EVG 610 SDB mode User Manual

Version of 2024-11-19.

1. Introduction

This manual explains how to operate the EVG 610 in silicon direct bond (SDB) mode to align and put in contact two wafers that will directly bond together by applying vacuum and a piston-driven pressure on the stack.

This mode uses different tools compared to the standard wafer to wafer bond aligner: The two bonded wafers are coming out of the tool from the loading slide and not mounted on the EVG 510 bond chuck.

Note: The EVG 610 standard operation mode is wafer to wafer bond aligner. Users are trained and responsible for switching the EVG 610 set of tools from bonding to SDB, and back at the end of the process.

2. Alignment mode options and requirements

The EVG 610 can align wafers with different methods which all have specific requirements in terms of wafer material and alignment marks side and position.

Make sure to respect these requirements!

A. Silicon / Glass, visible illumination
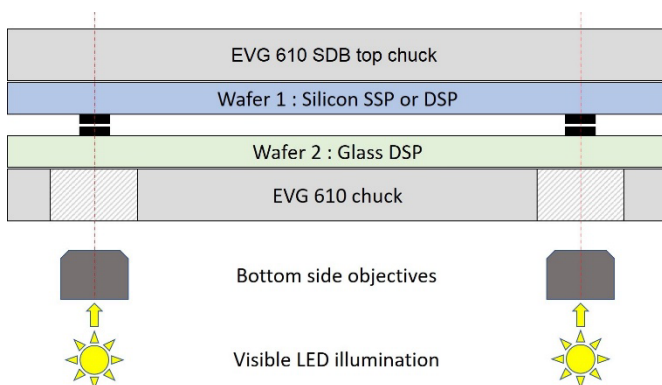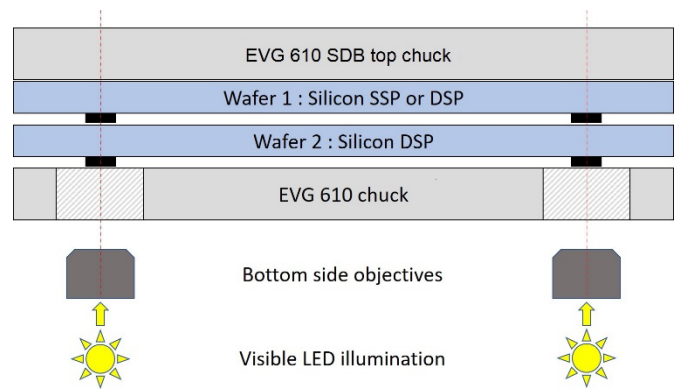

This configuration is used when one of the two wafers is transparent to visible illumination, or has punched-trough openings (to see the other one).

Requirements:

- The bottom side-wafer is double-side polished (DSP) and transparent, or has punched-trough openings.
- Alignment marks are present on the bond interface of both wafers.
- Marks position on both the left and right side of the wafer are within +/- 15000 < X < +/- 45000 [um], and +/- 10000 < Y < +/- 10000 [um].

B. Silicon / Silicon, visible illumination

This configuration is used when both wafers are silicon, opaque to visible illumination, and without punched-through openings. The fabrication will require additional process steps since the alignment marks will need to be replicated on the opposite side of wafer 2.

Requirements:

- The bottom silicon wafer (wafer 2) is double-side polished (DSP).
- Alignment marks are present on the bond interface of wafer 1, and on the opposite side of wafer 2.
- Marks position on both the left and right side of the wafer are within +/- 15000 < X < +/- 45000 [um], and +/- 10000 < Y < +/- 10000 [um].

In this operation mode, the first wafer is loaded and the alignment mark positions are found

with the bottom side objectives. <u>The positions are recorded by placing a visual indicator on the mark (crosshair) or by grabbing an image (overlay).</u> The second wafer is then loaded and aligned with the crosshair or the overlay image.

3. Login on CAE

Login with your "CMi" username and password on the Zone 06 CAE accounting computer.

