# Oxford DRIE

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These instructions are for 3-step Bosch processing on Silicon wafer using normal chiller processing temperatures. The DRIE is also capable of cryogenic temperatures, but their use is less common.

It is strongly recommended to complete some outside reading of DRIE processing to get a general understanding of the basics. It will really help with recipe development and tuning!

**Wafer Preparation**

*No Metal is allowed in the DRIE processing chamber. This includes buried layers of metal even if they would not be exposed during the etch process.*

1. Your Silicon wafer will need a masking layer before going into the DRIE. This can be an oxide, a nitride, a patterned photoresist, or a combination of those.
2. Early tests with masking layers have not shown much difference in selectivity between SiO2 and photoresist. Both are usually providing around 50:1 selectivity.
3. It is strongly advised that if you are using photoresist for a masking layer that you perform an extra step to remove photoresist from the outer edge of the wafer (~2-3mm). This is to ensure that the clamping mechanism inside the DRIE does not stick to the wafer and cause it to get lost in the chamber and break.

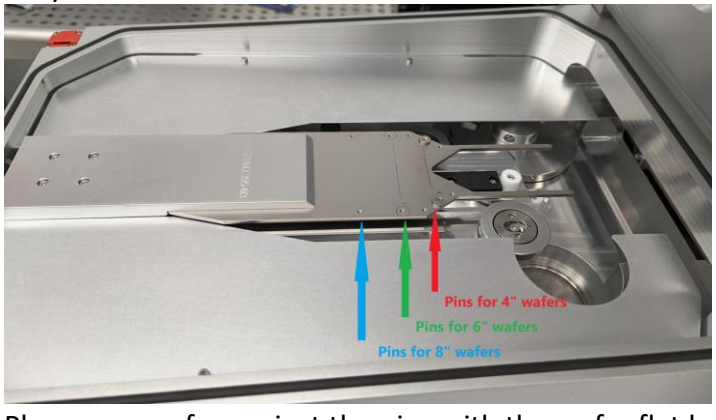
**DRIE Processing Procedure**

This section assumes that you have prepared a sample and have a processing recipe ready for the tool. If you do not have a recipe ready, then you must make one. Consult MNTC for guidance and also consult the DRIE recipe guide section below for pointers.

1. Log into FOM and turn on the "DRIE – Oxford" tool. This will turn on the computer which should immediately connect to the already running DRIE
2. Click to open the PTIQ Software
3. You will be greeted by the login screen. For this SOP the following credentials are used
    a. Username: MNTC User
    b. Password: silicon (lowercase)
4. For a basic user there are several windows that are available to you:
    a. Automatic: This will be where recipes are executed
    b. Manual: Used to access the load lock control and check status of tool
    c. Recipes: Place for editing recipes
    d. Data: Can check the process data for completed runs
    e. Alarms: Check for any active alarms
5. Verity that there are no active alarms (will see red numbers on the alarm tab, check figure 1)

and if there are, inform the MNTC right away. You will not be able to run the tool with active alarms

6. Verify that the tool is set to run with the chiller and not with the cryo tools. You can do this by checking the Manual →Estrelas #1 window (lower left corner, see figure 1)
7. Load your wafer by navigating to the Manual→Transport window (see figure 2) and selecting "Vent"
8. After 30 seconds or so, the loadlock will begin audibly hissing. You can open the lid and load your wafer.
    a. Verify first that the DRIE is set correctly for your sized wafer. This will normally be for 4" wafers. If it is not set correctly then let the staff know and request that it be changed for you.




    b. Place your wafer against the pins with the wafer flat between them.

9. Once the wafer is loaded, click "Pump" on the transport window to begin pumping down the loadlock chamber. This process should take about 1 minute and you can monitor pressure during the process.
10. Navigate to the Automatic window and Select "Actions" on the right hand side.
11. Enter a batch ID and select your desired recipe (see relevant section for recipe design)
12. Select "Run" to begin your process
13. Allow the process to run for its established time. Once complete, the wafer will be returned to the load lock
14. Remove your wafer by navigating to the Manual→Transport window and selecting "Vent". Once you have your wafer, close the lid and select "Pump"
15. If you need to run additional processing on this wafer or additional wafers, repeat this process from step 7.

