Minilock Operating Procedure (May 2005)

The gases available are Cl2, BCl3, HBr, CF4, O2, Ar and N2.

Max power on the ICP is 500 watts, 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 small Alcatel rotary pump (labeled "LOAD LOCK") to the right of the Minilock is turned ON.

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

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

If the Minilock is shutdown (screen is blank) :

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

Wait for Pfeiffer turbo pump to accelerate to speed (this takes about 10 minutes). There is no speed indicator so one just waits 10 minutes.

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

(screen says Standby), press the "Cancel" button and the machine will come up with the main menu screen.

Fill in the Minilock log sheet (date, name, time)

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.

Note that using high power (300 to a max of 500 watts) on the RIE or ICP may get the sample really hot and melt it.

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.

If you change the gas or pressure 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.

If the Load lock lid can not be lifted by had, press "Vent Load lock" on the menu. When the machine says it is vented, slowly lift up the lid.

The graphite carrier is used for small pieces.
Check that the graphite carrier is dust-free and clean. The graphite carrier is very delicate so do not press on or drop it. Use a wipe with a tiny bit of isopropyl alcohol on it. Some graphite powder will rub off onto the wipe.

Place sample carefully onto the carrier. For better contact with the graphite carrier, one can apply a very *** tiny *** bit (a very thin grease layer) of Mung paste (in small jar) on the back of the sample before placing onto the 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 !

Slowly close the lid.

Keep fingers away from the lid edge !

Press the "Load Wafer" button. The machine will begin to pump down the load lock chamber. Watch the "Lock Pressure". It will slowly go down to 300 mTorr over 8 minutes.

If it fails to reach 300 mTorr, an Error message will show up and a "Manual Recovery Panel" menu will pop up. Press "Exit" and try "Load Wafer" again.

If the "Manual Recovery Panel" pops up again, contact the Lab Manager as there may be a leak somewhere or lots of water vapor adsorbed on the graphite or sample.

When the load lock reaches 300 mTorr, the gate to the main reactor chamber will open, the robot arm will move the graphite plate into the reactor, the reactor gate will close.

Press "Automatic Process Control" and 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 click “Okay”.

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

Click the “Unload wafer ” button. The machine will pump some more on the load lock chamber, open the gate to the main reactor chamber, extend the robot arm and retract the graphite plate and vent the load lock.

Slowly open the lid and remove your sample.

Load another sample and follow the above steps.

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When all the samples are done:

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

Leave the graphite carrier inside the Load lock chamber (do not load it into the plasma chamber)

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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, set the RIE power to zero, increase the ICP power to 400 and run the “Clean” for up to 25 minutes.

If the greenish or other color tinge persists, the chambers will have to be hand cleaned. Notify the Lab Manager.

Turn off the small “LOAD LOCK” pump to the right of the Minilock.

Record the RF hours (on the main screen), the machine hours (timer located between the load lock and the plasma chamber), Stop time and description of samples etched (number, type, recipe) on the Log Sheet

After the cleaning is done, acknowledge the pop up message.

Do not put the ethcer in “Standby” as the turbo pump needs a long time to cool down.

If the “Standby” button is pressed while the turbo is still hot, the turbo pump will “crash”.

Report any machine problems or quirks to the Lab Manager.

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

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Tips:

1. When you place a small piece on the graphite 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 you Unload the sample.

3. If you smell traces of chlorine when you remove your sample, you should add a step to your recipe to flush with nitrogen 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 to determine if you have to do a manual tune of the reflected power (see section below).

Manual tuning

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.