Select the "EVG 610 – Double side mask aligner and bond aligner"

> ⓘ   Z06 EVG 610 - Double side mask aligner and bond aligner
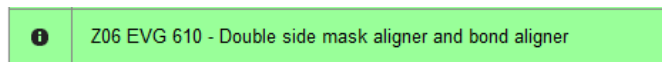
4. Setting up a "SDB" job with the EVG 610 User Interface

The EVG 610 user interface should be always opened. At the bottom of the user interface, different tabs are available, but only **"Recipes"**, that should be active by default, is used by the operator.
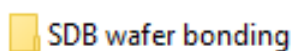
> Recipes

Recipes are loaded into the main window by clicking on:

> Open Recipe
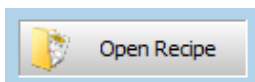
In the default "Recipes" folder, five recipes will be available for mounting wafers on the EVG 510 chuck for bonding experiments.

Recipes for the SDB mode, will be found in the "SDB wafer bonding" folder :

> 📁 SDB wafer bonding

! Do not change the parameters in the recipes unless it has been discussed and approved by the Staff. User-modified recipes should be saved in the "User" folder!

Once the recipe has been loaded, it will be started by clicking on:

> ▶   RUN

## 5. Sequence example: 4 inch wafers alignment (with overlay) and bonding

This sequence consists in a series of ~20 steps that will be detailed below.

Make sure to follow all the steps until the end of the process!

To help you progress through the steps, indications will be given in textual format, with an image and a small animation of the task to be performed.

<u>Once completed, the operator can move to the next step by clicking on "Continue".</u> Some steps, such as alignment, can be repeated if the user is not satisfied with the results by clicking on "Undo".

> ▶ Continue   Undo
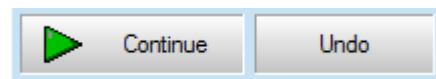
An overview of the user interface (UI) during the running recipe sequence is available at the end of this guide.

<u>Steps in details:</u>

When the users start with the EVG 610, the tools for the bond chuck preparation will be loaded in the machine.
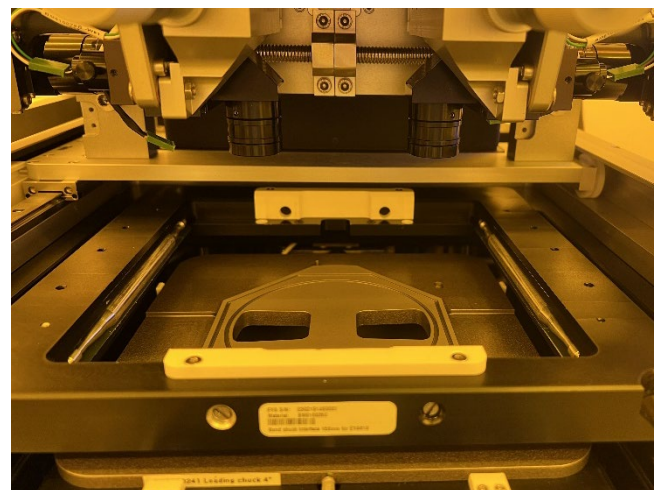
<u>Step 1:</u> "Configure Optic" → no operation needed

Step 2: "Move Tray Out" → Pull the tray our completely

Step 3: "Insert Adapter frame" → Ignore this step

With the current design of the bond tool, this step is actually wrong since the adapter frame needs to be removed and replaced with the SDB bond tool.

Step 4: "Fix Adapter Frame" → Ignore this step

Step 5: "Insert Bond Tool" → Exchange the adapter frame with the SDB bond tool

The adapter frame is loaded inside the machine and should be removed first, then the SDB bond tool can go in.

[1] Unscrew and push the clamps out
[2] Pull the adapter frame out without touching the optics
[3] Check for the presence of the 4 rubber rings!

