

University of MN, Minnesota Nano Center

Standard Operating Procedure

Equipment Name: Deep Trench Etcher

Badger Name: deeptrench

Revision Number: 8

Model: SLR -770

Revisionists: Paul Kimani

Location: Bay 3

Date: 14 October 2015

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.

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- 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. If the screen saver is on when you first approach the system, touch any button on the keyboard or move the mouse to activate the system.

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- c. The Operator login window should now be in the middle of the screen. In the Operator box, type **nfc** and press TAB. In the password box enter **1234** and click **OK** or press **ENTER** on the keyboard.
- d. The system monitor window will now appear on the screen. Click on the **PROCESS** pull-down menu, select and click on **BATCH**. The **BATCH EDITOR** window will now appear.
- e. Click on the **FILE** pull-down menu on the **BATCH EDITOR** window and select and click on **LOAD**. The **LOAD BATCH FILE** window will come up.
- f. Select the batch you want to run (see recipe list) and click on it. Click the **OK** button or press **ENTER** on the keyboard to load the program
- g. Move the mouse pointer to the **FILE** pull-down menu on the **BATCH EDITOR** window. Select and click on **EXIT**. The loaded batch will now appear in the **BATCH** box on the System Monitor window on the bottom right of the screen.
- h. Move the mouse pointer to the **UTILITIES** pull-down menu. Select **LOADLOCK** and click on it, then select and click on **VENT** to vent the loadlock. It takes a couple of minutes to vent the loadlock. On the screen, the left chamber will turn from white to red. The pressure indicator will change from reading **VACUUM** to **ATMOSPHERE** when the system is vented. The loadlock lid will pop up when it reaches atmosphere.
- i. Load wafer onto the robot arm making sure the flat is aligned with the flat of the arm
- j. Press the **READY** button on the bottom of the system monitor window. When the system has met all initial parameter requirements, the entire **READY** button will turn yellow. Once the system is in the **READY** mode, click on the **RUN** button to start the recipe while still pressing down on the loadlock lid. The system will pump the loadlock down, move the wafer to the **PROCESS** chamber, run through the gas stabilization, plasma lighting and the etching process. When the process is aborted or completes its allotted time, the wafer moves back to the loadlock and loadlock vents so that the wafer can be unloaded.
- k. In the standard **BOSCH PROCESS** there are three main steps that define the etch process. **STEP 4** (polymer deposition), **STEP 5** (breaking of polymer on trench bottom) and **STEP 6** (silicon etch). 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

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either the number of loops or making use of a timer. To stop the etch process; press the **ABORT** button situated at the bottom of the screen when in **STEP 6**. *Do not abort the process at any other step.* The plasma will extinguish after **STEP 6** is completed. A window will pop up asking whether or not to **ABORT THE PROCESS**.

Click on **YES** to abort the process. The process is now terminated. Another window will pop up asking whether to **ABORT THE BATCH**. Click on **NO!**

Clicking yes will cause your wafer to be retained in the process chamber. The chamber will then pump down, the wafer will be transferred to the loadlock and the loadlock will vent to atmosphere. The wafer can now be removed

- l. There are some non-standard recipes available in the Deep Trench Etcher, that do not have loops. Such recipes can be aborted when desired since there are no steps. However, you still need to click on **NO** when the query **ABORT THE BATCH** comes up.
- m. If you have no more wafers to run, pump down the loadlock by moving the mouse pointer to the **UTILITIES** pull-down menu, clicking and selecting **LOADLOCK**. Then select and click on **PUMP**. It takes a couple of minutes to pump down the loadlock. On the screen, the left chamber window will change from a red to a white color.
- n. After the loadlock is pumped down, click on the **STANDBY** button. The button will turn yellow when the system is finally in standby mode. Move the mouse pointer to **UTILITIES**, click and select **LOG OUT** to log out of the system.
- o. Disable the Deep Trench Etcher in **BADGER**

8. Problems/troubleshooting

- a. Helium out of compliance
 - i. Silence the alarm by clicking on the **ALARM SILENCE** button.
 - ii. Abort the process.

Use attached lighting and check through the window for the following:

- Wafer is still on the chuck: Do not abort the batch. **Click on NO** to let the machine unload normally

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- Wafer is not on the chuck: **Click YES** to abort the batch to leave wafer in the process chamber. Contact a staff member to let them know what happened and to help retrieve your sample.