1. Description

The deep trench etcher etches vertical trenches in silicon wafers

2. Safety

Watch fingers around the load-lock lid when pumping down the system.

3. Restrictions/requirements

a. Must be a qualified user on deep trench etcher

b. The etcher is for SILICON etching ONLY. Do NOT etch anything else except silicon

c. The etcher is for 4-inch wafers or smaller size substrates. Smaller substrates need to be bonded onto a 4-inch wafer.

d. Wafers should not have any chips or nicks. The backside of the wafer must be clean.

e. Do not leave the etcher for more than 30 minutes at a time during a run. The user MUST check the status of the recipe at least once every 15 minutes to verify there are no alarms. This is not required when running a clean.

f. Do NOT use the Deep Trench Etcher to thin your wafers.

g. Approved masking materials:

i. Oxide – thermal or PECVD

ii. Positive photoresists e.g. S1800, Futurrex or AZ series resists

iii. Nitride (LPCVD or PECVD)

iv. Other: staff approval required

h. Masking material not allowed:

i. METAL Masks – Absolutely NO METAL MASKS are allowed in the system

ii. SU-8 Masks

All metals or SU-8 resident on the wafer side to be etched must be covered with sufficient photoresist to last throughout the length of the etch.
i. A wafer needs to be loaded for all runs. If running a clean or warm-up, use one of the dummy wafers located in wafer box by the machine.

j. If doing a through wafer etch, the wafer being etched needs to be bonded to another (carrier) wafer prior to breaking through the silicon. This is intended to protect the chuck. A thick oxide or other film deposited on the back of the wafer can be used instead of bonding as long as the film does not etch through as well. See staff if you have any questions.

k. Enable/disable with each use in BADGER

4. Required facilities
   a. Compressed air 80-90 psi
   b. Process water
   c. Nitrogen gas
   d. Electrical 208/240 VAC
   e. House exhaust

5. Definitions

6. Setup
   a. Choose recipe to run:
      i. **Warmup.bch:** It will run for approximately 20 minutes then unload automatically. A warm up batch needs to be run if the system has not been used in at least 4 hours. This will condition the process chamber prior to etching.
      ii. **Bosch.bch:** This is the standard silicon etching recipe
      iii. **Clean.bch:** It will run for approximately 60 minutes then unload automatically. This recipe runs oxygen clean on the system. It should be run after the system has been vented or when it has been heavily used. Staff will typically run the recipe as needed.
      iv. **Other recipes:** Other recipes with different parameters can be run with staff approval. Remember that the DRIE is used to etch silicon only

7. Operating instructions
   a. Enable the Deep Trench Etcher in **BADGER**.
   b. Below is an image of what the screen should look like when you enable the tool in badger. You will already be logged in as an operator in the software.
c. In a (rare) situation that log in is required, follow the steps outline below:
1. Click the **User Login** button at the top of the screen. The Log In/Out dialog box appears.

2. The user account that was previously logged in is selected by default. To select a different account, click the name in the Users box; the selected user name appears highlighted. In the Password box, type the user’s password, and then click **Log In**.

![Log In/Out dialog box]

*To log in, select a user (A), type the account password (B), and click **Log In** (C).*

d. Select Operator and type **1234** in the password box then click on **log in** or press **ENTER**
e. Select and click on **VENT LOCK** to vent the load-lock. It takes a couple of minutes to vent the load-lock. The load-lock lid will crack open slightly when it reaches atmosphere (~ 730 - 760Torr). You can view the status bar at the top to keep track of the load-lock pressure and see when venting is complete.
f. Load wafer onto the robot arm making sure the flat is aligned with the flat of the arm

g. Select a recipe to run in the recipes window, and then click on the **START JOB** tab on the left side of the screen to start the recipe while still pressing down on the load-lock lid. A window pops up requesting to confirm the recipe (see image below). Click on **START JOB** to confirm and run the recipe.
h. The system will pump the loadlock down, move the wafer to the **PROCESS** chamber, run through the gas stabilization, plasma lighting and the etching steps. When the process is aborted or it completes its allotted time, the wafer is moved back to the loadlock and loadlock vents so that the wafer can be unloaded.

i. In the standard **BOSCH PROCESS** there are three main steps that define the etch process. **STEP 4** (polymer deposition), **STEP 5** (ETCH A) and **STEP 6** (ETCH B). A loop comprises the three steps occurring sequentially. Up to 999 loops can be defined in a recipe. Users can choose to control the etch duration using either the number of loops or making use of a timer.
j. To stop the etch process; press the NEXT STEP button situated on the left side of the screen, when you get to STEP 6. You will have to closely watch the end of the step 6-time and click on the next step key to extinguish the plasma and move to the venting (or whichever other step comes next). You can also use the ABORT JOB key, and then confirm by clicking on ABORT PROCESS AND CONTINUE FLOW option to ensure your wafer is returned to the load-lock. Process does not halt, nor does plasma extinguish until you click on this key.
k. The wafer will now be transferred to the loadlock and the loadlock will vent to atmosphere. Keep track of the load-lock pressure on the Status bar on the top. The wafer can then be retrieved.

l. There are some non-standard recipes available in the Deep Trench Etcher, that do not operate with loops (like CNF-14V). Such recipes can be aborted when desired since there are no steps. To abort these recipes, use the same approach as in (j) above.

m. If you have no more wafers to run, click on **PUMP LOCK** to pump down the load-lock

n. Disable the Deep Trench Etcher in **BADGER**.

8. **Problems/troubleshooting**

a. Helium out of compliance
   
   i. Silence the alarm by clicking on the **ALARM** (bottom right of screen) then **SILENCE ALARM** button.
   
   ii. Abort the process (See below).
Active Alarms

- Time: 2017/09/11 09:49:43.169
- Severity: Warning
- Description: Pressure is out of compliance. Setpoint = 20.0 ± 5.0, Actual = 3.7.

- If restart fails, abort the process here.

- Silence the alarm

- Try this first, after the alarm