Front rubber o-ring (one on each side)
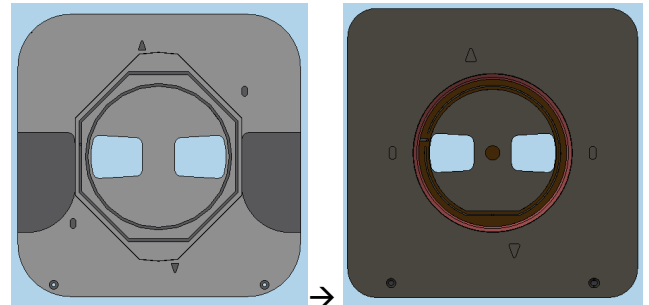
Back rubber o-rings
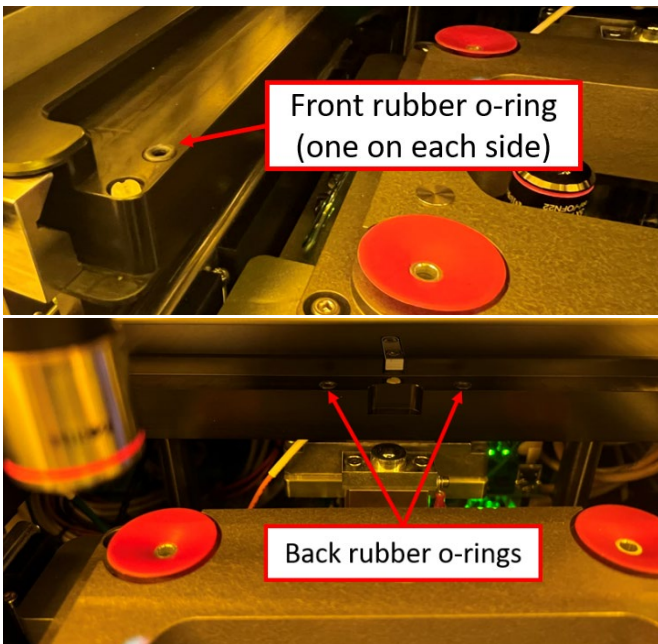
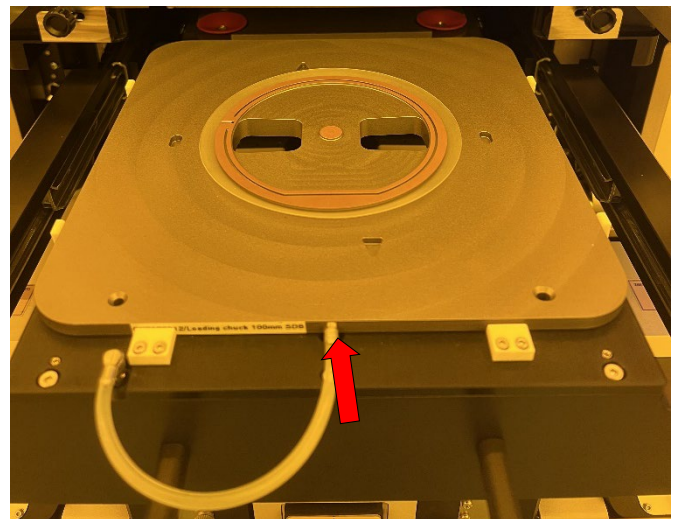[4] Insert the SDB bond tool
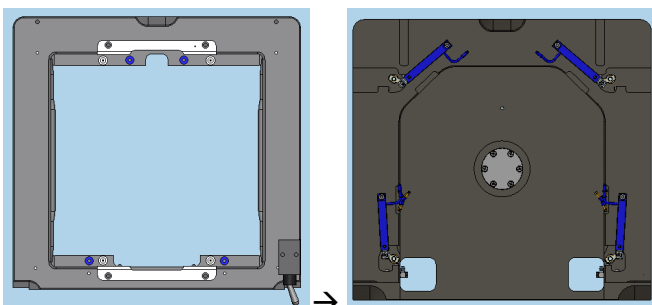
Step 6: "Fix Bond Tool" → make sure to screw the maskholder in place with the clamps
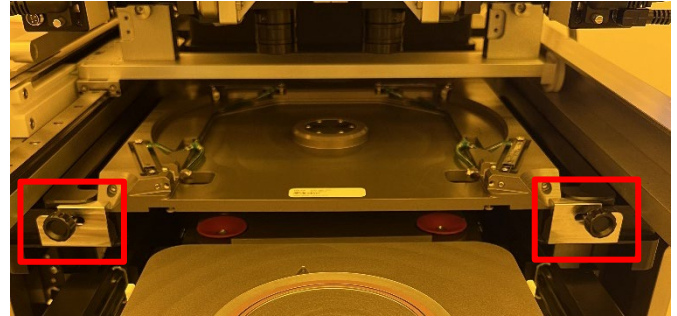
Step 7: "Insert Chuck, Connect Vacuum" → Replace the bond loading slide by the maskaligner chuck


