EVG 501 Wafer Bonder SOP

Safety

Hot Surfaces – During operation the outside chamber can be as hot as 150°C and will burn you badly if touched. Avoid touching the chamber during operation. The inner samples & carrier can be very hot when immediately removed from the process chamber. Sufficient cooling time must be allowed prior to sample handling.

Equipment Restrictions

Only thermal-compression bonding processes of **4" (100mm) wafers** can be processed on this instrument.

Equipment Specifications:

The EVG 501 is a flexible wafer bonding system set-up for 100mm wafers. This tool is setup for all thermal compression-based bonding processes such as: glass frit, solder, eutectic, transient liquid phase, and direct bonding. Currently, anodic bonding is not functional with this instrument. Process conditions are as follows:

- Temperature: 25 - 450°C.
- Piston pressure up to 3500N (125 psi on a 4" wafer.)
- Vacuum down to 1E-4 mbar (7.5E-5 torr)
  - Can also operate under a Nitrogen purge.
- Wafer alignment compatible with the EVG 620.

ONLY USE 4" Wafers. NO PIECES!

Operation Instructions
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1.0   Initial Setup

1.1   Login to the TUMI computer.

1.2   Turn on the red and yellow Main Switch on the bonder power supply. The default state is "chamber vented" and "piston up".

Figure 1. Overall Power Switch for EVG 501

1.3   Turn on the heater switch on the bonder power supply. Note: The heater switch must be turned on from the very beginning. Never turn it on in the middle of process since it could damage the heater.

Figure 2. Heater Power Switch for EVG 501

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1.4   Turn on the roughing pump switch.

Figure 3. Roughing Pump Power Switch for EVG 501

1.5   If the computer is not already on, power on the computer.
1.6   Start the bonding system program from the computer. Choose "HEATING CHUCK TC".
1.7   Open the chamber by turning the four star knobs and bringing them down.
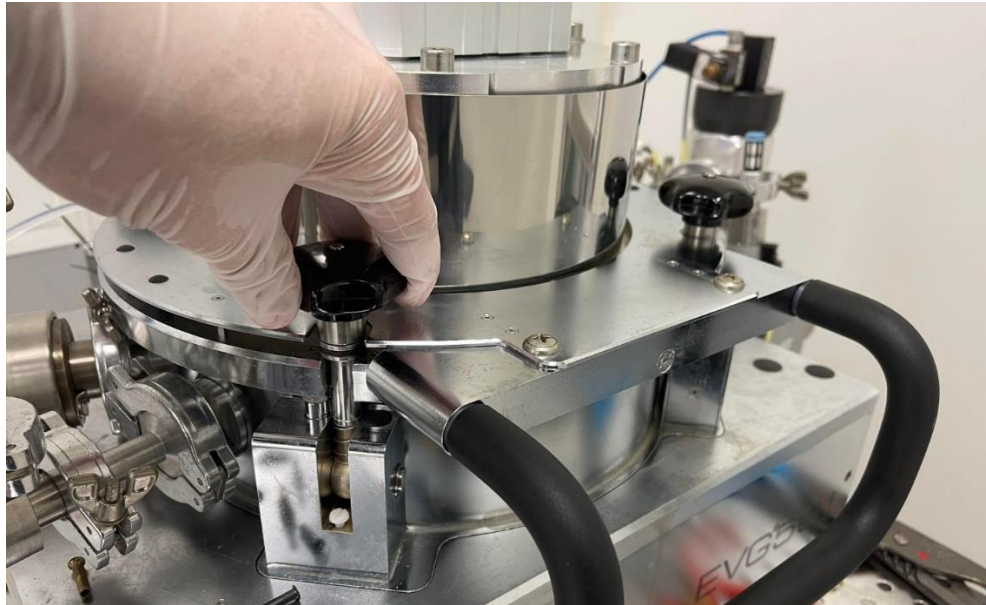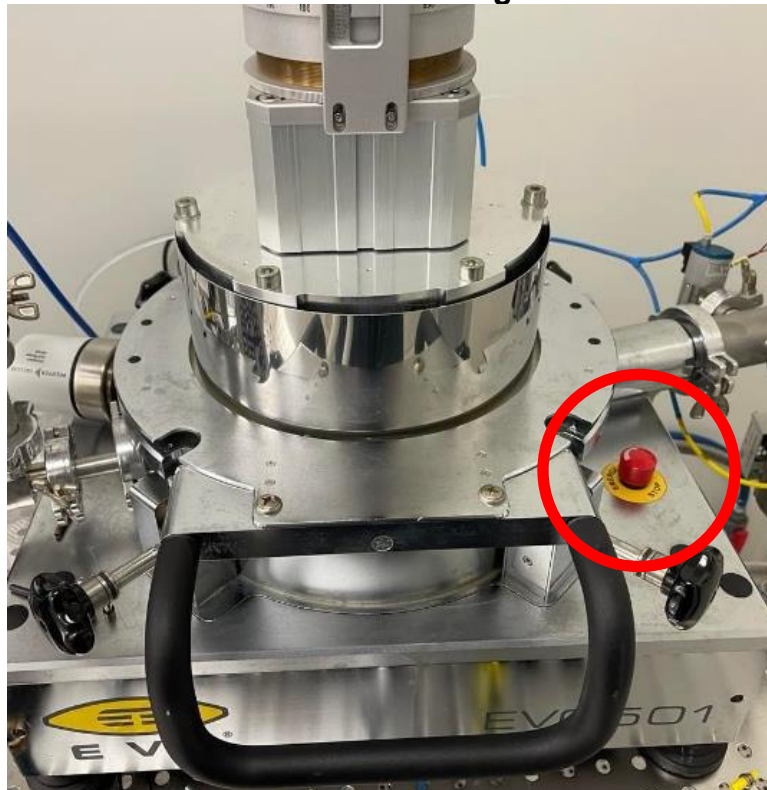
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Figure 4. Star-locking knobs for holding the chamber lid to the chamber.

