WAFER BONDER - EVG 501

System Owner: Ritu Rashmi (rishmi@ee.iitb.ac.in, 9969437093)

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Authorization Procedure: Hands on training followed by practical cum written test. No authorization till both the tests is cleared.

Expiry of authorization: If user fails to operate the system for more than three months. Clearing both practical and written test mandatory for re-authorization

Norms of violation:

1. Proper shut down of the system including the Nitrogen supply and the mains power.
2. Entering the log book each time the pressure insert is changed.
3. Entering the process parameters and the end result in the log-book after each process.

System Specifications

Allowed Substrates: Silicon, Glass, GaAs (2"and 4")

Types of bonding: thermo compression, anodic, and eutectic.

Maximum heating temperature: 550 C for both top and bottom heaters.

Maximum voltage:

Intern- 2000V
Extern 1- 2000 V
Extern 2- 250 V

Maximum current:

Intern- 50 mA
Extern- 150 mA
Extern- 23 A

Maximum contact force: Refer table below; varies with the size of the wafer, the type of pressure insert used and the sequence of process steps; shaded value when heating is followed by application of pressure while the unshaded values when heating precedes application of pressure.

Pressure Insert	2" wafer		4" wafer	
Stainless steel	1KN	6KN	4KN	30KN
Quartz	0.5KN	2KN	2KN	5KN

OPERATING PROCEDURE

- Mains ON.
- Switch ON the CPU, PC Monitor and the Bonder.
- Turn ON GN2. If pressure below 6 psi on the gauge, connect to a cylinder.
- Turn ON Main Switch on the Bonder.
- Double click on the EVG 501 icon.
- Select HEATING CHUCK TC.

CHANGING THE PRESSURE INSERT

- Click on the MANUAL MODE & press VENT.
- Open the bonding chamber cover by untightening the 4 star knobs crosswise.
- Bring out the bond chuck top using the handling tool.

I. Mounting steel insert

- Take out the quartz pressure insert by removing the clamping pins.
- Remove the bow pin with the help of the key provided with the system
- Remove the three o-rings from the socket meant for the bow pin with the help of a screw driver.
- Fix the flat stub of the steel insert into the socket and tighten it to the extent that it is in level with the top heater.
- Put the graphite discs on the steel insert with the help of IPA in the order that smallest disc lies innermost & largest one is the outermost.

- Fix this pressure insert stack to top heater by means of pins in such a way that he two slots on the steel disc are horizontal.
- Place the top thermocouple in between the middle and last graphite discs and ensure that it is tightly fixed.

II. Mounting Quartz insert

- Remove the steel insert and the central flat stub as mentioned above.
- Place the three o-rings in the socket meant for the bow pin such that the thickest one is the outermost with its polished surface facing out.
- Fix bow-pin tightly in the socket meant for it.
- Stack the graphite discs on the Quartz insert, clamp it to the top heater and fix the thermocouple in the same manner as above.

LOADING the wafer (Manual Alignment)

- Place the first wafer on the bond chuck top followed by the flags (in case flags are being used), then the second wafer, align the wafers properly and finally clamp the bond glass. Put the graphite electrode on top of the bond glass in the slot made for it.

- Place the bond chuck with the handling tool inside the chamber. Ensure that the two positioning pins fit into the holes of the bond chuck top so that the tool thermocouple fits exactly into the hole on the steel insert.

- Remove the handling tool and close the chamber by tightening the four star knobs cross wise.

Adjust Wafer Bow Pin

- Calculate wafer stack thickness e.g. for 2”Silicon wafers

Thickness of first wafer	275 μ
Thickness of second wafer	275 μ
Thickness of flags	50 μ
Thickness of electrode	1000 μ
Total stack thickness	1600 μ

i.e. 1mm 600 μ, one turn of the wheel means a change of the stroke by 1mm which is indicated on the scale for coarse adjustment beside the wheel. For adjustment of micrometers, the scale for fine adjustment on the wheel is used.

Manual Setup

- Double click on the icon for Manual Setup
- Enter the temperature, piston force, voltage and current in the window.
- Enter the time of bonding in the bonding section.
- Activate the various process steps by clicking on the different buttons on the activating bar.
- Press state update button to load actual state of bonder & Rec button to record the different curves of process. Maximum recording time is 24 hour.
- Manual mode is used for exploring new processes.

