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1.0   **Purpose/Scope**

    1.1   This document is intended to give the User an understanding of the proper procedure for the use of this tool. Should question arise that are not covered in the document it is requested that you ask a CSSER Staff member prior to continuing with any experiments as you might damage the tool, your sample or contaminate the chamber resulting in the possibility of causing harm to another User's project.

2.0   **Reference Documents**

    2.1   Chemical Safety & Hazardous Waste Management Rules & Procedures

    2.2   CSSER Rules & Procedures Handbook

3.0   **Equipment/Supplies/Material**

    3.1   Wafer or standard tweezers

    3.2   Isopropyl Alcohol

    3.3   Clean room wipes

    3.4   150 mm carrier wafer.

    3.5   Diffusion pump oil.

4.0   **Safety**

    4.1   Follow all safety procedures outlined in the CSSER Handbook

    4.2   Follow all Lock Out/ Tag Out procedures where they may apply.

    4.3   Follow safety procedures for high voltage when working with high voltage or RF energy.

    4.4   Follow safety and handling procedures when working with high pressure, pyroforic, or toxic gases.

    4.5   In an emergency:

        4.5.1   In an emergency, such as risk of personal injury, press the EMO (big red button) on the front of the tool. This will turn off all power to the machine, including the roughing pump in the sub-fab. Contact CSSER staff if this button is pressed.

5.0   **Set Up Procedures**

    5.1   There are standard recipes on the tool. You can modify parameters that are marked with an asterisk. You cannot save your changes.

    5.2   Ensure that either the 150 mm community carrier wafer is present, or you have your own carrier wafer.

        5.2.1   If you provide your own carrier wafer, it must be a <100> silicon wafer with a single SEMI flat.

    5.3   Check UP/DOWN status of tool; DO NOT proceed if tool is DOWN. If you encounter any problems during your process contact a member of staff, place the tool sign to DOWN, and enter a service request at the CSSER Nanofab website at https://fultonapps.asu.edu/csser/sr

6.0   Procedure

6.1   Initial Steps

6.1.1   Log in to the tool using your user name and password.

6.1.2   Ensure that there is a carrier wafer in the load lock.

6.1.3   If there is no carrier wafer in the load lock perform the following procedure.

6.1.3.1   Vent the load lock by pressing the "Vent" button on the side of the load lock.

6.1.3.2   Open the load lock and place a 150 mm carrier wafer on the end effector.

6.1.3.3   Place the carrier wafer on the end effector such that the flat is banked against the two pins farthest from the slit valve, and in between the two pins closest to the slit valve.

6.1.3.4   Close the load lock lid.

6.1.3.5   Pump the load lock by pressing the "Pump" button. Press down on the lid of the load lock to ensure a good seal of the lid against the o-ring.

6.2   Chamber Clean

6.2.1   Cleaning the process chamber prior to etching a sample is recommended, but not required. To clean the process chamber, perform the following procedure.

6.2.1.1   When the lighted ring around the "Vent/Pump" button has stopped flashing, press the "Load" button to load the carrier wafer into the process chamber.

6.2.1.2   WAIT until the clamping ring has clamped the wafer into place on the feature plate.

6.2.1.3   Click on the "Start batch" button.

6.2.1.4   Choose the "Process" folder in the "Recipe" window.

6.2.1.5   Choose the recipe "Standard OXYGEN chamber clean".

6.2.1.6   In the unlabeled window below the "Recipe" window, choose "1 – clean*".

6.2.1.7   Choose "Parameters".

6.2.1.8   The parameter "Steptime (m)*" is set to 10 minutes. This is the recommended cleaning time. If you wish to change the cleaning time, perform the following procedure.

6.2.1.8.1   Double click on "Steptime (m)*".

6.2.1.8.2   Change "Set Value" to the desired time in minutes.

6.2.1.8.3   Click "OK".

6.2.1.9   Click "Start".

6.2.1.10   Allow the program to run.

6.2.1.11   When the program is finished, the tool will sound four beeps, twice. WAIT until this happens before doing anything else.

6.2.2   If the user intends to do a conditioning run, proceed to the next section of this procedure.

6.2.3   If the user does not intend to do a condition run, perform the following procedure.

    6.2.3.1   WAIT until all of the lights on the side of the load lock are done flashing.

    6.2.3.2   Press the "Unload" button. WAIT until the end effector removes the tool from the process chamber.

    6.2.3.3   If the tool does not immediately begin unloaded the wafer from the process chamber, WAIT until it does.   DO NOT press the "Unload" button again.