16. If you are done using the tool, you may close the PTIQ software and log off the tool from FOM

Figure 1: Manual Tab System View

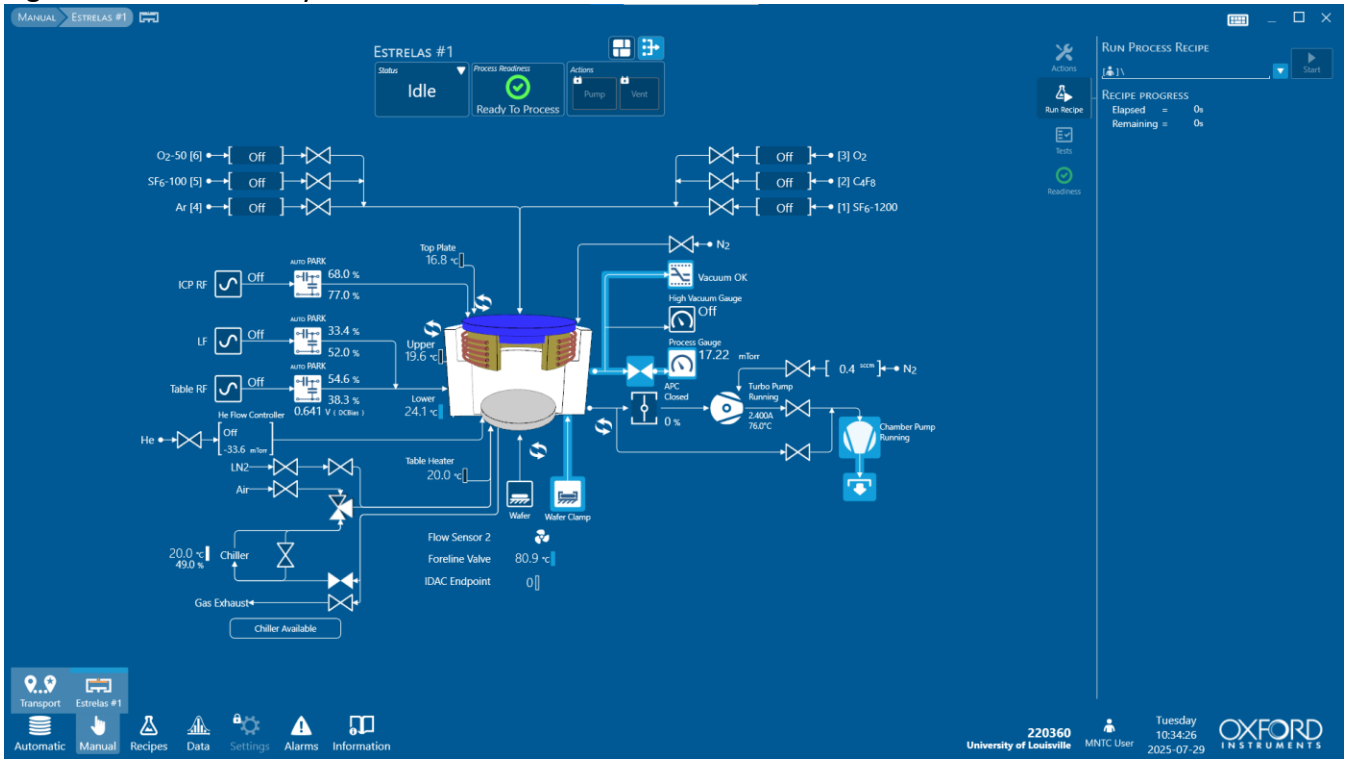



Figure 2: Manual Tab Transport View

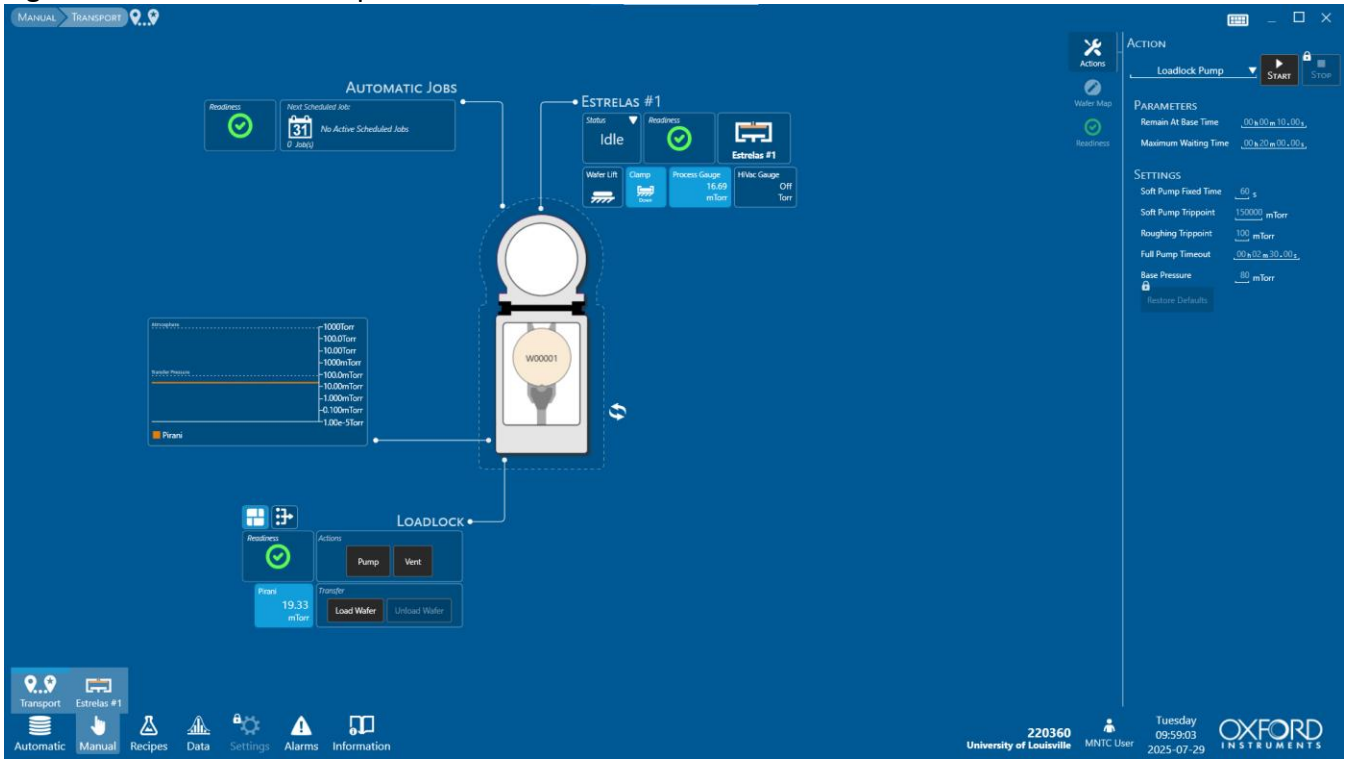
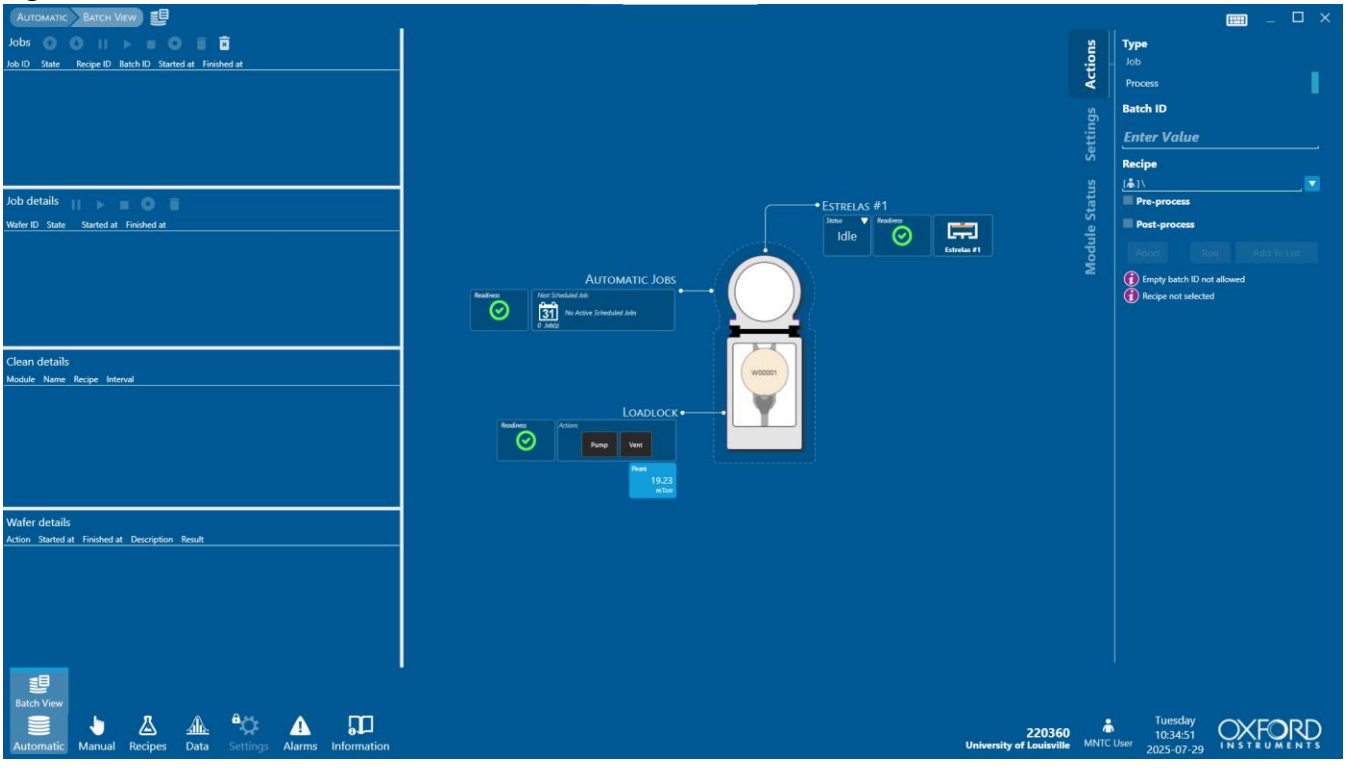