Automatic setup

- For writing a new recipe or editing an existing one, press password button & enter the correct password.
- Press the automatic button on the automatic setup window & write the recipe by double clicking on the commands on the right hand side followed by enter. Next enter the corresponding process parameter and press enter.
- Press RUN button to start the process.

Program for anodic bonding in Automatic mode

PUMP ON -

WAIT

PRESSURE - 1E-2

PUMP OFF

PURGE ON

WAIT - 3 sec

PURGE OFF

PUMP ON - High Vacuum

WAIT

PRESSURE - 1E-5

HEATING

WAIT - Temperature Top - 300C

WAIT - Temperature Bottom - 300C

WAFERBOW

WAIT - Time- 10 sec

FLAGS OUT - ALL

WAIT - Time- 10 sec

PISTON DOWN PRESSURE 1500N

WAIT - Time- 2min

VOLTAGE ON INTERN NEG 600V

WAIT - Time- 5min

VOLTAGE OFF

PISTON UP

PUMP OFF

PURGE ON

WAIT - Time- 5sec

PURGE OFF

COOLING

WAIT - Temperature Top -30C

WAIT - Temperature Bottom -30C

END

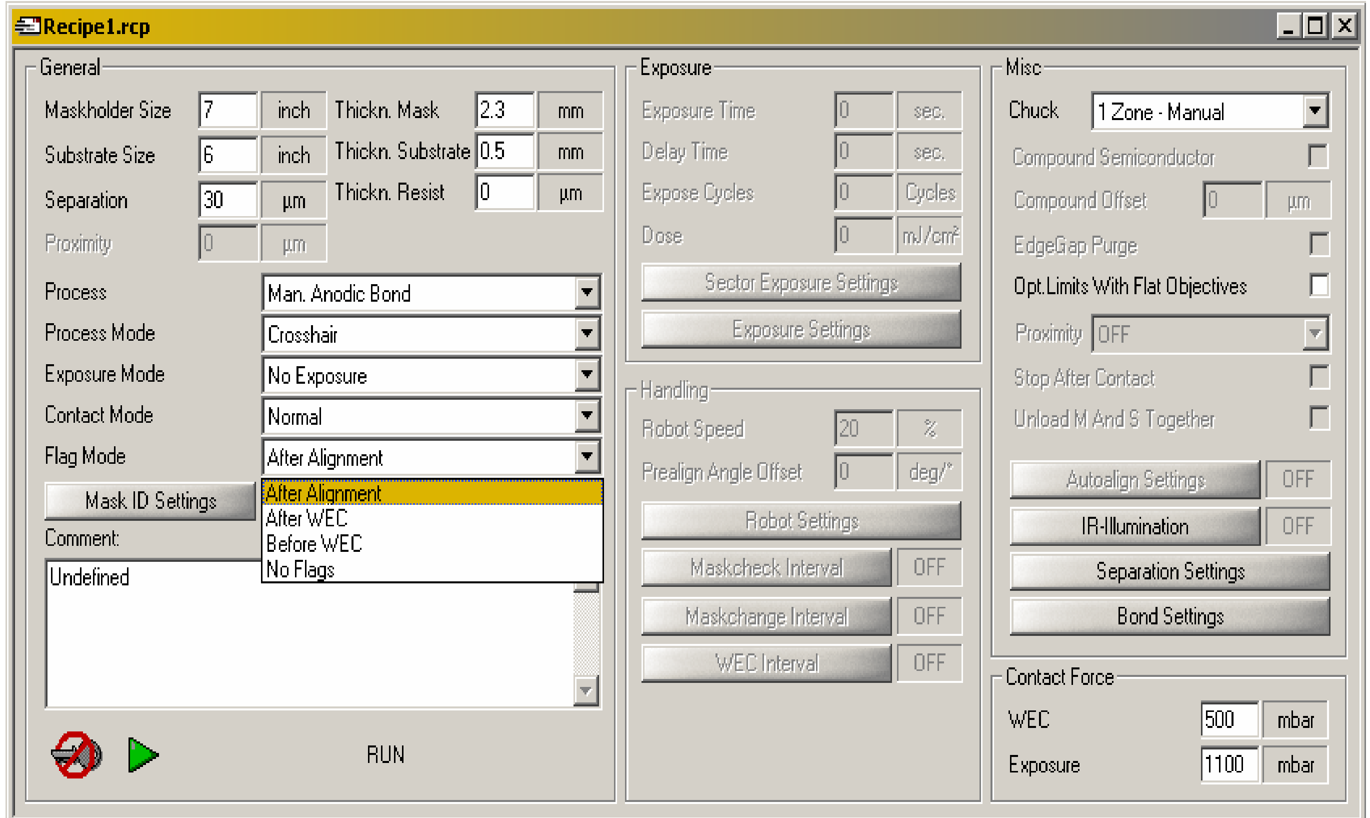
- The steps can be altered as according to one's process requirements.
- For thermo-compression bonding the voltage step is omitted and rest of the program remains the same.