1.8   NOTE: The EMERGENCY STOP is front right.

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2.0   Sample Loading

2.1   For wafer setup/alignment there is two methods. One is manual alignment which is outlined in this section. The other is alignment utilizing the EVG Model 620 Wafer Aligner. The SOP for that can be found as an addendum file on the instrument and requires its own separate training. **Note: This training only goes over manual wafer alignment!**

   2.1.1   **Only 4" wafers can be processed on this machine! NO PIECES!**

2.2   The sample holder as seen below should be set on the instrument table with the flags (3 little levels fully pulled back). **Note:** This means not over the circle.

2.3

Figure 5. Example of incorrect flag (3 small tabs) position. These need to not be over any part of the inner ring.
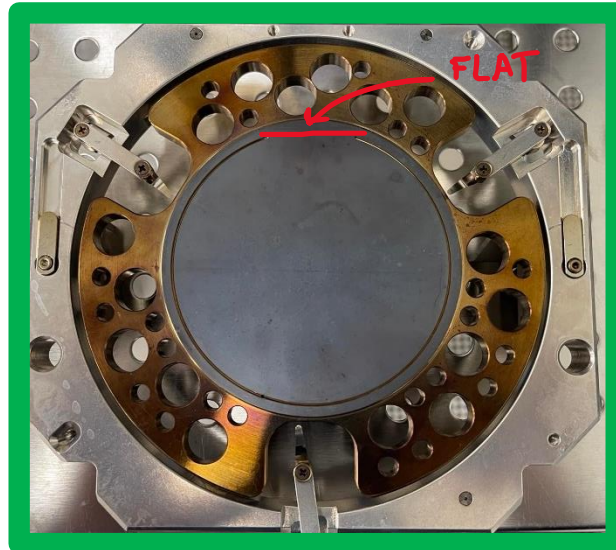
ONLY USE 4" Wafers. NO PIECES!

Figure 6. Example of correct flag position. Additionally note the flat of the chuck.

2.4   Place bottom and top wafers on chuck with flats aligned facing the flat section of the chuck. **Note:** Pre-treatment/cleaning of bonding surfaces prior to this step is important for proper bonding. Consult process specific SOPs for treatment type or ask staff.
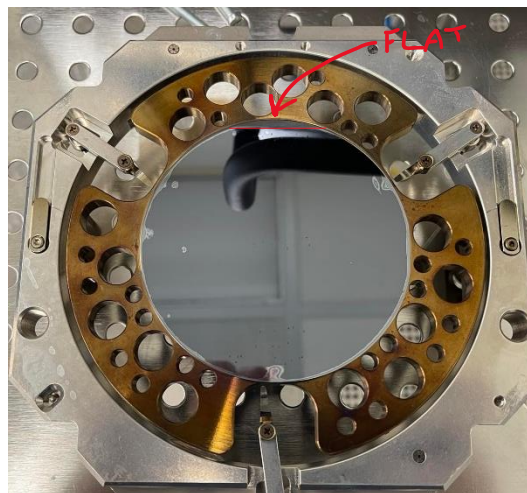

Figure 7. Example of wafers aligned flat of wafer with flat of chuck.

2.5   Place the EVG Bonder Alignment Glass on the sample holder, on top of the two wafers to be bonded.
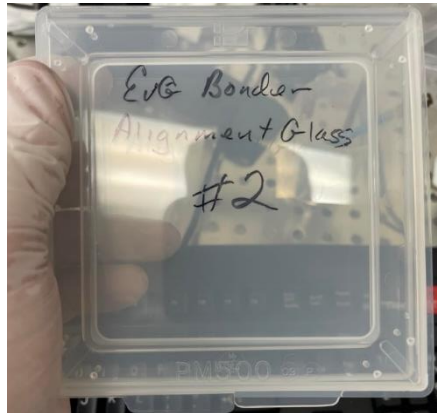
ONLY USE 4" Wafers. NO PIECES!
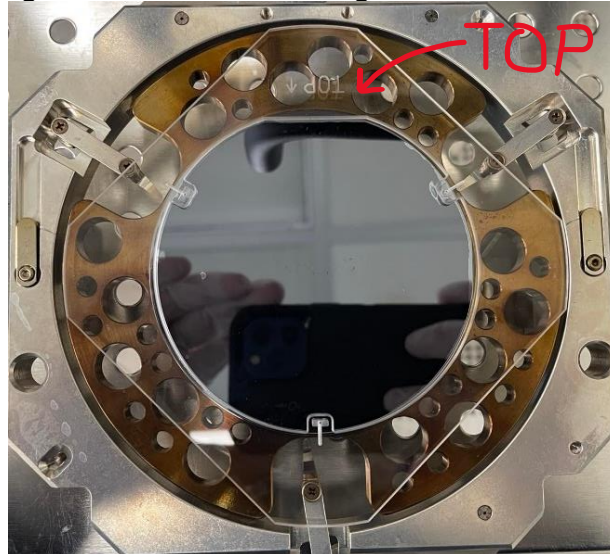
Figure 8. EVG Bonder Alignment Glass case.

Figure 9. Alignment of wafer alignment glass on wafer chuck. Note top is in line with flat.

