

PDMS-Glass Bonding via Oxygen Plasma

Standard Operating Procedure

Faculty Supervisor: Prof. Robert White, Mechanical Engineering (x72210)

Safety Office: Peter Nowak x73246 (Just dial this directly on any campus phone.)

(617)627-3246 (From off-campus or from a cell phone)

Tufts Emergency Medical Services are at x66911.

For more information on the March Plasmod or plasma in general see:

<http://www.marchplasma.com/>

Revised: April 5, 2007

1.0 Material Requirements:

1.1 Equipment: Wafer tweezers/forceps

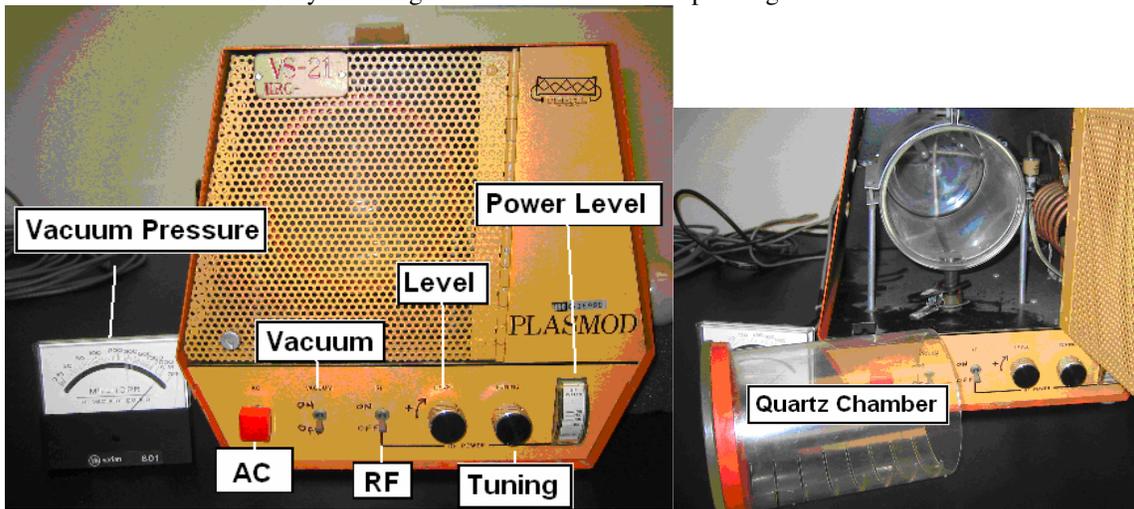
1.2 Personal Protective Equipment: Nitrile gloves and goggles.

2.0 Procedure:

To ensure optimal surface hydrophilicity, plasma treatment and bonding should be done immediately before the devices will be used. PDMS returns to a hydrophobic state within hours.

2.1 For best results, you may want to clean any glass parts being bonded. Rinse each glass piece with acetone, isopropanol, and methanol, and allow to air dry.

2.2 Turn on Plasmod with “AC” button in front. The button will not light up; you can make sure the unit is on by checking if the fan in the back is operating.



2.3 Open metal door (arrow on handle points left) and pull out the chamber.

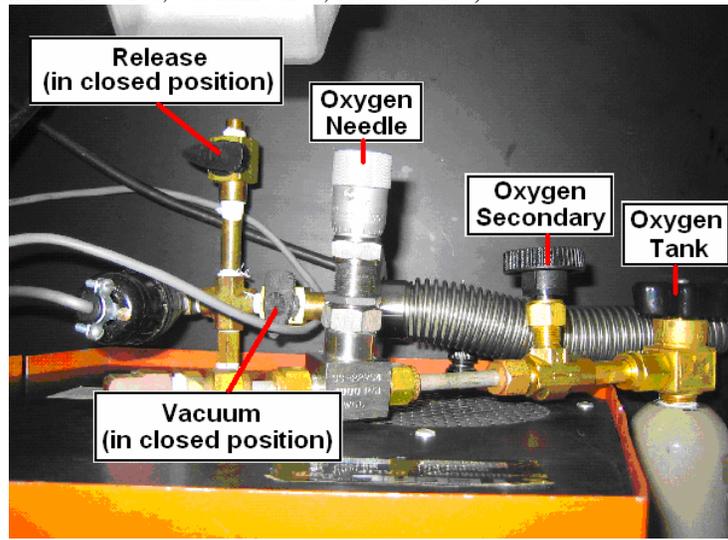
2.4 With forceps or wafer tweezers, place pieces to be bonded in chamber and replace chamber. The door can be left open – the chamber needs to be held in place when vacuum is first turned on to ensure a tight seal.