Do not forget to connect the vacuum tube!

Step 8: "Mount Seal Ring" → No action needed (seal already mounted)

Step 9: "Insert Ruler" → !Read below!

The ruler is a simple tool to align the wafer on the chuck. Since it is extremely clunky to use, we will not insert it.

Step 10: "Load Top Substrate" → Load wafer 1 on the chuck.

The substrate is loaded with the bond interface facing **DOWN**. Make sure to align the flat towards the front.
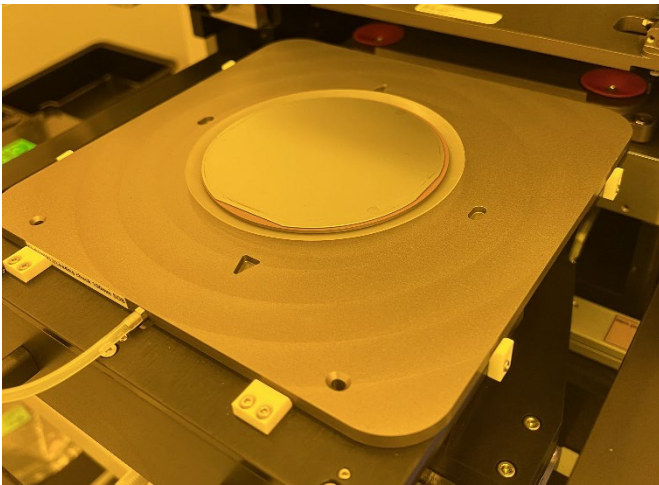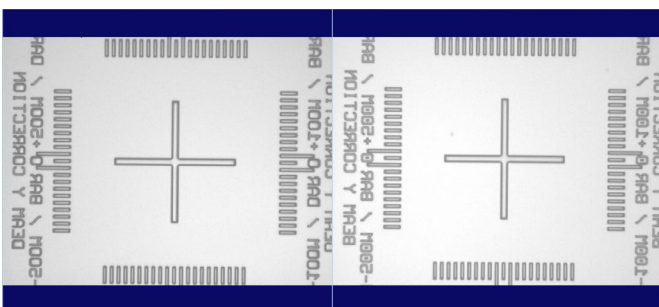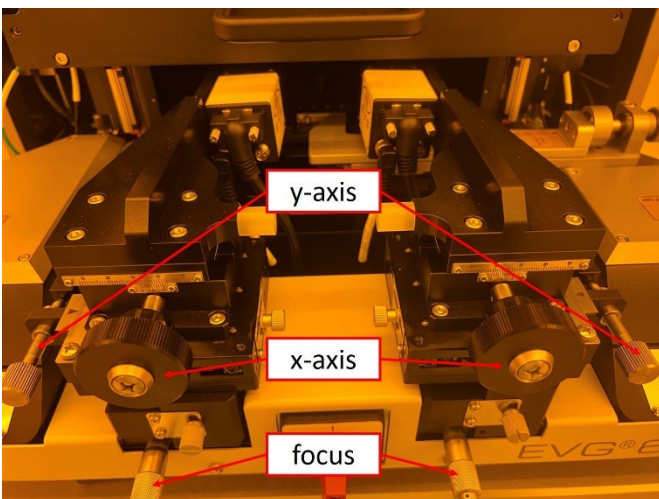

Step 11: "Remove Ruler" → No action needed

Step 12: "Move Tray In" → Push the tray all the way in the machine.