2.6   Place the Bonder Graphite Electrode onto the wafers within the alignment glass. Make sure the flat section matches the flat section on the wafers.

Figure 10. Bonder Graphite Electrode case. Note: 2.989 mm thickness.
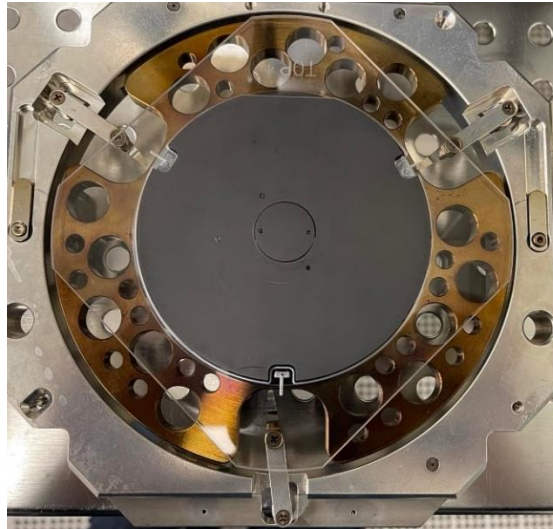
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Figure 11. Alignment of bonder graphite electrode on wafer chuck.

2.7   Move the set-pins so they hold the alignment glass in place. These are pins that have springs on the underside of the sample carrier that allow you to spin them over the alignment glass.
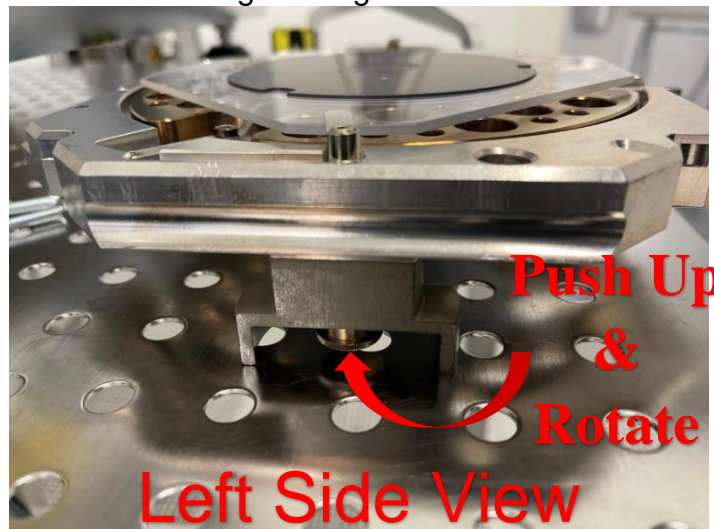

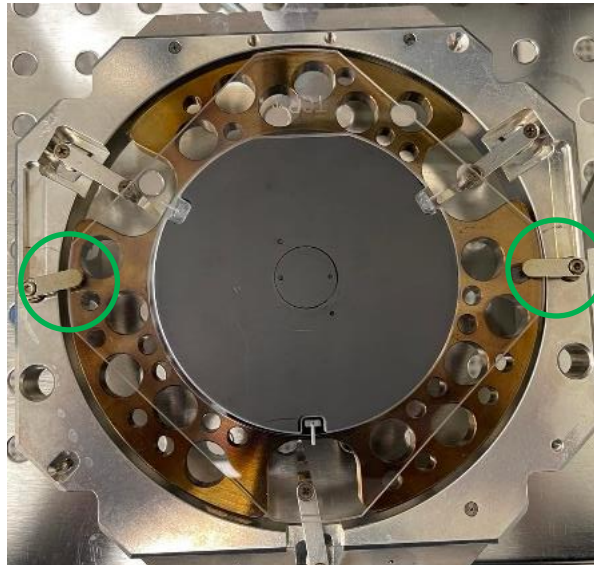Figure 12. Set pins for holding alignment glass in place.

Figure 13. Correct alignment for set pins.

2.8   Use the sample chuck carrier to move the sample chuck to the
        instrument.
        2.8.1   To open the carrier lift the latch near the handle of the
                carrier. This opens the hinge and allows for it to sit on the
                side of the sample chuck.
        2.8.2   Squeezing the handles allows for the sample chuck to be
                secured in place and the latch to be relatched. Note: The
                latch must be locked before lifting the sample chuck.
        2.8.3   Then align the sample chuck alignment holes with the
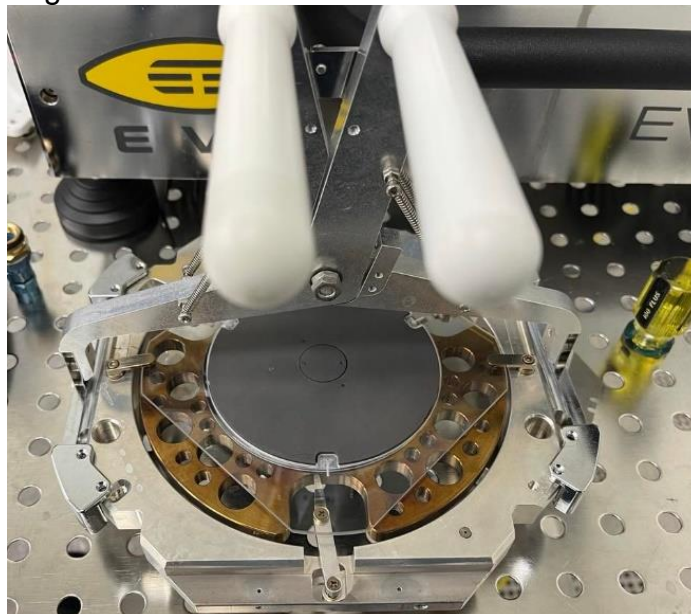   alignment rods in the wafer bonder.

