

SOP  
Creating molds for the casting of thick, uniform PDMS

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June 11, 2022

This SOP details the steps for molding flat, uniform PDMS on top of wafers. This process was developed specifically for a formulation of PDMS that consists of 1 part of SYLGARD 184 base to 2 parts of curing agent. This formulation cures to be much less compressible than the more common 10:1 ratio formulation. This process is extendable to any formulation of PDMS, and it can be used with curable materials different from PDMS as well.

This procedure requires:

- The wafer or wafer pieces, on top of which the PDMS will be molded
- A flat ceramic tile that is at least an inch longer on each side than the wafer or pieces
- Polymer clay (can be bought at arts and crafts stores)
- A blade
- A digital level with self-calibration, ideally accurate to two decimal places
- A hot plate or oven
- Aluminum foil
- Dental floss
- SYLGARD 184 base and curing agent

Safety equipment:

- Latex gloves
- Safety glasses
- Oven mits

The schematic of the mold is depicted in Fig. 1.

The steps for creating the mold and casting the PDMS are:

- 1) Level the curing heating element (i.e., the hot plate or oven). This step is necessary to ensure that the pool of PDMS cures flat. This is demonstrated for an oven in Fig. 2.
  - a. Tear a sheet of aluminum foil that is 6" in length.  
Tear strips along the length of the aluminum foil sheet that are half an inch in width.  
Fold the strips several times, into flat rectangles of varying thicknesses.
  - b. Using the level, measure the degree offset of the flat surface (on which the molded PDMS will be cured) in each direction: left-right and up-down.
  - c. Based on the readings of the level, place the little flat squares of aluminum foil under the corner of the flat surface that would help bring both the left-right and up-down readings of the level closer to 0.
  - d. Repeat steps 1.b-1.d until the level reads 0.00° in both directions.

- 2) Make the walls of the mold out of polymer clay.
  - a. Place a dummy wafer flat in the center of the tile.
  - b. Tear a piece of polymer clay from along the length of the block, and roll it with both hands to form a long, thin rod of clay.
  - c. Push the rod down on the tile around the dummy wafer, leaving about half an inch of space between the clay and the edge of the dummy wafer.
  - d. Remove the dummy wafer, and use your thumb nail to flatten the clay on the inside of the circle (the side that will be facing the wafer)
  - e. Visually inspect the interface between the clay and the tile to make sure that it is watertight. If there are gaps, press down on the clay to close them.
- 3) Mix the PDMS (using the ratio necessitated by your process), using a conditioned mixer (such as the Thinky mixer in Exfab 155 Mavericks!)
- 4) Pour the PDMS in the mold
  - a. Place the wafer or pieces flat and centered in the mold.
  - b. Pour 95% of the PDMS you intend to be in the mold on the center of the wafer.
  - c. Wait for the PDMS to spread to the edges of the wafer, where it will bead if there is not sufficient PDMS to break the surface tension and leak into the mold, on the tile.
  - d. Start dripping the 5% of remaining PDMS very slowly along the circumference of the wafer, such that each drop breaks the surface tension of the PDMS, allowing it to spill over onto the tile from on top of the wafer.
  - e. Let sit for 10 minutes on the leveled surface for 1:2 ratio PDMS (longer for formulations with lower curing agent concentrations). (e.g., 24-72 hours recommended for 10:1 ratio PDMS, depending on how uniformly flat the final product needs to be).
- 5) Cure the PDMS by heating it, as usual (temperature and curing time are up to your processes' requirements)
- 6) After removing the sample from the heat source, wait to cool
- 7) Remove the sample
  - a. As depicted in Fig. 3, use the blade to cut around the perimeter of the PDMS, within the clay walls.
  - b. Gently but firmly lift the clay upwards and away from the tile, as shown in Fig. 3.
  - c. Using the blade, wedge it perfectly horizontally between the wafer and the tile. Make a small groove underneath the wafer (just big enough for the dental floss to catch the bottom of the wafer)
  - d. Cut off 2 feet of dental floss. Wrap each side of the dental floss several times around your forefingers, then gently put the floss underneath the wafer and start pulling firmly and parallel to the tile. Continue pulling until the wafer is released.
- 8) Clean up the sample
  - a. Using the blade, carefully cut around the wafer, removing the remnants of PDMS extending over the edges of the wafer.
  - b. Using a clean glove, carefully hold the wafer from the circumference (similar to how one would hold a CD) and scrape the bottom with your blade to remove any

remnants of PDMS. Scrape several times in the same spots, until the wafer is clean of all PDMS.

