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The gases available are SF6, CHF3, O2, and He.

**Max ICP is 1500 watts, Max RIE is 500 watts but samples may get really hot and melt.**

Check with Lab Manager to ensure all the etcher gasses are on, compressed air is okay, enough nitrogen gas, cleanroom exhaust running, no maintenance going on in cleanroom, etc ...

Check that the large chiller is at 17C to 20C and running (only green "snowflake" symbol is flashing, no other symbols flashing).

Check that the compressed air pressure is about 80 psi on the wall gauge.

If the Phantom is shutdown (nothing on the screen) :

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Press "Main" switch and wait for computer to boot and main Phantom menu (Files, Manual Process Control, Automatic Process Control, Vent Reactor, Standby, etc) to display on the LCD screen.

Wait for Osaka turbo pump to accelerate to 19,800 rpm (this takes about 15 minutes). The speed indicator is located knee level at the front.

If Phantom is in "Standby" (screen says "Standby")

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Press the "Cancel" button and the machine will come up with the main menu screen.

Main Screen

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(Shows buttons such as Files, Manual Process Control, Automatic Process Control, Maintenance, etc... )

Fill in the Phantom log sheet (date, name, start time)

Check that the OSAKA pump speed (readout down at knee level on the front) is above 19,000 rpm. If it is not at speed, contact Lab Manager

Check that the two toggle switches under the panel below the keyboard are in the up (Auto) position.

Using a pen stylus, press "Files" to access known, proven recipes. Choose a recipe and then press "Exit".

Press the "Manual process control" button to see the parameters of the recipe. Adjust the etch time by touching the "Process time set" box. A keypad will pop up on the screen so that you can enter the number of seconds of etch.

You can check if there is more than one step in the recipe by clicking the "Next Step" button.

A recipe can have a maximum of 16 steps.

**Note that using high power (above 300 watts) on the RIE or ICP may get the sample really hot and melt it.**

Note the Phantom has an electrostatic clamp that can be turned on in the recipe. This applies a voltage to the sapphire which results in a clamping force that pulls it close to the anodized aluminum base. This assists in conducting heat away from the sample.

Note that the Phantom has helium gas cooling that can be turned on in the recipe. When the electrostatic clamp is on and helium gas cooling is turned on, a helium gas cushion is formed underneath the sapphire that increases heat conduction away from the sample and into the anodized aluminum base.

\*\*\* Recommended setting for helium gas is 2 (mTorr).

If you change the gas flow (SF<sub>6</sub>, CHF<sub>3</sub>, etc), RIE, ICP power, plasma pressure, clamping, helium cooling settings and want to save this modified recipe click the "Files" button, then "Save" and give the recipe a new name when prompted. Note that if there are too many recipes on the hard drive, it will not show up on the "Files" selection screen so you will have to save it onto a floppy disc and load it from there.

*If this is a recipe you have not tried before you may wish to do a test run and do manual tuning of the reflected power (see "Manual tuning" at the end of this procedure). To do a test run, return to the main menu by pressing "Exit". Then press "automatic process control" to run the recipe. Watch the reflected power and do a manual tune if necessary.*

If you are not doing a test run, press "Exit" to get back to the main menu.

Press "Vent reactor" button to vent the chamber and eventually the lid will lift up automatically. If the lid does not lift up, try lifting it with your hand. If it is stuck down, contact Lab Manager.

The sapphire carrier is used for small samples (pieces). Check that the sapphire carrier is dust-free and clean. The sapphire carrier is very delicate so do not press on or drop it. Use a wipe with a tiny bit of isopropyl alcohol on it.

There is also a vacuum cleaner hose on the floor that can be used to vacuum small particles. Be careful not to suck up the sapphire carrier.

Place sample carefully onto the sapphire carrier.

Check the large lid o-ring is free of hair and dust particles. Use a wipe with a tiny bit of isopropyl alcohol.

Keep fingers away from the lid edge !

Press "Close lid".

Keep fingers away from the lid edge ! The lid will automatically come down and close.

Press "Automatic Process Control" and the chamber will begin to pump down, gas will start flowing, the chamber pressure will stabilize and the RF power come on to start the etch process.

(Note that if you use the “ Manual process Control” to do an etch that the time will keep increasing and not stop. You can etch through the chamber if you go away for many hours.)

After the etch is finished, the screen will pop up a message. Click “ Okay”.

The sample may be hot so you may have to wait 10-15 minutes for it to cool before proceeding.

Press “Vent Reactor” to let the chamber up to atmosphere

Remove your sample.

Load another sample and follow the above steps.

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**When all the samples are done:**

Clean the sapphire carrier.

Check that the toggle switches are both in the “Auto” Position.

Leave the sapphire carrier inside the chamber.

“Close lid”

Choose the “Clean” recipe and run the “Clean” recipe (oxygen with ICP and RIE power).

Look into the view port near the end of the “Clean” and check that the color is bluish. If there is a greenish or any other color tinge, the “Clean” recipe should be run again.

After the Clean recipe is done, click “Okay” to acknowledge.

Record the RF hours (on the main screen), turbo hours (front knee level readout where the turbo speed is indicated), stop time, description of samples, number of samples, etched, recipe used on the Log Sheet.

Press “Standby” to leave machine ready for next day.

Report any machine problems or quirks to the Lab Manager.

Cleanup the work table and put away tweezers, pens, etc.

**Tips:**

1. When you place a small piece on the sapphire carrier, ensure the back of the piece lies flat as possible so that the heat is conducted away efficiently.

You may have to use some solvent to carefully remove any photoresist stuck on the back of the piece.

You may have to use a tiny bit of Mung paste (silicon grease and silver) on the back to get good heat conduction.

You may have to etch for a short time then stop to allow the sample to cool and then etch again for another short time, etc.

2. After etching, the sample may be hot. Allow time for it to cool before venting up to air and removal.

3. If you smell traces of fluorine when you remove your sample, you should add a step to your recipe to flush with helium gas and another step to pump on the sample (with no gas or RIE/ICP power applied) for awhile.

4. Do a test run of a recipe (with no sample in the etcher) to determine if you have to do a manual tune of the reflected power (see section below).

**Manual tuning**  
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Normally the machine will automatically tune itself to provide minimum reflected power and hence maximum transmitted RF power to the plasma. See the Operator's manual for a description of the equivalent electrical circuit formed by the fixed and variable capacitors and the plasma.

Certain extreme conditions of gas pressure and RF power will not allow the Automatic tuning to work properly. The reflected power will be large and variable hence etch conditions will not be steady and reproducible. With the chamber empty, one can do a manual tune as described in the Operator's Manual in order to minimize the reflected power. After a manual tune, leave the toggle switches in "Manual" and proceed to load the sample and do the etch.