GUIDE TO MICROFLUIDICS

Nanobiotechnology Center

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Mixing PDMS/Wafer Prep/Pouring PDMS **Sylgard 184= PDMS**

Mixing PDMS

- Mix 30g Sylgard 184 base with 3g (10:1 Ratio) Sylgard 184 curing agent.
- Stir at least 1-2 minutes, mix will be white with bubbles.
- Degas until all bubbles are gone, periodically releasing the valve to pop the bubbles or place in -20 freezer for 1 hour. This is a good way to do it if you want to mix up 120 g for future use. You can't degas that much PDMS because it will harden before it can degas. This is good for 4-6 weeks if you keep it in a tightly closed container with little airspace.

Wafer Prep

- Wash wafer with Dawn dish detergent diluted in water and hot tap water, rinse with DI water, rinse with ethanol or isopropanol and dry.
- Place on spinner and add 2ml of Sigmacote, making sure to cover every bit of the wafer. If not, the PDMS may permanently stick to the wafer and destroy it.

Pouring the PDMS

- Place wafer in the petri dish, pour PDMS over the wafer, remove any visible bubble; place in the 60°C oven for 90 minutes or room temp for 24 hours.

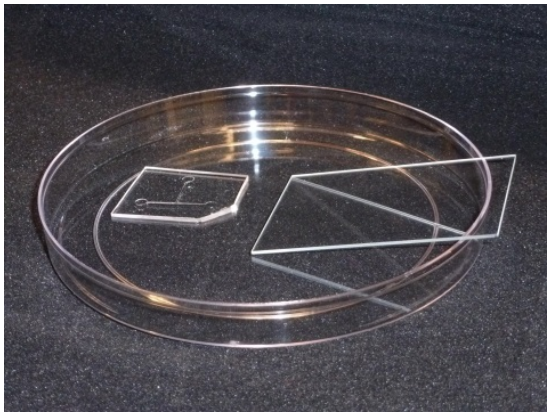
Notes:

Regular Dawn dish detergent works the best, maybe because it has polar and non-polar properties. Alconox does not seem to work as well; any detergent with oxy in the name is not as good. This same wafer prep is used on the glass slides and is a very important step. If your wafer and glass prep are not perfect nothing after that will work.

You MUST wash the wafer after each use with the procedures.

Plasma Cleaning/Bonding PDMS to Glass Slide

- Cut cured PDMS, place pattern side up in petri dish, cover.
- Wash glass slide (both sides) with dilute Dawn dish soap, DI water; rinse with ethanol or isopropanol, dry with nitrogen gun. Place the glass slide on the edge of the petri dish so the plasma can get to both sides of the glass, this will make it easier to pick up without touching any part of the glass other than the sides.



- Turn on pump and plasma cleaner; pump down to the optimal pressure on the vacuum gauge.
- Bright pink plasma is best. If it is not pink, it will not bond.
- Turn RF knob to high for 1 minute for bonding. More is not better.
- Take out the petri dish immediately, and bond the PDMS to the slide, roll out any bubbles with Exacto knife handle. Use light pressure to remove the bubbles, otherwise you may collapse the channels. You only have approx. 3 minutes to bond the PDMS and the glass. If you wait too long it will <u>not</u> bond and it does not <u>always</u> work if you plasma treat it again.
- You have only a small window to prime the channels of the device before it goes hydrophobic. You can use DI water, or ethanol or the buffer that you will be using for the final device.

Notes:

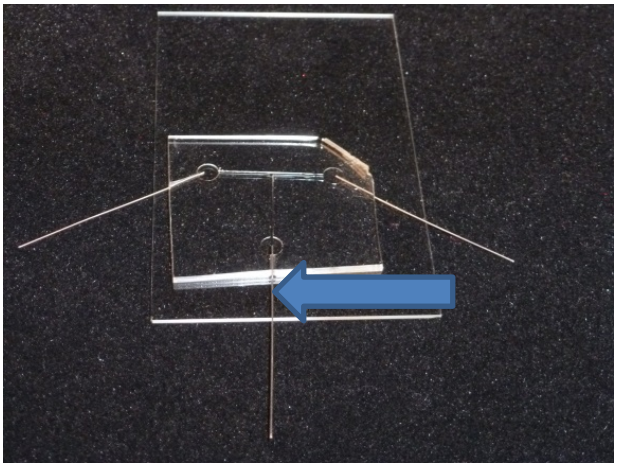
A device may not work the first time you make it! These first two pages of instruction are the most critical and should be done with the same steps every time.