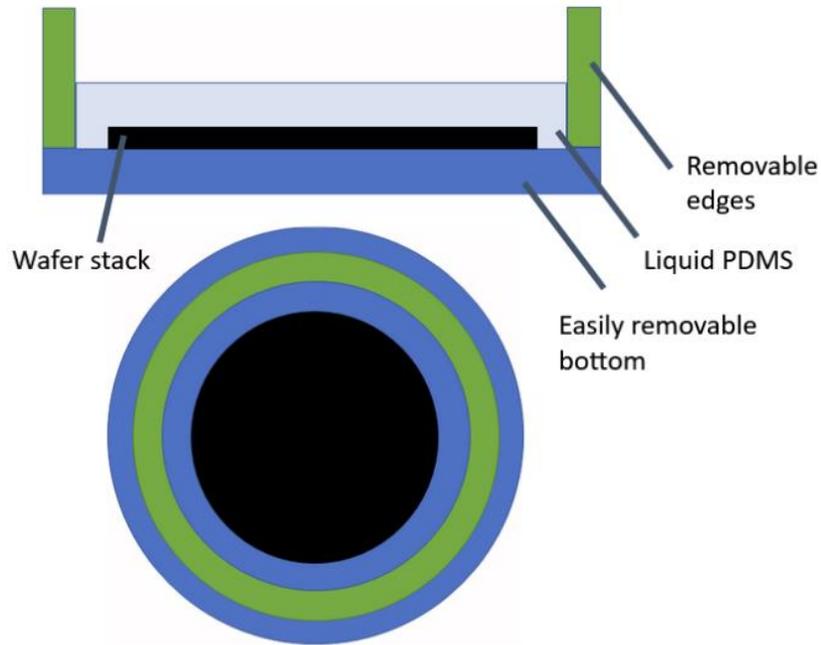


Fig. 1 – Front (top) and top-down (bottom) views of a schematic of the mold. The blue material is a flat ceramic tile, the green material is the polymer clay, and the black material is the wafer sample.



Fig. 2 – Levelling an oven shelf using little squares of aluminum foil to achieve a perfectly flat surface for curing the molded PDMS.

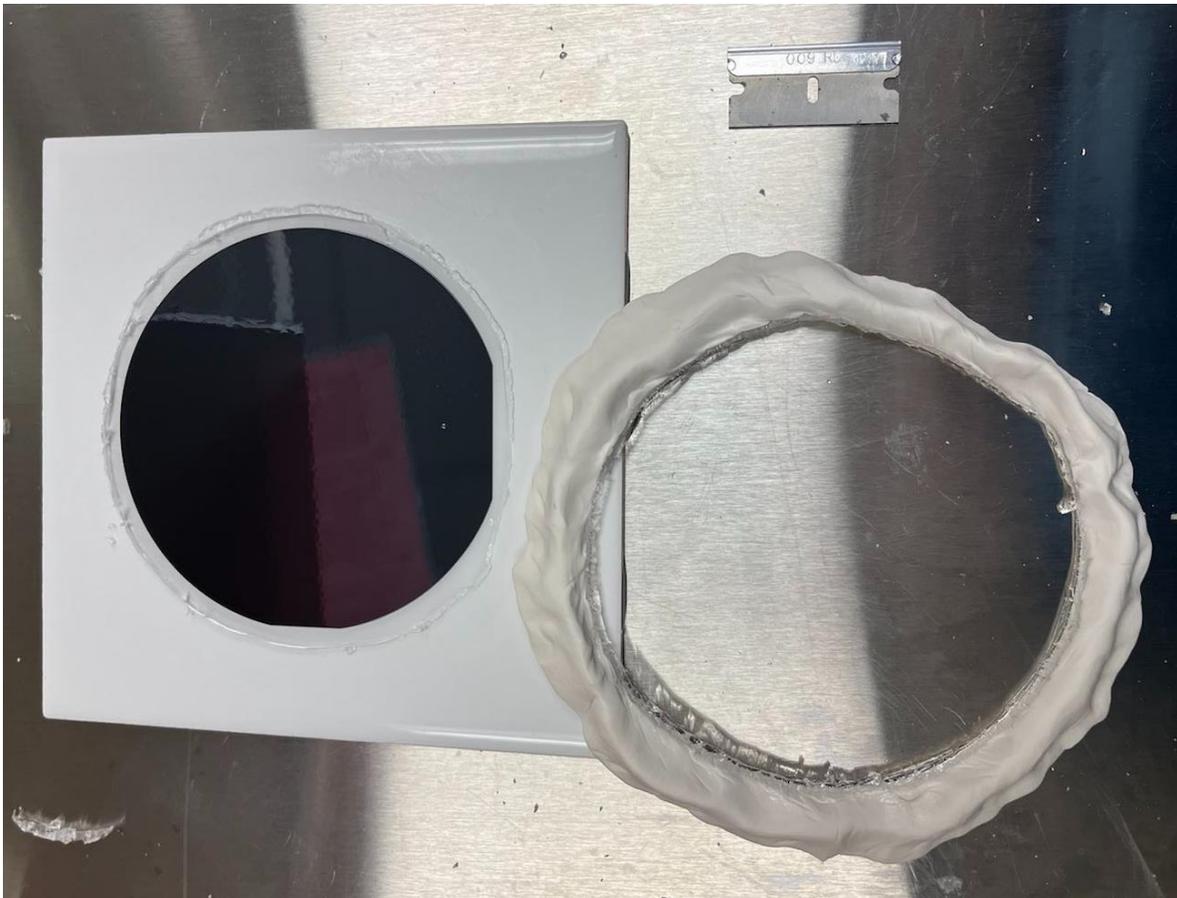


Fig. 3 – Using the blade, cut around the perimeter of the PDMS, then gently pull the clay up and away from the ceramic tile.