Figure 14. Sample chuck carrier correctly installed on chuck.

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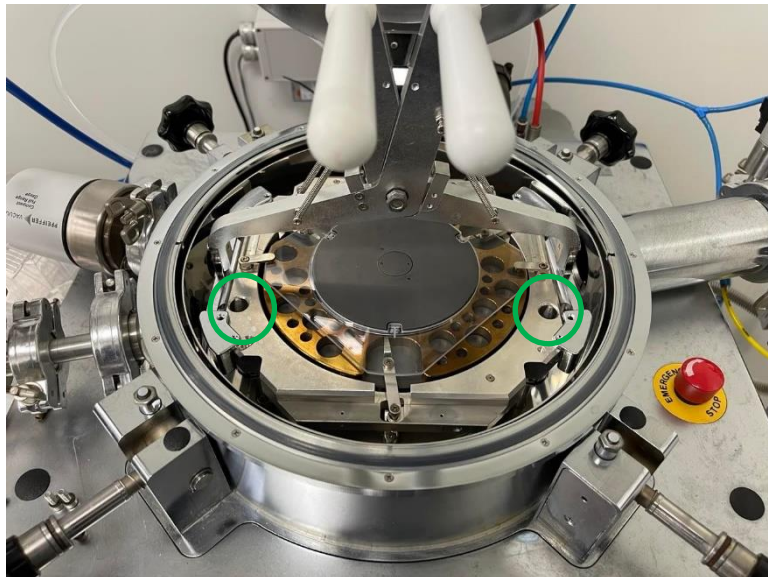
Figure 14. Sample chuck docked correctly on machine. NOTE (in green):
Chuck holes aligned with alignment rods in chamber.

2.9   Remove the sample chuck carrier by lifting the locking lever. While
        holding the white handles lift up on the locking lever which will open the
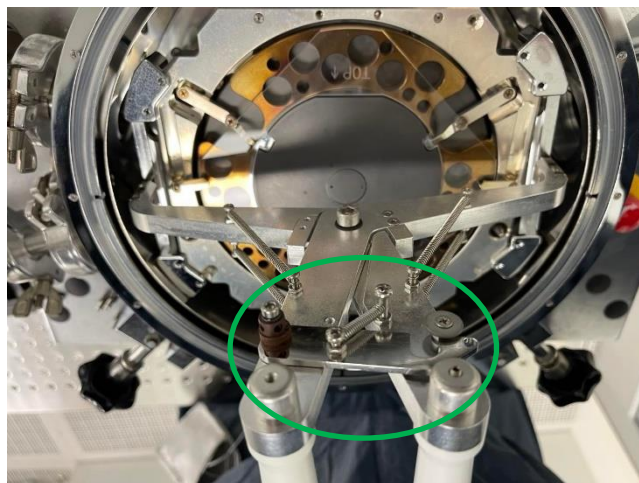   clamp.

Figure 15. Sample chuck carrier lever for releasing chuck. If the lever is
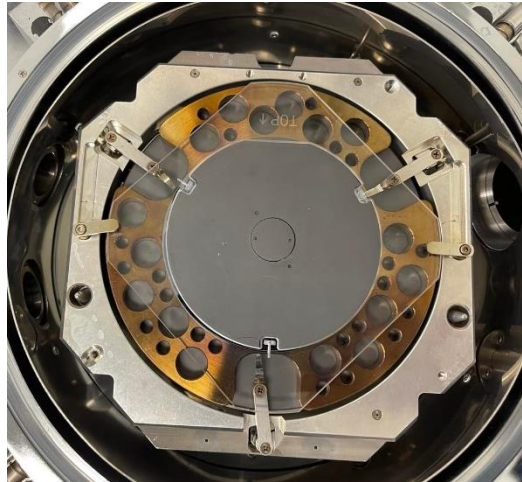latched the carrier is secured to the chuck. Release lever to release
chuck.

Figure 16. Sample chuck correctly installed into chamber. Note: This is exactly how your samples should look. Only use 4" wafers with this system!

2.10   Close the lid and move the 4 star knobs back to the locking position. Tighten them down hand tight. DO NOT OVERTIGHTEN.
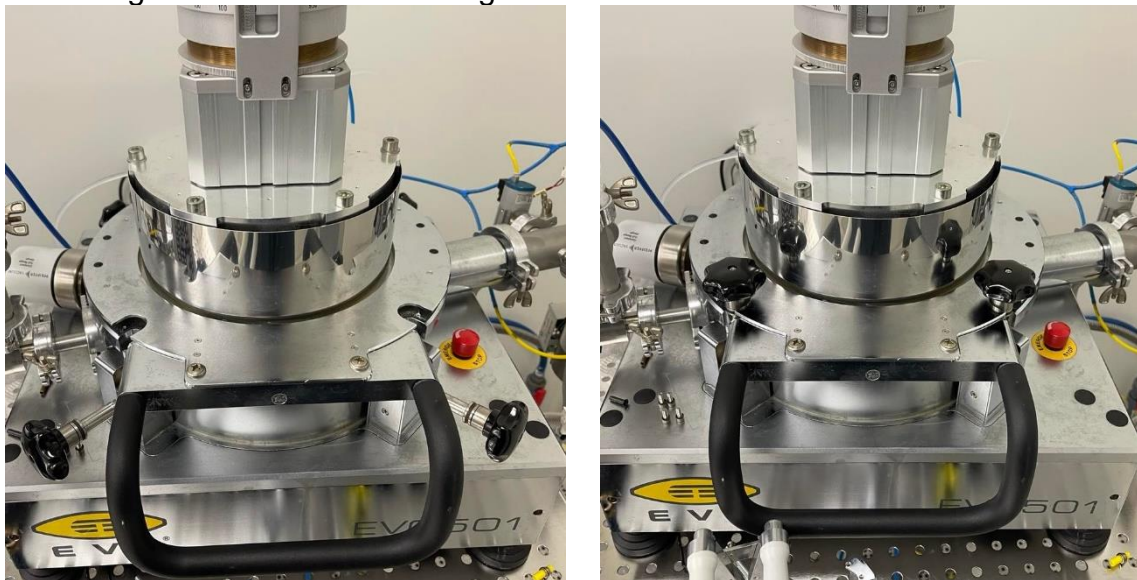
Figure 17. Chamber star knob positions. Left is for opening chamber (star knobs down). Right is closed chamber for operation/pump down (star knobs up and secured in place). Make sure all 4 knobs are lightly tightened prior to operation.