OPTIMIZED RECEIPES

Bonding Substrates	Temp. Top & Bottom(C)	Pressure(N) @time	Time of bonding	Voltage
Si-Si	250	1500 @30min	1 hr.	-
SiO2-SU8	176	1500 @30min	1 hr.	-
Gold-Gold	500	2000	10min	-
Si- SiO2	250	1000	1hr	-
Si-SU8	250	1000	1hr	-
Au on SiO2-Au on SiO2	450	1000	1hr	-

Alignment in DSA

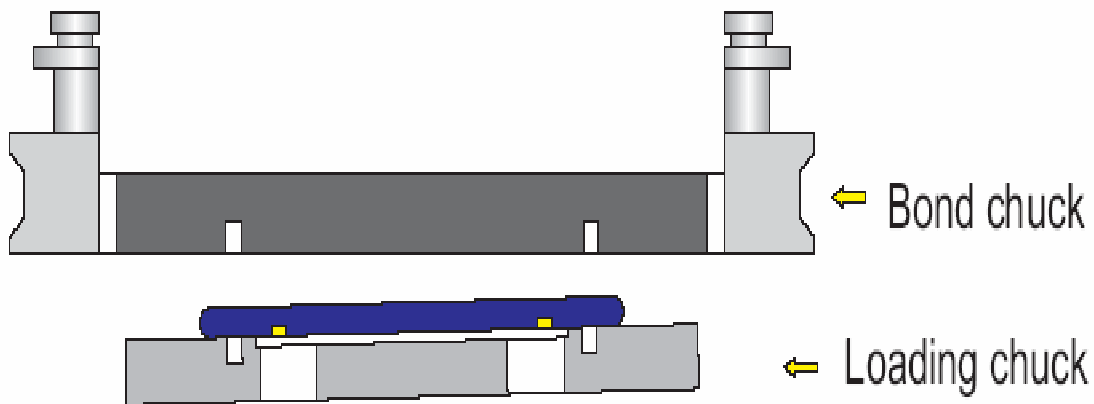
- Adjust the flag mode in the recipe as shown below



2. Flag Mode: After Alignment

Follow the steps in aligner as follows:

Initialization Process
Insert Chuck, Connect Vacuum And Press <Continue>
Insert Bond Tool And Press <Continue>
Fix Tool Clamp as shown below



Load Top Substrate And Press <Continue>
Fix Substrate On Chuck
Remove Ruler And Move Tray In
Check Flags - Must Be Out And Press <Continue>
Wedge compensation
Adjust Microscope And Press <Continue>
Move Tray Out
Load Bottom Substrate And Press <Continue>
Remove Ruler And Move Tray In
Insert Separation Flags And Press <Continue>
Wedge compensation
Remove Separation Flags And Press <Continue>
Adjust Stage And Press <Continue> To Move In Contact
Insert Separation Flags And Press <Continue>
Clamp Aligned Substrates And Press <Continue>
Remove Bond Tool And Press <Continue>
Move Tray Out
End Of Process - Press <Continue> Or <Exit>

Flag Mode: After WEC

Initialization Process
Insert Chuck, Connect Vacuum And Press <Continue>
Insert Bond Tool And Press <Continue>
Fix Tool Clamp
Load Top Substrate And Press <Continue>
Fix Substrate On Chuck
Remove Ruler And Move Tray In
Check Flags - Must Be Out And Press <Continue>
Wedge compensation
Adjust Microscope And Press <Continue>
Move Tray Out
Load Bottom Substrate And Press <Continue>
Remove Ruler And Move Tray In
Wedge compensation
Insert Separation Flags And Press <Continue>
Adjust Stage And Press <Continue> To Move In Contact
Clamp Aligned Substrates And Press <Continue>
Remove Bond Tool And Press <Continue>
Move Tray Out
End Of Process - Press <Continue> Or <Exit>