    6.2.3.4   Skip to section "Sample Placement and Mounting on Carrier Wafer" of this document.

6.3   Conditioning Run

6.3.1   A conditioning run prior to etching a sample is recommended, but not required. To do a conditioning run, perform the following procedure.

    6.3.1.1   If the carrier wafer has not been loaded into the process chamber, perform the following procedure.

        6.3.1.1.1   When the lighted ring around the "Vent/Pump" button has stopped flashing, press the "Load" button to load the carrier wafer into the process chamber.

        6.3.1.1.2   WAIT until the clamping ring has clamped the wafer into place on the feature plate.

    6.3.1.2   Click on the "Start batch" button.

    6.3.1.3   Choose the recipe that you intend to use on your samples.

    6.3.1.4   Ten minutes is the recommended conditioning time. If you wish to change the conditioning time, perform the following procedure.

        6.3.1.4.1   Double click on "Steptime (m)*".

        6.3.1.4.2   Change "Set Value" to the desired time in minutes.

        6.3.1.4.3   Click "OK".

    6.3.1.5   Enter an identifier for your run in the "Material input" box.

    6.3.1.6   Click "Start".

    6.3.1.7   Allow the program to run.

    6.3.1.8   When the program is finished, the tool will sound four beeps, twice, WAIT until this happens before doing anything else.

    6.3.1.9   Unload the carrier wafer from the process chamber by performing the following procedure.

        6.3.1.9.1   WAIT until all of the lights on the side of the load lock are done flashing.

        6.3.1.9.2   Press the "Unload" button. WAIT until the end effector removes the tool from the process chamber.

6.3.1.9.3 If the tool does not immediately begin unloaded the wafer from the process chamber, WAIT until it does. DO NOT press the "Unload" button again.

6.3.2 Vent the load lock by pressing the "Vent" button on the side of the load lock.

6.3.3 Open the load lock lid.

6.4 Sample Placement and Mounting on Carrier Wafer

6.4.1 If you are processing a 150 mm wafer with a single SEMI flat, then you do not need to use the carrier wafer. If you are processing a sample of any other form factor (including a notched 150 mm wafer), then you must use a carrier wafer.

6.4.2 Ensure that your sample will fit onto the carrier wafer such that no part of the sample is less than 1 centimeter away from the edge of the carrier wafer.

6.4.3 If any part of your sample is less than 1 centimeter away from the edge of the carrier wafer, then you must cleave your sample is smaller pieces.

6.4.4 Diffusion pump oil may be used to secure your sample to the carrier wafer, if desired. Reasons for doing this include the following.

6.4.4.1 Ensuring that there is good transfer of heat away from the sample to the carrier wafer.

6.4.4.2 Ensuring that the sample does not move on the carrier wafer.

6.4.5 If you wish to use diffusion pump oil with your sample, perform the following procedure.

6.4.5.1 Place a very small amount of diffusion pump oil in the center of the carrier wafer. A plastic toothpick is provided for this purpose.

6.4.5.2 Place your sample on top of the diffusion pump oil.

6.4.5.3 Ensure that no diffusion pump oil is on the front of the carrier wafer, including oil that may have seeped out from behind your sample.

6.4.5.4 If diffusion pump oil is on the front of the carrier wafer, or if it seeps out from behind your sample, you must clean both your sample and the carrier wafer using the following procedure.

6.4.5.4.1 Remove your sample from the carrier wafer.

6.4.5.4.2 Use isopropyl alcohol and a clean room wipe to remove the diffusion pump oil from both the carrier wafer, and your sample.

6.4.5.4.3 Mount the sample on the carrier wafer using less diffusion oil.

6.5 Sample Processing

6.5.1 Create a run entry in the electronic log on the iPad located near the tool. See section 7 for information on the electronic log.

6.5.2 Place the sample and carrier wafer on the end effector such that the flat of the carrier wafer is banked against the two pins farthest from the slit valve, and in between the two pins closest to the slit valve.

6.5.3 Close the load lock lid.

6.5.4 Pump the load lock by pressing the "Pump" button. Press down on the lid of the load lock to ensure a good seal of the lid against the o-ring.

6.5.5 Ensure that your sample has not shifted in position on the carrier wafer such that any edge of your sample is less than 1 centimeter away from the edge of the carrier wafer.

6.5.6 If your sample has shifted such that any edge of your sample is less than 1 centimeter away from the edge of the carrier wafer, vent the load lock and attach your sample to the carrier wafer with diffusion pump oil by performing the following procedure.