2.11   Calculate the total stack thickness. (Thickness of both wafers + thickness of graphite electrode (2.989 mm)). Then set the thickness dial to the total stack thickness. **NOTE: This is important for not breaking the machine, wafers and achieving a successful bond.**
      2.11.1 **Tolerance is within ~100um.**

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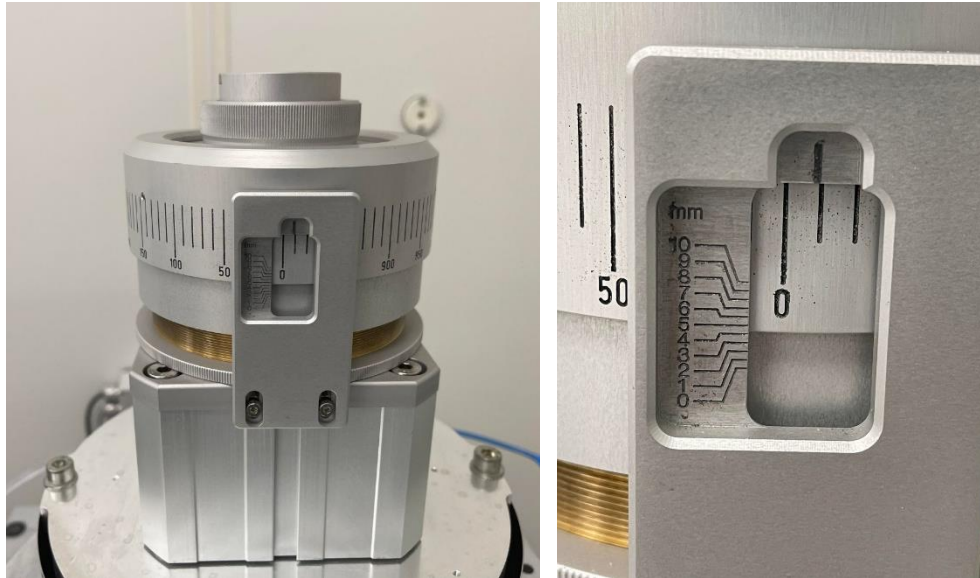
Figure 18. Wafer Thickness setting; mm is set by the inner numbers (right); um is set by the outer numbers (left). **NOTE: DO NOT OVER TIGHTEN and do not adjust during operation.**

2.12   Now the sample should be successfully loaded for operation.

3.0   Method Setup

3.1   In order to run a method select File → Open. Then in the lower left-hand corner of the Open File menu swap from Manual files (*.abm) to Automatic files (*.aba). Select your method to load the method setup. If creating a new method consult staff to ensure adequate steps are included.

      3.1.1   For thermal or eutectic bonding please use ThermalBond.aba as the template.

Figure 19. Opening a program.

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Figure 20. Selecting automatic runs.

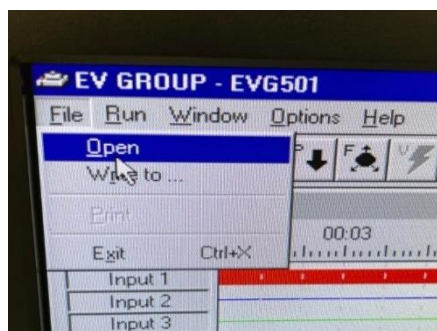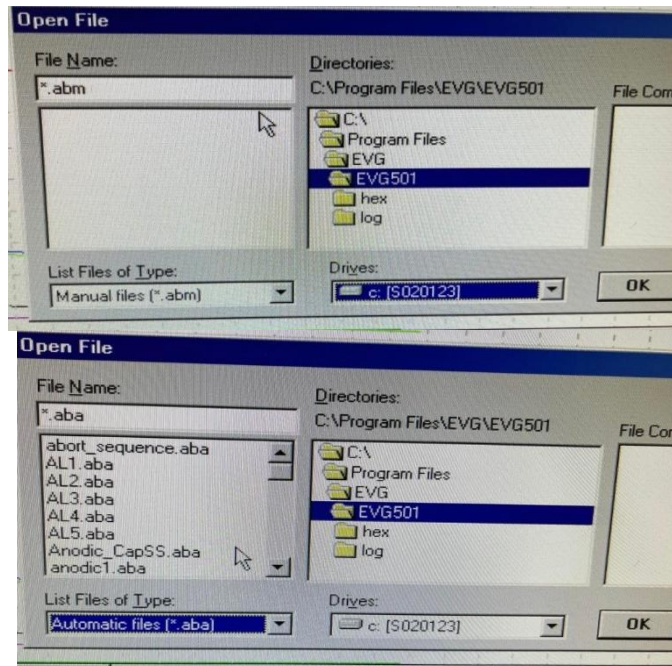3.2   Adjust method parameters as needed. The attached method is for Thermal bonding at 400C with 3000N of force for 30 min. Typically used for Au-Si eutectic bonding.

