PDMS (Silicone) Protocol

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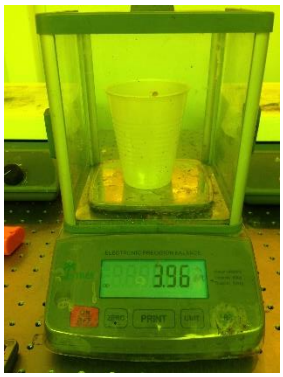
1 Pouring & Mixing

Polydimethylsiloxane (PDMS) is a two-part polymer (Base Elastomer and Curing Agent). Our lab uses Sylgard 184 from Dow Corning. The standard mixing ratio for PDMS is 10-parts base elastomer and 1-part curing agent. This ratio provides the mechanical properties that are desirable and optimum biocompatibility.

Uncured PDMS is toxic to cells

All steps should be done in Cleanroom



1. Turn on the PDMS scale
2. Measure the mass of the mixing container and mark it down (*example → 3.96 g*).

3. Obtain PDMS Base Elastomer carboy or small PDMS Base Elastomer container (*depends on how much the lab has bought at the time*)
4. Place mixing container under the spigot.
5. If a precise elastomer measurement is needed, place mixing container in scale
    a. Once the reading is steady, press "TARE" to normalize
    b. Hold PDMS Elastomer carboy/container of the top opening in the scale and s*lowly* pour into the mixing container (*PDMS is very viscous*)
    c. Make sure not to spill onto scale! If you do, wet a KimWipe with acetone and clean any surface with PDMS on it
    d. Mark down the mass of the PDMS (*example → 100 g of PDMS Elastomer*)

Reference

A single PDMS microfluidic device (1"x 3"x 0.5") only needs about ~ 5 grams of elastomer.

A full 4" wafer mold needs about 50 grams of elastomer to give a depth of about 0.25"

6. If a rough amount is needed, place carboy on top of a solid base.
    a. Open spigot (*PDMS is very viscous and will pour out slowly*)
    b. Make sure you know roughly how much elastomer you need before pouring.
    c. Mark down the mass of the PDMS minus the mass of the mixing container! (*example → 103.96 g of PDMS Elastomer & Container – 3.96g of Container = 100 g of PDMS Elastomer*)

7. Close spigot and use dry KimWipe to wipe off remaining PDMS on blue spigot opening

8. Obtain the PDMS Curing Agent
    a. Place mixing container (full of PDMS Elastomer) onto scale and press "TARE" once ready is stabilized.
    b. Divide the mass of the PDMS Elastomer poured by 10. That will be the amount of PDMS Curing Agent needed (*example → 100 g of PDMS Elastomer needs 10 g of PDMS Curing Agent*)
    c. Careful not to spill! If you do, follow step 5c

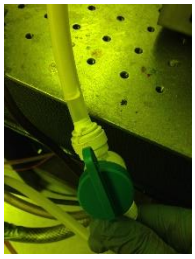
9. Take out mixing container & turn off scale
10. Grab mixer (*example → cleaned plastic fork*) and mix the two parts vigorously for 1-3 minutes, depends on the amount of elastomer and curing agent used.
    a. Once done mixing, dispose of the mixer in the hazardous waste container

11. Put away PDMS Elastomer and PDMS Curing Agent to designated storage locations

2 Degasification

The act of mixing the PDMS Elastomer and PDMS Curing Agent generates a lot of air bubbles. These are not desirable, especially for microfluidic devices. To expedite the degassing of the PDMS (removing all the air bubbles), we can place the mixing container in a vacuum desiccator. The desiccant in the vacuum desiccator creates a moisture-free environment and the vacuum pulls the majority of the gases in the chamber.