The wafer is pushed against the SDB bond chuck (WEC).

Step 13: "Adjust Microscope" → Adjust the position and focus of the bottom-side left and right microscope objectives until the alignment marks are centred in the field of view.

The wafer will now be transferred to the bond chuck and held by vacuum.

Step 14: "Move Tray Out" → Pull the tray our completely

Step 15: "Insert Ruler" → no action needed

Step 16: "Load Bottom Substrate" → Load wafer 2 on the three contact points.

The substrate is loaded with the bond interface facing **UP**.

Step 17: "Remove Ruler" → no action needed

Step 18: "Load Tray In" → Push the tray all the way in the machine.

The WEC procedure will start between the two wafers. Wait until completion.

Note: The WEC is done with separation flags automatically inserted between the wafers to avoid contact and non-aligned direct bonding of the surfaces.

Step 19: "Align Substrate" → Align the two wafers
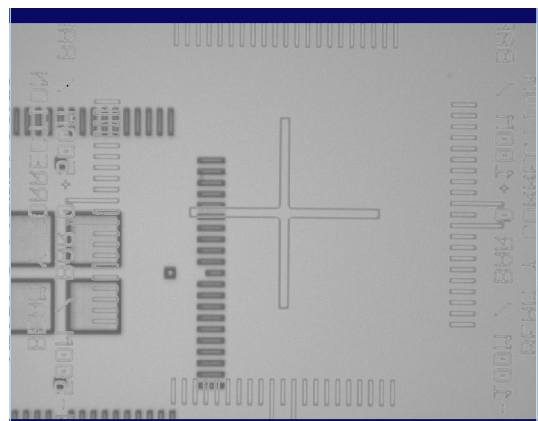
Wafer 2 should now be visible in the field of view of the microscope objectives, assuming the alignment marks have been correctly replicated on the wafer backside.

If wafer 2 is not visible, it means that the overlay transparency settings are not set correctly. These settings are found in the "Controls" advanced settings (right side of the screen). The button changes the polarity of the transparency (either dark or clear pixels become transparent), while the sliders control the level of transparency.
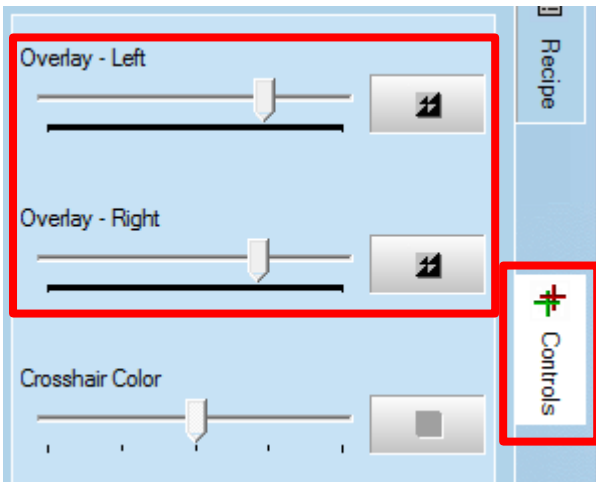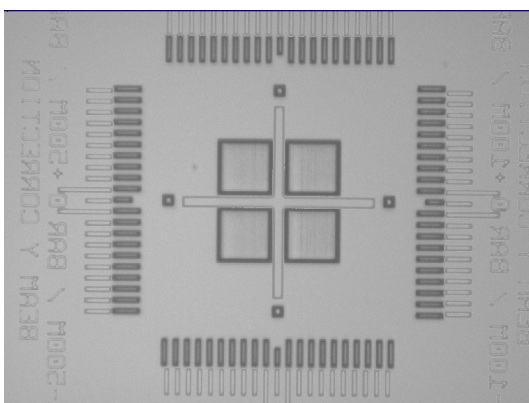

The wafer is moved with the stage knobs on both side of the machine!