    3.2.1   The Password for editing the file is 1234. Which unlocks the edit button for inserting, deleting or adding new lines to the process.

Automatic SETUP:[ThermalBond.aba]

Password

Unit: [N] – [mbar]

0

	Command	Param 1	Param 2
1	Pump on	high vacuum	
2	Wait	Pressure	1.00E-03
3	Heating	300	0:00:00
4	Wait	Temp. bottom	295
5	Wait	Time	0:05:00
6	Waferbow		
7	Wait	Time	0:00:03
8	Piston down	3000	
9	Heating	400	0:00:00
10	Wait	Temp. bottom	395
11	Wait	Time	0:30:00
12	Cooling	40	0:00:00
13	Pump off		
14	Purge on		
15	Wait	Time	0:00:30
16	Purge off		
17	Wait	Temp. bottom	200
18	Piston up		
19	Vent on		
20	** END **		
21			
22			
23			

Automatic SETUP:[ThermalBond.aba]

EDIT

Unit: [N] – [mbar]

|0   Insert   Delete   New

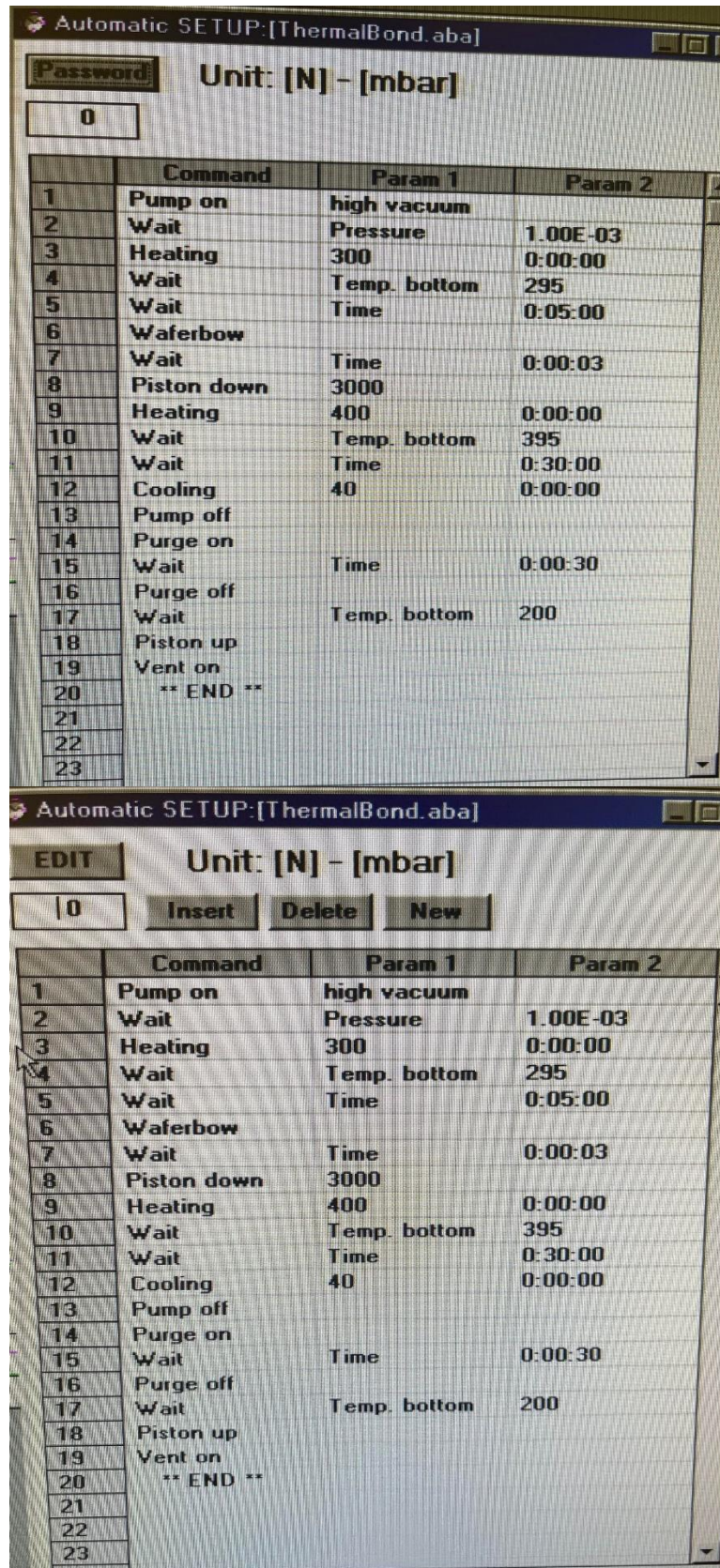|	Command	Param 1	Param 2
1	Pump on	high vacuum	
2	Wait	Pressure	1.00E-03
3	Heating	300	0:00:00
4	Wait	Temp. bottom	295
5	Wait	Time	0:05:00
6	Waferbow		
7	Wait	Time	0:00:03
8	Piston down	3000	
9	Heating	400	0:00:00
10	Wait	Temp. bottom	395
11	Wait	Time	0:30:00
12	Cooling	40	0:00:00
13	Pump off		
14	Purge on		
15	Wait	Time	0:00:30
16	Purge off		
17	Wait	Temp. bottom	200
18	Piston up		
19	Vent on		
20	** END **		
21			
22			
23			

Figure 21. Example recipes for eutectic bonding.