Figure 3: Automatic Tab Batch View



**DRIE Recipe Development and Guidance**

Recipe development in PTIQ will give you access to a wide range of parameters that can all be edited and controlled both in process steps and in tabular format. You can also control what parameters are shown and controlled in your recipe and what is controlled by default in the software. Figure ___ has an example of what a standard recipe might look like.

1. In the recipe editor, the easiest way to begin is by starting from a known recipe that works by picking a file on the left-hand side of the window. You can also search using key words present in the filename
2. To begin, each recipe is first divided into "Steps". These are overarching tool steps reserved for tool actions (pump down, moving the lift and clamp, etc) and sets of etch processing
3. During a processing step, each "column" represents a processing during etching while each row is an available variable that you can edit.
    a. During the same processing step, each variable will have an alarm feature that functions as a tolerance. It is recommended to keep these levels at the default unless you run into specific issues with your sample/process.
4. Each phase will have a time setpoint which controls its duration, for Bosch and Cryo etching, this is where you will control etch and passivation times.
5. The list of available parameters available to control is extensive and cannot be completely covered here. However, some of the common ones will be:
    a. Table Temperature
    b. Chamber pressure
    c. HF and LF Power
    d. AMU (Auto Matching Unit)
    e. Gass Flow Rates
    f. He Flow for Backside cooling and Leak Up
6. For most variables, you will be able to either directly input a desired value (e.g. changing the table chiller to 10°C) or "unchanged" which uses the default value from the software (for example leaving chiller temperature unchanged will give 20°C)
    a. You can also use this to set a variable once and use it for the remainder of the recipe. In considering our table temperature example. Setting it to 10°C at the beginning of the recipe and using unchanged later will keep the setpoint at 10°C
7. AMU Control: for the AUM (controls the tuning of the plasma to reduce reflected power). The two primary choices are "Autopark" and "Autostay". Autopark maintains a constant start point for tuning that the AMU returns to at every cycle while Autostay will maintain the tuned parameters for the entire recipe. Ideally, the best way is to use Autopark and adjust the starting values if your reflected power is too high. Contact MNTC for help if this is giving you trouble.
8. Plasma Control: Plasma control requires 4 inputs:
    a. Power Demand: This is forward power for plasma etching
    b. Max Reflected Power: Typically, about 5-10% of forward power (Ideally 5%)
    c. Tolerance Time: Allowable time for the reflective power to exceed the maximum (will cause recipe to fail). 5 seconds is a recommended default value
    d. Min Substrate Bias: Required if you are looking for a specific substrate bias for specific etches and selectivity. We would not recommend altering this unless you specifically need it.

9. Loop Counter: Loop counters will be used to control the number of cycles performed during a Bocsh and Cryo etch process. This will be created by selecting a start and end point for the loop (see example) and adjust the “n” value to max your desired number of cycles
10. For a new recipe, it is recommended to run with a short loop counter (5 cycles) and a dummy wafer to ensure the recipe runs the way you intend to and protect your valuable sample from becoming ruined.
11. Important note: You are free to edit recipes while the tool is processing <u>but</u> the tool will not recognize recipe changes unless you <u>save</u> the file first. Even if you keep the file name the same and rerun from the batch tab, it will only use the most recently saved version
    a. Example: You have completed an etch recipe for 200 cycles and you remove the sample to check your etch rate and determined you need an additional 500 cycles to reach your target depth. If you change the loop counter to 500 but do not hit save, when you run the recipe will only do 200 cycles.
    b. This is different than the previous software where you can change the recipe and run it without saving so be careful!

Figure 4: Recipe Editor