

Anodic Bonding Operational Procedure

(Bonding setup – room 144)

1.0 Title

Anodic Bonding Setup for bonding silicon and glass wafer together.

2.0 Purpose

This bonding setup is to bond silicon and glass substrate together.

3.0 Scope

This document covers the bonding setup operational procedure, which includes temperature and voltage setting, wafer loading/unloading, process status monitor, and wafer cleaning requirements.

4.0 Definitions & Process Terminology

Anodic Bonding: a wafer bonding process to seal glass to either silicon or metal without introducing an intermediate layer; it is commonly used to seal glass to silicon wafers in electronics and microfluidics. This bonding technique, also known as field assisted bonding or electrostatic sealing, is mostly used for connecting silicon/glass and metal/glass through electric fields. The requirements for anodic bonding are clean and even wafer surfaces and atomic contact between the bonding substrates through a sufficiently powerful electrostatic field. Also necessary is the use of borosilicate glass containing a high concentration of alkali ions. The coefficient of thermal expansion (CTE) of the processed glass needs to be similar to those of the bonding partner.

High Voltage: an electrical potential large enough to cause injury or damage.

5.0 Safety

Follow general safety guidelines in the lab as well as the specific safety rules as per follow:

5.1 **Electric Shock Hazard:** This setup utilizes **high voltage** power supply (low current) to generate electrostatic field. Do not touch the high voltage electrical parts!

5.2 **Burn Hazard.** The hotplate is set to above 400°C during the bonding. Avoid touching of any part of the hotplate! No flammable chemical, especially organic solvents should be in the bonding station.

6.0 Bonding Procedure

6.1 Clean wafer

Anodic bonding requires clean wafer surfaces.

Cleaning wafers by soaking and rinsing with acetone, IPA, and DI water, then blow dry with nitrogen gun.

The wafers should then be cleaned using Piranha if possible. Avoid particles or residues left on wafer surfaces!

6.2 Load wafer

Stack silicon and glass wafer pair together, then load them onto the polished aluminum surface with silicon on top of the glass.

Then apply the top metal piece onto the wafer pair.

Connect the ground of the power supply to the metal piece beneath the wafer pair, then connect the positive output of the power supply to the metal piece on top of the wafer pair.

6.3 Temperature field setup

Turn on the hotplate.

Set the temperature to 460°C.

Wait for temperature field to be balanced. Hours waiting time may be required!

6.4 Electrostatic field setup

Set the output of the high voltage power supply to be zero.

After the temperature is balanced, turn on the high voltage power supply.

Increase the voltage output gradually (for example, increase 100 volts each time, and then wait for current to come down). Avoid high current output for better bonding quality!

Set voltage at 800 volts. Electrical shortage (signaled by suddenly reduced voltage output) may happen at even lower voltage! If shortage is observed, stop increasing the voltage!

Wait for bonding to be finished (signaled by no current output any more). Approximately more than 1 hour waiting is needed!

6.5 Remove electrostatic field

After the bonding is completed, gradually reduce the voltage output of the power supply. For example, reduce the output 100 volts each time, then wait for 5 minutes; repeat until the output is 0 volt.

Turn off the high voltage power supply.

6.6 Cool down

Turn off the hotplate.

Wait for the setup to cool down to below 50°C.

6.7 Unload wafer

After the setup is cooled down, disconnect the power supply.

Remove the top metal piece.

Unload the bonded wafer pair.
Record any valuable observations.