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3.3   Saving new files is File → Write to…
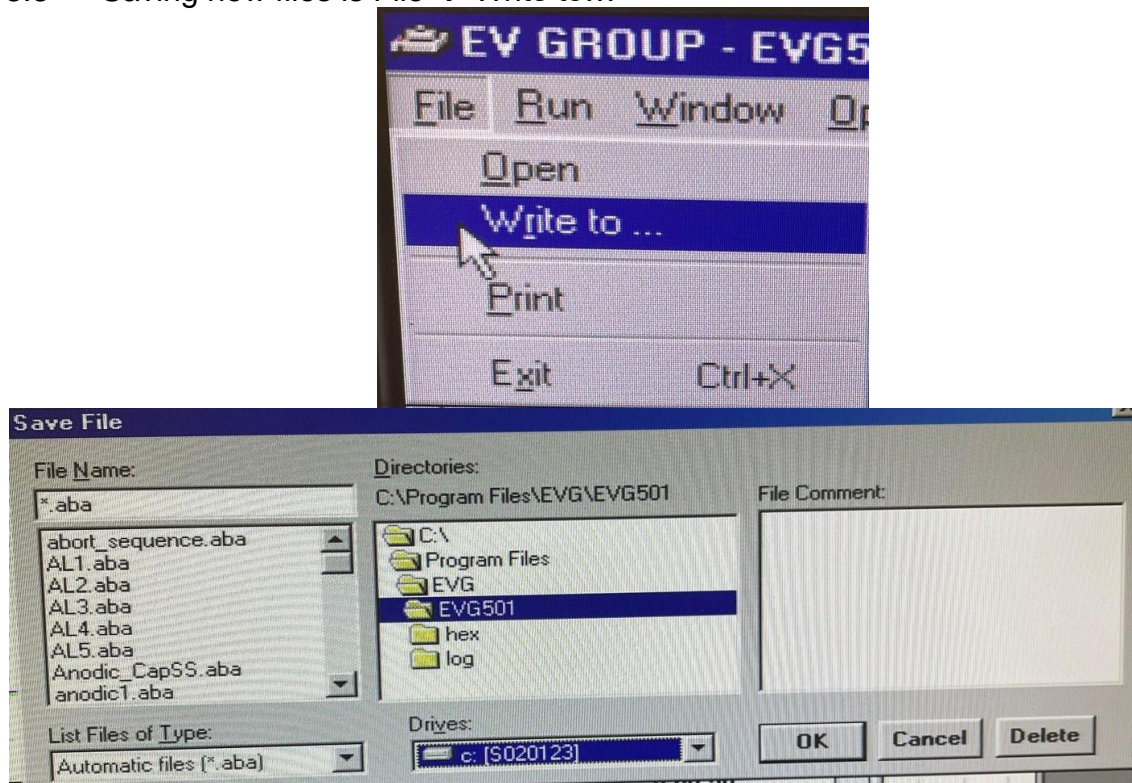

Figure 22. Menus for saving new recipes.

4.0   Running a process

4.1   Once the method is loaded and open on the screen, clicking on Run in
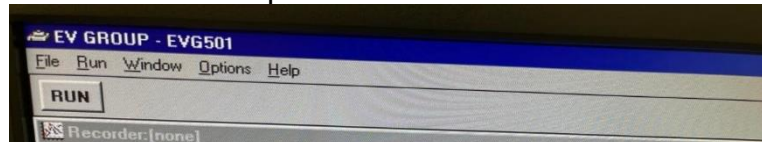   the top left corner starts the process.

Figure 23. Example header when automatic methods are loaded and ready.

4.2   Monitor the process through the process recorder window.

Figure 24. Process recorder/display.
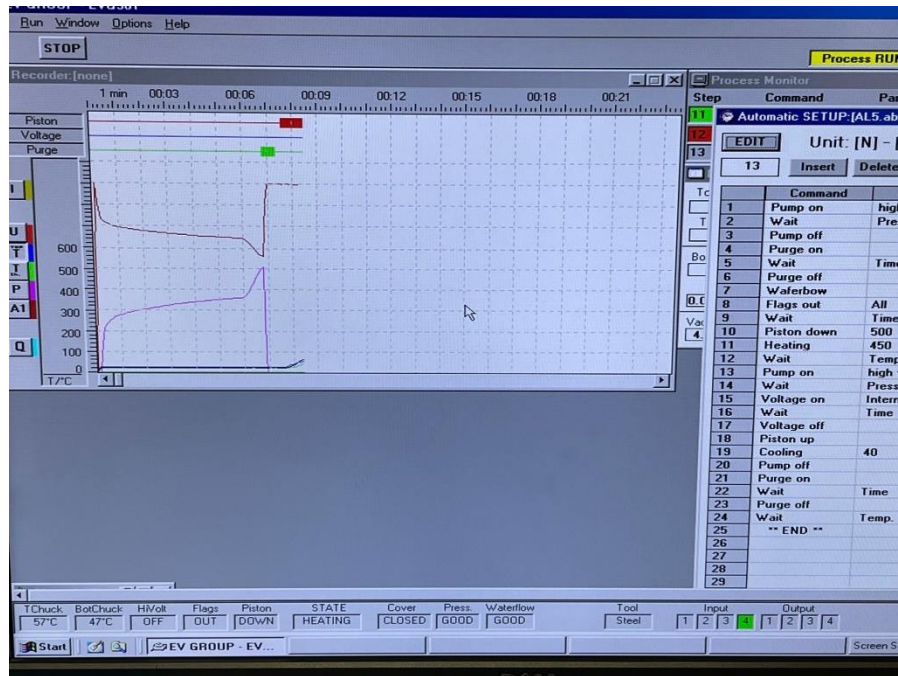
As well as through the External setpoint monitor:

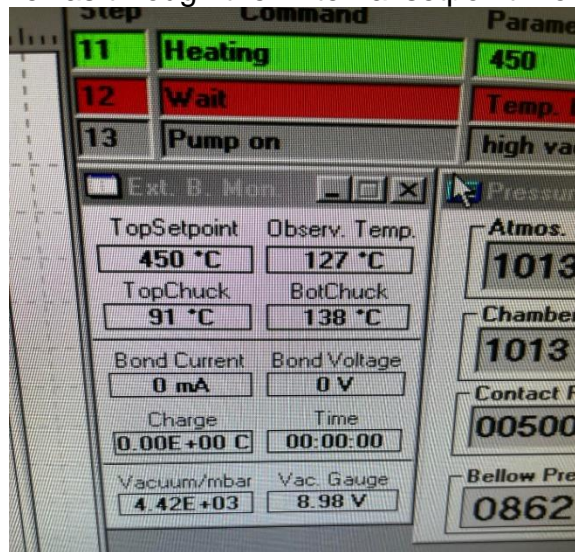

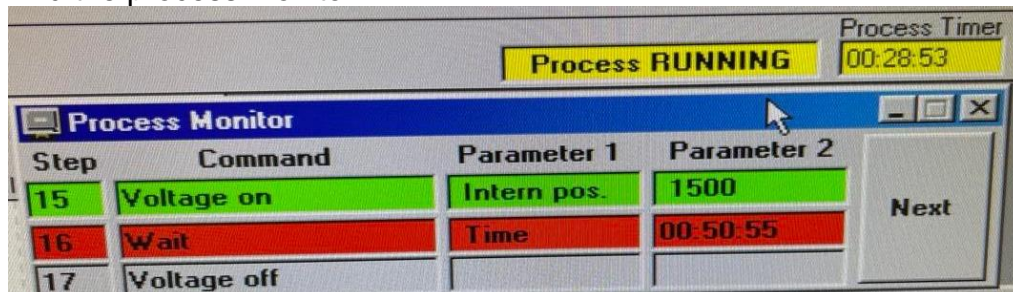Figure 25. External setpoint monitor.

And the process monitor:

Figure 26. Process step monitor. Note: Hitting next will skip the current step.

4.3   If the process does not achieve pressure to go to the next step, make
        sure the turbo pump light is displaying as shown (box is on the right of the
        machine under the turbo pump): If it's not contact staff.

Figure 27. Turbo pump power supply in working condition.

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4.4   If the process does not achieve temperature and gives an error or turns
        off the heating, please contact staff.

4.5   Otherwise allow the process to run and the instrument to fully cool before
        removing the sample.

5.0   Sample Removal

5.1   Once the process has completed, the samples have cooled (Observed
        temp <50C) and the pressure has been brought back to ambient (You
        may need to hit vent). Then unscrew the 4 star knobs securing the top of
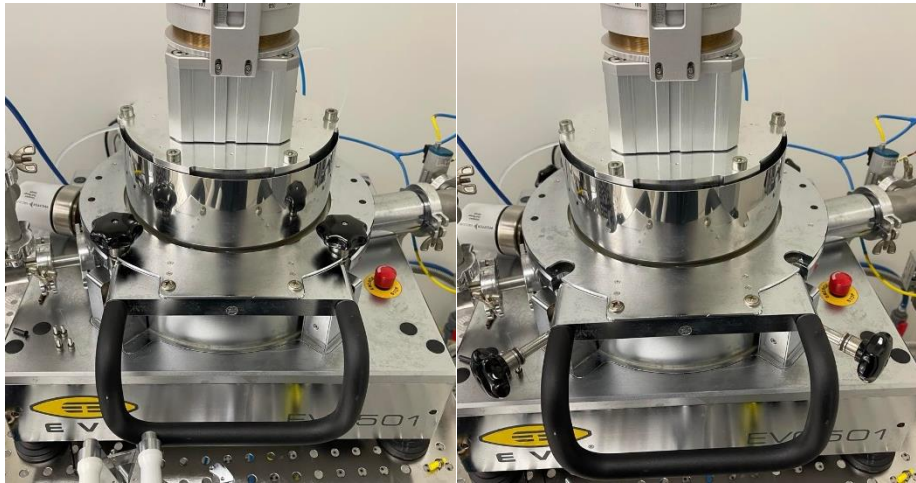   the bonder in place.

Figure 28. Chamber star knob positions. Left is closed chamber for
operation/pump down (star knobs up and secured in place). Right is for opening
chamber (star knobs down). **Note: Wait till chamber pressure shows close to
atmospheric before opening chamber.**

5.2   Using the sample chuck carrier remove the sample chuck from the
        instrument.

5.3   Remove the graphite electrode and return it to the case.

5.4   Remove the alignment glass and return it to the case.

5.5   Remove sample.

5.6   Close the wafer bonder to prevent dust/particulates from entering the
        chamber. And tighten the star knobs slightly to keep it under slight
        vacuum.

5.7   Turn off the roughing pump, heater switch and main power to the bonder.

5.8   Log-off the TUMI. Please note any special process notes or issues.

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