2.5 **Place the pieces to be bonded with the bonding side DOWN. The plasma is dense near the walls, and you will get a much better bond if the surfaces you want to bond are close to the chamber walls.**

Notes: 1. Any part of the PDMS that is actually in physical contact with the chamber walls will not be exposed to plasma and so will not bond.

2. The tube leading to the vacuum pump comes up to the front of the chamber. Do not obstruct that part of the chamber with your samples, or the chamber will not pump down very well.

- 2.6 Make sure all valves are closed (5 valves: oxygen tank valve, oxygen secondary valve, oxygen needle valve, vacuum valve, release valve)



- 2.7 Turn on pump under the table (switch is on the front).
- 2.8 Open valve connected directly to the vacuum hose (“vacuum” valve). The thermocouple vacuum gauge should now indicate that a vacuum has formed. Wait for reading to drop below 100 mTorr.
- 2.9 Turn on the “vacuum” switch on the front of the Plasmod while holding the quartz canister tight to the seal. The chamber is now being pumped out. You will need to move the outer chamber around gently and press it up against the seal to get a good seal. You will hear the hissing sound stop when you get a good seal, and the pressure will start to drop again.
- 2.10 Close the metal door.
- 2.11 Wait for the chamber to pump down so that the vacuum gauge to reads ~100 mTorr.
- 2.12 Open the oxygen valve on the oxygen tank completely; do the same with the “oxygen secondary” valve on the line.
- 2.13 Open the “oxygen needle” valve slowly to create a controlled leak and allow oxygen into the chamber. It takes ~6 full turns of the needle valve before it first opens. After it opens, you will need to adjust it gently to balance the oxygen leak against the pumping rate to achieve your desired operating pressure.
- 2.14 Control the needle valve so the vacuum reading stays around 500 mTorr and remains stable.
- 2.15 Wait for two minutes... you are allowing oxygen to flow through the chamber and purge out most of the remaining nitrogen.
- 2.16 Adjust the needle valve to achieve your desired operating pressure for the plasma treatment. 200 mT is recommended.
- 2.17 Make sure the metal chamber door is closed.
- 2.18 Make sure that “Level” dial is turned completely down, and then turn on “RF” switch.
- 2.19 Turn “Level” up to 50 Watts. You should see a plasma glow in the chamber. The plasma should be a blue-ish color. Once the plasma forms, adjust the matching network tuning using the “tuning” knob to create a bright, uniform, and stable plasma. Plasma will flicker off when tuning is adjusted too far; back it down and retry.
- 2.20 Once plasma is stable, set desire power level using the “Level” knob (50 Watts is recommended), and plasma treat the surfaces for desired time. (Approximately 30s is suggested for bonding PDMS to glass.)
- 2.21 Turn down power level completely.
- 2.22 Turn off “RF” switch.
- 2.23 Close oxygen valves (starting at the valve on the tank and working back to Plasmod)
- 2.24 Turn off “vacuum” switch.
- 2.25 Open metal door, take out quartz chamber and remove pieces with forceps/tweezers. Replace the chamber and close the door.

- 2.26 Place the PDMS in contact with the glass (remember, use the sides that were facing down in the plasma tool!).
- 2.27 Press the PDMS onto the glass. You should see a darker region form at the interface when the two surfaces bond.
- 2.28 Put the glass/PDMS structure on a 75°C hotplate for 5 minutes to increase bond strength.
- 2.29 Close pump valve.
- 2.30 Turn off pump.
- 2.31 Open vacuum release valve (the valve farthest back and facing the wall).
- 2.32 Open pump valve.
- 2.33 Close all valves.
- 2.34 Turn off “AC” button on front.

If at any time you feel a situation is dangerous, do not hesitate to call the safety office (x73246, Peter Nowak) or the faculty supervisor/lab manager (x72210, Robert White).

Report all accidents (injuries, major spills, fires) to the safety office at x73246 (Peter Nowak). For emergencies, call Tufts Emergency Services at x66911.