Warning: Make sure not to touch the objective knobs!!
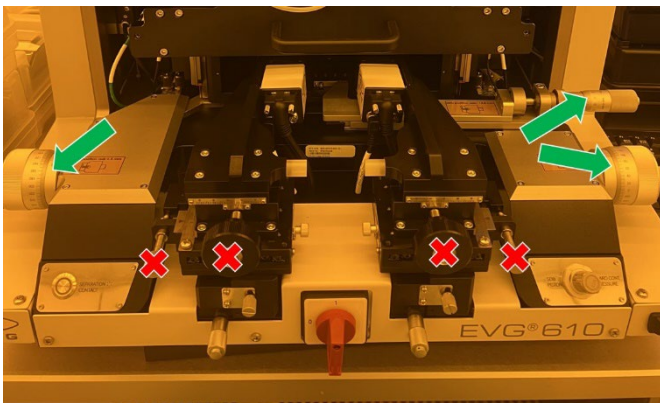
Move the wafer until it is correctly aligned on both sides.

After pressing "Continue", the bottom wafer moves in proximity to the first wafer and the SDB bonding process will initiate. This consist in:

- Application of piston-driven pressure at the centre of the stack for a certain duration to force the initial contact and bonding at the centre [4s]
- Vacuum contact applied between the wafers to propagate the bonding front up to the edges [4s].
- Bond stabilization time [20s].

The bonded wafers are now ready for unloading.

Step 20: "Move Tray Out" → Pull the tray our completely

Step 21: "Remove Substrate" → Remove the bonded substrates

Step 22: "End Of Process" → Press Continue or Exit

- Press "Continue" to bond additional wafers. The procedure repeats from Step 10.
- Press "EXIT" to finish the process and go back to the recipe selection window.
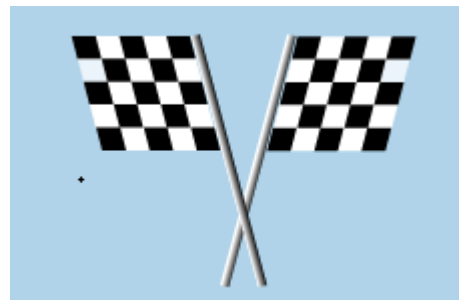
Switch back the set of tools (chuck & adapter frame) from SDB to bonding.

At that point users may log out of the equipment on CAE.

EVG 6Series - Unlimited Registration - DirtyBond.rcp

Man. Anodic Bond

Engineer

OK

2024-09-24   14:32

Insert Bond Tool And Press <Continue>

Indications in:
- **Textual format**
- **Schematic**
- **Animation**

Advanced menu & settings

Lamp / Camera settings

Vacuum / Tool force monitoring

← Continue / Undo buttons

Contact Mode
Stop After Contact   On   OFF
Alignment Offset   ON   OFF
WEC Interval   OFF
Sector Exposure Settings

Exposure Time   Set
Dose   0   Set

Alignment Accuracy   0.3   µm   Set
Separation   80   Set
Proximity   0   Set
Vacuum Contact   800   Set
Process   500   mbar   Set

Substrate Size: 4 inch
Process Mode: Overlay
Exposure Mode: —
Spacer Mode: None
Mask ID: —

		bar
Contact Force	0.014	bar
Vacuum Mask	0.000	bar
Vacuum Chuck	-0.054	bar

Scan Stage   Scan Optic   Scan IR

LED Red Left   LED Red Right   Shutter
LED Green Left   LED Green Right   Brightness
Contrast

4x   2x   1x   L   R

Continue   Undo   Sep/Cont   Exit