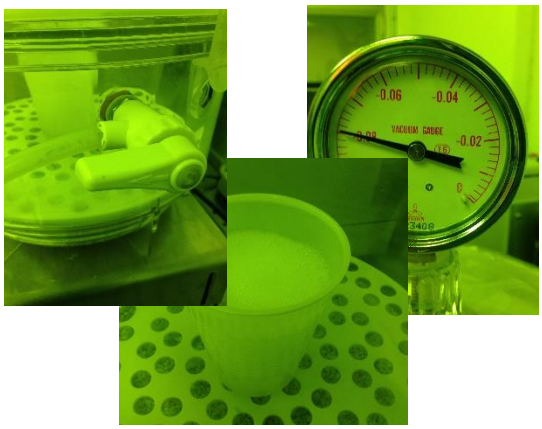
1. Place mixing container in vacuum desiccator and close latches
2. Close the spin coater vacuum line (red) and open the desiccator vacuum line (yellow)



3. Turn on the vacuum (*red rocker switch in between spin coater and desiccator*)

4. Open the desiccator value all the way and allow the pressure to go down to ~ 0.08 MPa

5. Allow vacuum to pull out ALL of the air bubbles for 15 mins to 1 hour (*depends on the amount of PDMS mixed*)



6. Allow air back into the chamber SLOWLY! If too fast, the air rushing in can knock over container
7. Take out container and make sure the desiccator lid is latched back on
8. Turn off vacuum

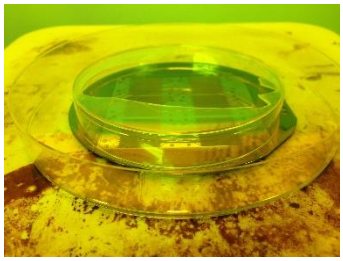
3 Pouring of PDMS onto Mold

For microfluidic applications, PDMS is usually the material of choice for the backbone of the device. To have a desired pattern, a mold is created using photolithography. The structures are typically made from SU-8 on a silicon substrate.

Before PDMS can be casted onto the mold, a passivation layer must be put on the mold so that the PDMS and SU-8 do not bond, thus ruin the mold. The first time passivating a mold, the passivation layer should be done through silanization. Further castings can implore silicone release agent sprays. *For both procedures see "Passivation Protocol" *

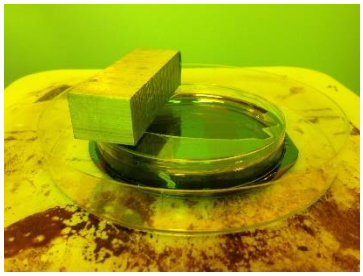
1. Make sure that the mold is passivated.
2. For Sylgard 184, heat can be a catalyst to expedite the cross-linking
    a. At room temperature (20℃) → 48 hrs
    b. At 100℃ → 35 mins
    c. At 125℃ → 20 mins (*plastic containers begin to melt higher than this temp*)
    d. At 150 ℃ → 10 mins
3. Either 2b or 2c are the most reliable
4. Begin by placing mold in a container to hold the PDMS (*example → petri dish*)

a. You want the diameter of the petri dish to be around the same size as the mold, so no PDMS goes to waste

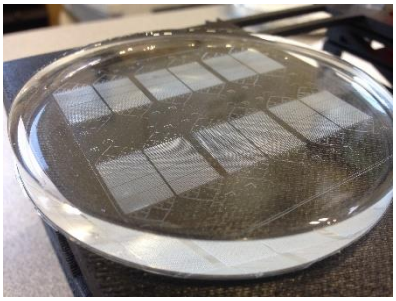


b. *Example shows 100mm wafer with 95mm petri dish on top with pouring hole and a 150mm petri dish on bottom to hold the PDMS in case any PDMS seeks out*

5. SLOWLY pour PDMS onto the mold
   a. Starting point of pour should NOT be on the features



   b. *Example shows a weight placed on top of boundary container so it stays in place and allows minimal leakage*
6. Tiny bubbles may generate from pouring but most are superficial and can be popped using a clean, sharp needle or wire
7. Allow for cross-linking based on time picked from step 2
8. Take off of hot plate
9. CAREFULLY and SLOWLY peel PDMS off of mold



10. Turn off hotplate.