   6.5.6.1 Vent the load lock by pressing the "Vent" button on the side of the load lock.

   6.5.6.2 Open the load lock lid and remove your sample and the carrier wafer from the load lock.

   6.5.6.3 Remove your sample from the carrier wafer.

   6.5.6.4 Place a very small amount of diffusion pump oil in the center of the carrier wafer. A plastic toothpick is provided for this purpose.

   6.5.6.5 Place your sample on top of the diffusion pump oil.

   6.5.6.6 Ensure that no diffusion pump oil is on the front of the carrier wafer, including oil that may have seeped out from behind your sample.

   6.5.6.7 If diffusion pump oil is on the front of the carrier wafer, or if it seeps out from behind your sample, you must clean both your sample and the carrier wafer using the following procedure.

      6.5.6.7.1 Remove your sample from the carrier wafer.

      6.5.6.7.2 Use isopropyl alcohol and a clean room wipe to remove the diffusion pump oil from both the carrier wafer, and your sample.

   6.5.6.8 Mount the sample on the carrier wafer using less diffusion oil.

   6.5.6.9 Place the sample and carrier wafer on the end effector such that the flat of the carrier wafer is banked against the two pins farthest from the slit valve, and in between the two pins closest to the slit valve.

   6.5.6.10 Close the load lock lid.

   6.5.6.11 Pump the load lock by pressing the "Pump" button. Press down on the lid of the load lock to ensure a good seal of the lid against the o-ring.

6.5.7 When the lighted ring around the "Vent/Pump" button has stopped flashing, press the "Load" button to load the carrier wafer into the process chamber.

6.5.8 WAIT until the clamping ring has clamped the wafer into place on the feature plate.

6.5.9 Click on the "Start batch" button.

6.5.10 Choose the recipe that you intend to use on your samples.

6.5.11 You are allowed to change any parameters in the recipe that have an asterisk (*). To change a parameter, perform the following procedure.

   6.5.11.1 Double click on the parameter.

   6.5.11.2 Change "Set Value" to the desired value.

6.5.11.3   Click "OK".

6.5.12   Enter an identifier for your run in the "Material input" box.

6.5.13   Click "Start".

6.5.14   Allow the program to run.

6.5.15   When the program is finished, the tool will sound four beeps, twice, WAIT until this happens before doing anything else.

6.5.16   Unload the carrier wafer from the process chamber by performing the following procedure.

6.5.16.1   WAIT until all of the lights on the side of the load lock are done flashing.

6.5.16.2   Press the "Unload" button. WAIT until the end effector removes the tool from the process chamber.

6.5.16.3   If the tool does not immediately begin unloaded the wafer from the process chamber, WAIT until it does.   DO NOT press the "Unload" button again.

6.5.17   Vent the load lock by pressing the "Vent" button on the side of the load lock.

6.5.18   Open the load lock lid and remove your sample and the carrier wafer from the load lock.

6.5.19   Remove your sample from the carrier wafer.

6.5.20   Use isopropyl alcohol and a clean room wipe to remove the diffusion pump oil from both the carrier wafer, and your sample

6.5.21   Place the carrier wafer on the end effector such that the flat is banked against the two pins farthest from the slit valve, and in between the two pins closest to the slit valve.

6.5.22   Pump the load lock by pressing the "Pump" button. Press down on the lid of the load lock to ensure a good seal of the lid against the o-ring.

6.6   Finishing Up

6.6.1   Mark your run as complete in the electronic log on the iPad.

6.6.2   Log out of the tool.

7.0   Forms

   7.1   Electronic Run Log

      7.1.1   Use the electronic run log on the iPad located near the tool to record runs.

      7.1.2   Make one entry in the run log per wafer processed.

      7.1.3   If a wafer is reprocessed, a second entry in the run log is not necessary. Just change the etch time in the first run log entry.

      7.1.4   An entry in the run log for cleaning is not required.

      7.1.5   An entry in the run log for conditioning is not required.

8.0   Specifications

    8.1   Maximum and Minimum Parameter Settings.

        8.1.1   Gas flow rates.

            8.1.1.1   The maximum flow rate for all gases is 100 sccm.

            8.1.1.2   The minimum flow rate for all gases is 0 sccm.

        8.1.2   Power

            8.1.2.1   The maximum bias run power is 900 Watts.

            8.1.2.2   The minimum bias run power is 0 Watts.

            8.1.2.3   The maximum ICP run power is 900 Watts.

            8.1.2.4   The minimum ICP run power is 10 Watts.

        8.1.3   Pressure

            8.1.3.1   The maximum process pressure is 1000 mTorr.

            8.1.3.2   The minimum process pressure is 1 mTorr.