Tips:

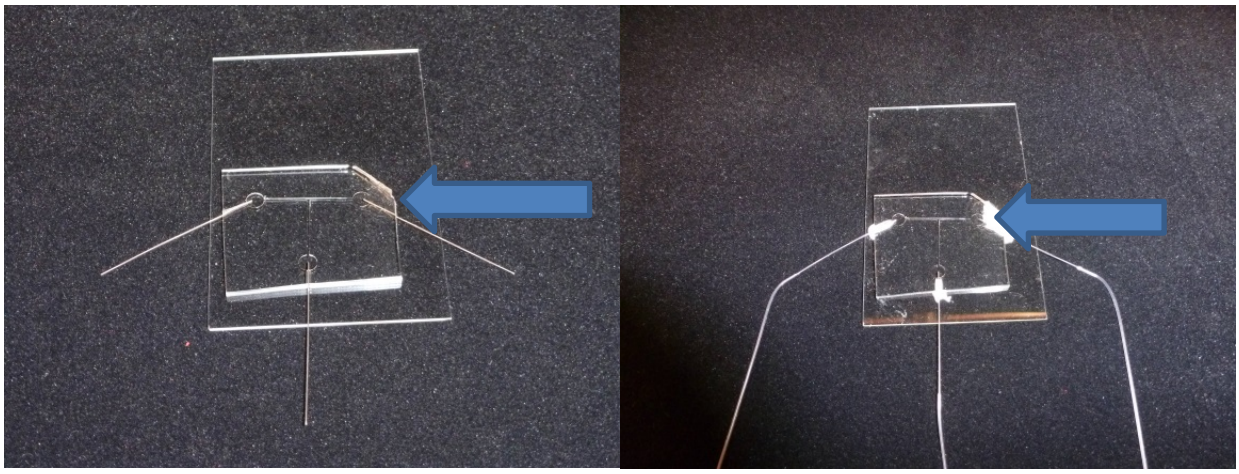
- Wear tight gloves, if your gloves are too big it will be hard to manipulate delicate components.
- Keep your hair pulled back so no hair gets between the device and the glass.
- Do everything the same way every time.
- If you have multiple devices on your wafer, start with the device that is the worst one. By the time you have made the last device on your wafer you should have a good one that works perfectly.

Adding Tubing & Blunt Needles to Device

- Use 1.5 – 2.0 inch 30 gauge blunt needles.
- Break off the hub of the needle by rocking it back and forth, this way does not collapse the needle.
- Slide the needle between the glass slide and the PDMS. Make sure it goes between the two and not into it. If you go into the PDMS your needle is now full of PDMS and it will not work. Lay the needle flat against the glass and push it in to the port of the PDMS. **See Example:**

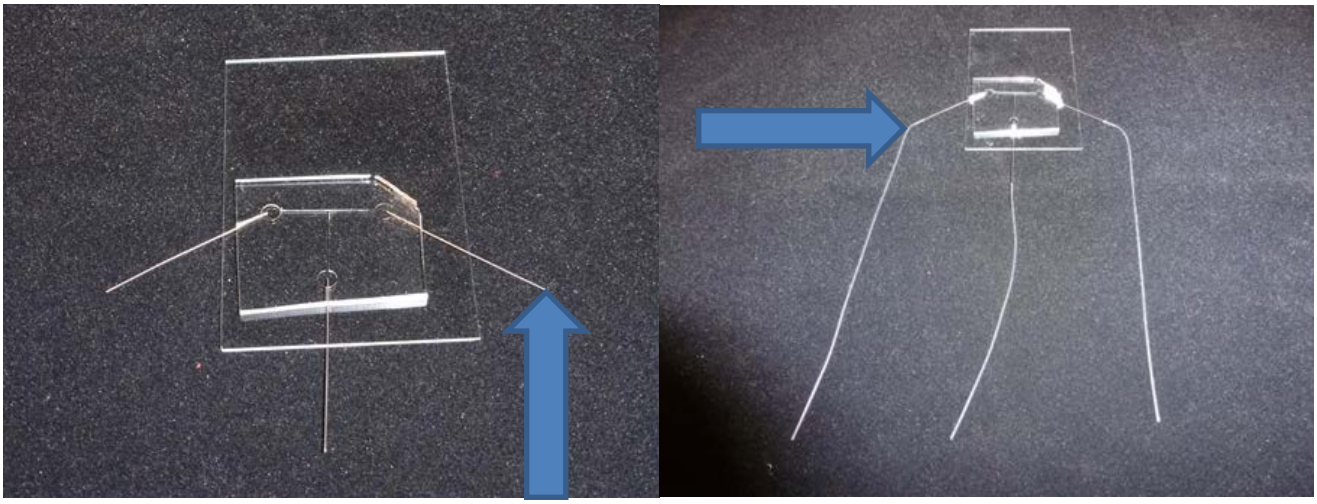


- There will be open gaps where the needle goes between the glass and the PDMS that will leak when introducing fluid. This must be filled with epoxy and allowed to dry before device can be used. **See Example:**



