loading effect.” Therefore, the quoted etch rate is an approximation and should be checked with your monitor. Ideally, your monitor should have the same photoresist pattern as the real wafers.

In general, you may have to adjust the time in Step 2 (main etch, max time) to suit your needs. For recipes with endpoints, calculate the expected time and add 25-50% extra to give the tool time to find the endpoint.

Anisotropic Poly or Si Etches:
Poly-EP: A Chlorine/Helium based recipe that uses an endpoint to stop on an oxide. Silicon etch rate is ~3300A/min with excellent selectivity to oxide. The photoresist etch rate is ~2000A/min.

Poly-Timed: The same recipe as above, but without the endpoint. A timed etch for backsides and shallow trench etches.

Anisotropic Nitride Etches:
Nitride-on-Si: A Sulfur Hexafluoride/Oxygen based recipe that uses an endpoint to stop on Silicon.

Silicon etch rate is ~1000A/min. The photoresist etch rate is ~200A/min. NOTE: This recipe can also be used as an isotropic Silicon etch. The etch rate remains the same.

Nitride-on-Ox: The same SF6/O2 recipe, but the endpoint parameters have been modified so as to stop on an oxide.

Miscellaneous Etches:
Black-Si: A timed etch with a high Chlorine content designed for stepper alignment marks. This etch greatly improves contrast for automatic alignment. The etch rate is ~1500A/min. Do not use for more than 3 minutes!

Deep-Si: The same chemistry as Poly-Timed, but the steps alternate between etching and Helium cool downs. NOTE: An oxide hard mask is required for deep etches.

BLACK-Si		ETCH RATE = 1500A/Min		9/3/03
	STABILIZATION	MAIN ETCH	PUMPOUT	END
	STEP 1	STEP 2	STEP 3	STEP 4
PRESSURE (mT)	200	200	0	
RF Power (W)	0	200	0	
Gap (cm)	0.5	0.5	0.5	
Helium (sccm)	30	30	0	
Chlorine (sccm)	150	150	0	
Comp	Stab or Time	Time	Time	Recipe
Max	30 sec	2min45sec	30 sec	

NITRIDE ON OXIDE RECIPE with ENDPOINT (EP)					**4/23/02**	
	STABILIZATION		MAIN ETCH	OVERETCH	PUMP OUT	END
	STEP 1		STEP 2	STEP 3	STEP 4	STEP 5
PRESSURE (mT)	300		300	300	10	
RF Power (W)	0		130	130	0	
Gap (cm)	1.25		1.25	1.25	1.25	
Oxygen (sccm)	19		19	19	19	
SF6 (sccm)	190		190	190	190	
Comp	Stab or Time		Time & EP	Time	Time	Recipe
Max	30 sec		6min	15sec	30sec	
			ETCH RATE ~ 1000A/min			
ENDPOINT PARAMETERS						
EP #		1				
Sampling Input		B				
Active During Step		2				

Delay Before Normalizing		20sec				
Normalize for		5sec				
Trigger at		90%				
of Normalized Value						

NITRIDE ON SILICON RECIPE with ENDPOINT (EP)				4/23/02		
	STABILIZATION		MAIN ETCH	OVERETCH	PUMP OUT	END
	STEP 1		STEP 2	STEP 3	STEP 4	STEP 5
PRESSURE (mT)	300		300	300	10	
RF Power (W)	0		130	130	0	
Gap (cm)	1.25		1.25	1.25	1.25	
Oxygen (sccm)	19		19	19	19	
SF6 (sccm)	190		190	190	190	
Comp	Stab or Time		Time & EP	Time	Time	Recipe
Max	30 sec		6min	15sec	30sec	
			ETCH RATE ~ 1000A/min			
ENDPOINT PARAMETERS						
EP #		1				
Sampling Input		B				
Active During Step		2				
Delay Before Normalizing		20sec				
Normalize for		5sec				
Trigger at		120%				
of Normalized Value						

POLYSILICON RECIPE with ENDPOINT (EP)			ETCH RATE = 3800A/min = 63A/sec		4/23/02	
	STABILIZATION		MAIN ETCH	OVERETCH	PUMP OUT	END
	STEP 1		STEP 2	STEP 3	STEP 4	STEP 5
PRESSURE (mT)	400		400	500	10	
RF Power (W)	0		200	100	0	
Gap (cm)	0.5		0.5	0.5	0.5	
Helium (sccm)	134		134	134	134	
Chlorine (sccm)	96		96	96	96	
Comp	Stab or Time		Time & EP	Overetch	Time	Recipe
Max	30 sec		1min30sec	50% of EP	30sec	
ENDPOINT PARAMETERS						
EP #		1				
Sampling Input		B				
Active During Step		2				

Delay Before Normalizing		20sec				
Normalize for		5sec				
Trigger at		103%				
of Normalized Value						

TIMED POLY or SI RECIPE (5000A)		ETCH RATE = 3800A/min = 63A/sec			4/23/02
	STABILIZATION	MAIN ETCH	OVERETCH	PUMP OUT	END
	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
PRESSURE (mT)	400	400	500	10	
RF Power (W)	0	200	100	0	
Gap (cm)	0.5	0.5	0.5	0.5	
Helium (sccm)	134	134	134	134	
Chlorine (sccm)	96	96	96	96	
Comp	Stab or Time	Time	Overetch	Time	Recipe
Max	30 sec	1min30sec	45 sec	30sec	

Author:R. Bicchieri, 2/03, rev. 9/03