

Plasma Bonding

Microfluidic devices made from PDMS typically need to be bonded to a glass slide before being used. The bonding process creates a tight seal between the PDMS and the glass, so that fluids and cells remain confined to the channel. This process is facilitated by a technique known as plasma bonding. In essence, exposing both bonding surfaces to an oxygen plasma makes them extremely clean, which facilitates the bonding process. The oxygen plasma is generated by a plasma cleaner like the one shown below. The plasma bonder we will be using in class looks somewhat different, but has the same functionality.



The first step in plasma bonding is to make any needed holes in your PDMS (i.e., fluid inlets and outlets). Next, make sure your device is reasonably clean and dry. If it is dirty (e.g. from fingerprints), wash it with soap and water and allow it to air-dry. You can speed up the drying process with compressed air if desired; don't use paper towels, which will leave fibrous residue on the PDMS.

Place your device, bonding side up, on a glass slide covered in transparent tape. The tape keeps the device from sticking to this slide. Place the glass slide to which you plan to bond the device on another tape-covered slide. Insert both slides into the chamber of the plasma bonder, as shown in the image below.



Close the chamber door, close the release valve (the picture below shows the device with the release valve closed; compare it to the first picture above). Flip both switches to the "On" position, but do not turn up the RF level yet.



The vacuum pump has two indicators that tell you when the vacuum is ready. First, a light on the pump itself turns from yellow to green. Second, the vacuum gauge shows that the pressure drops to about 65 mbar (i.e., 65/1000 of atmospheric pressure) and stabilizes there. At this point you can turn the RF signal on to the highest setting. When you do so, you should see a purple glow coming from the inside of the chamber.



The purple glow indicates that the RF coil is working. At this point we need to add enough oxygen to generate the plasma, while being careful not to release the vacuum entirely. To do this, open the release valve on the door **very** slightly. When it is opened just enough, the plasma will turn from a purple to a pink color. If you open it too far, the plasma will disappear entirely. Allow the devices to sit in the plasma for a full minute. After one minute, turn the RF signal off, shut off the pump, and release the vacuum by opening the release valve fully.



Take your devices out of the chamber, being careful to handle only the tape-covered slides. You must bond your devices within 60 seconds of shutting off the plasma. To bond the devices, simply bring the two cleaned surfaces into contact. You can do this by placing the PDMS on the glass slide or vice-versa, whichever you find easier. You should be able to see the PDMS device seal itself against the glass slide. You might need to apply pressure in some locations to ensure a good seal. Be sure not to apply too much pressure where your channels are, or you may cause them to collapse.