Flag Mode: Before WEC

Initialization Process
Insert Chuck, Connect Vacuum And Press <Continue>
Insert Bond Tool And Press <Continue>
Fix Tool Clamp
Load Top Substrate And Press <Continue>
Fix Substrate On Chuck
Remove Ruler And Move Tray In
Check Flags - Must Be Out And Press <Continue>
Wedge compensation

Adjust Microscope And Press <Continue>
Move Tray Out
Load Bottom Substrate And Press <Continue>
Remove Ruler And Move Tray In
Insert Separation Flags And Press <Continue>
Wedge compensation
Adjust Stage And Press <Continue> To Move In Contact
Clamp Aligned Substrates And Press <Continue>
Remove Bond Tool And Press <Continue>
Move Tray Out
End Of Process - Press <Continue> Or <Exit>

Flag Mode: No Flags

Initialization Process
Insert Chuck, Connect Vacuum And Press <Continue>
Insert Bond Tool And Press <Continue>
Fix Tool Clamp
Load Top Substrate And Press <Continue>
Fix Substrate On Chuck
Remove Ruler And Move Tray In
Check Flags - Must Be Out And Press <Continue>
Wedge compensation
Adjust Microscope And Press <Continue>
Move Tray Out
Load Bottom Substrate And Press <Continue>
Remove Ruler And Move Tray In
Wedge compensation
Adjust Stage And Press <Continue> To Move In Contact
Clamp Aligned Substrates And Press <Continue>
Remove Bond Tool And Press <Continue>
Move Tray Out
End Of Process - Press <Continue> Or <Exit>

- Clamp whole Stack, unload tool and transfer to EVG500 Bonder series and repeat the steps as for manual alignment.

Shutdown Procedure

- Turn Off the Heater switch
- Allow the system to cool to a temperature below 50C.
- Press VENT in Manual Setup.
- Open the cover and take out the bond chuck using the handling tool.
- Close the cover and press PUMP in manual mode for 2 min.
- Close the software window
- Shutdown PC
- Switch Off Mains Switch on Bonder.
- Turn off GN2 supply
- Switch off the MAINS, CPU, PC Monitor and the Bonder.

2nd System Owner

Student System Owner:

Sreetama (sreetama@ee.iitb.ac.in, 9769907810)

Project Staff System Owner:

Neha (nehar@ee.iitb.ac.in,9869547742)

First Level Tool Maintenance

- **Check the heating circuits:** Check the LED display on the right side wall of the bonder; 4 LED's labelled as bottom and the 1 labelled as top display the status of the 4 circuits of the bottom heating chuck and the top heating chuck respectively. If top LED is OFF it shows that the top heater is not working and in case one of the bottom LEDs are not glowing then the heating up time would last longer and the temperature uniformity would be bad.

- **Main pressure:** Inspect the main pressure regulator on the rear wall. The normal pressure would be around 6.5bar, when you activate cooling the pressure shouldn't drop below 6bar.

- **Bond tools:** Visually inspect the bond tool surface and ensure that there are no deposits or scratches visible. Clean the bond tools with alcohol. Particularly the top and bottom surface of the bond chuck insert.

- **Flags:** Make a visual inspection of the flags on the bond tools. Insure that the flags are not bent, and that the screws which hold them in place are secure. The flag height must be higher than the bottom wafer. Control the motion of the flag pulling mechanism manually. It has move real smooth and there shouldn't be any cracked wafer pieces in the bellow of the pulling mechanism.

- **Clamping glasses:** Make a visual inspection of the clamping glasses. Check if the glass is scratched or if it has a scratch.

Upgrading the tool

The system can be upgraded for handling smaller pieces of substrates by ordering for smaller pressure insert and bond chuck.

Written Questions for authorization

1. What needs to be done if emergency stop button is pressed?
2. How should be the wafers positioned in case of anodic bonding between glass and Silicon?
3. What needs to be done if a recipe does not require piston pressure both in the manual as well as automatic mode?
4. What is the utility of wafer bow step?
5. What should be done if maximum pressure cannot be achieved?
6. Give the sequence of steps one needs to carry out when end vacuum is not reached.
7. What are the probable reasons if bonder doesn't reach end temperature?
8. List the troubleshooting steps in case bonder doesn't heat.
9. Where can the reflector panel be found in the bonder?
10. What are the typical temperature, voltage and pressure values one must not exceed while using this bonder?