- Mix epoxy 907 in a small petri dish or small weighing dish according to instructions.
- Using a 1ml luer lock syringe, draw up as much epoxy as you can without introducing bubbles into the syringe.
- Clean up the tip of the syringe with a kim wipe or tissue.
- Screw on a 23 or 25 gauge blunt needle and squeeze out all the air and a little of the epoxy to make sure you are not introducing air into the device.
- Place epoxy filled needle & syringe next to the needle that is placed between the PDMS and the glass.
- Very slowly inject epoxy into the gap making sure it does not go too far into the port and plug the needle. Let dry per instructions of the epoxy. At this point you could also place the device in a 146°C oven for 5 minutes to cure the epoxy just enough to introduce the fluid that will keep the device hydrophyllic. **See example:**

Adding Tubing & Blunt Needles to Device



- Cut Dow Corning #2415496 Silastic Tubing (Fisher # 11-189-14) to length and place over the 1.5-2.0 inch blunt needle. At the other end of the blunt needle place a blunt needle with hub attached; join Syringe. **See example:**

Notes:

- When cutting the Silastic tubing, it helps if you cut it at an angle for placing it over the needles.

Identifying multi layers or direction of flow with colored dots using Elmer's Glue (polyvinyl acetate) and food coloring

Lab on a Chip
Miniaturization for chemistry, physics, biology, materials science and bioengineering

29 Jun 2012

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Why is this useful?

When making devices that are direction-specific and very small, you need to check them in the microscope each time to see which side to start your flow. With this technique you can mark the PDMS with a color marker that does not interfere with the device. When working with a multilayer device that has multiple valves and channels it is convenient to have identification markers.

What do I need?

- PDMS
- Elmer's Glue (polyvinyl acetate)
- Food coloring
- Applicator stick
- 1ml syringe
- 27ga blunt tip needle

What do I do?

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1. Put 2-3 ml of Elmer's Glue in a small container and mix 1-3 drops of food coloring, depending on how bright you want the color to be. Mix a large enough amount of colored glue so that you can draw it up into the syringe without adding bubbles. Larger volumes are easier to draw into the syringe.
2. Express some of the glue out of the syringe so that you do not introduce any bubbles into the PDMS.
3. Mix PDMS in the usual 10:1 ratio and pour over your wafer, checking for bubbles.
4. Gently insert the syringe needle into the PDMS and inject a small amount of glue. Injected glue tends to stay where it is injected (Fig. 1).
5. Carefully remove the syringe from the PDMS.
6. Cure the PDMS as normal (Fig. 2).

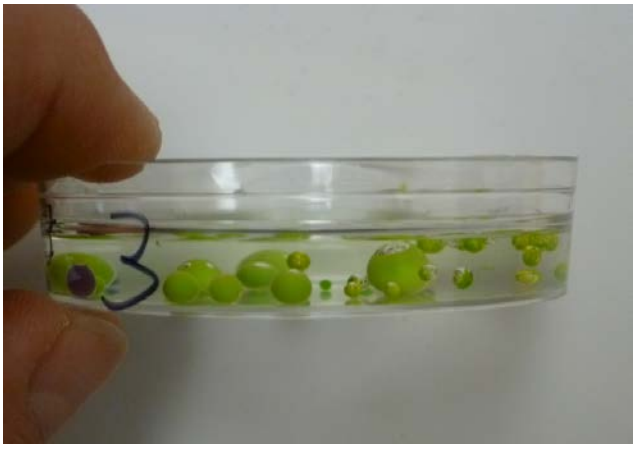

Fig.1: Injected glue tends to stay where it is injected

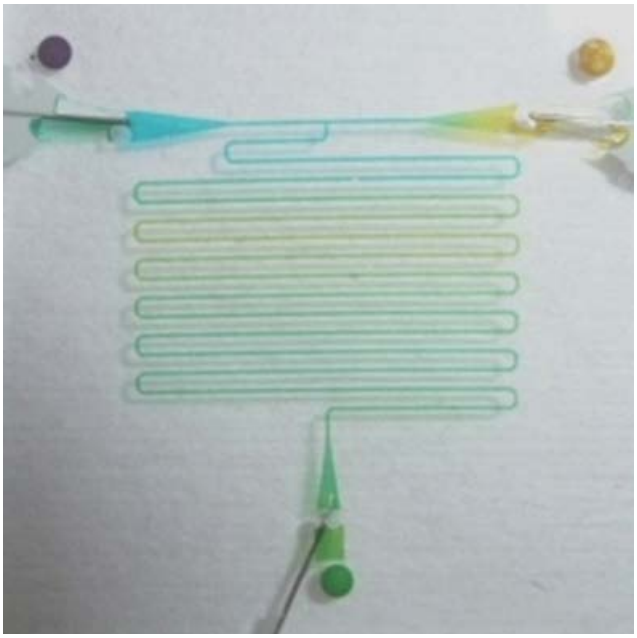

Fig. 2: Cure the PDMS as normal

What else should I know?

An applicator stick may be used instead of a syringe. Also, this procedure will work on top of the PDMS, but it will change its surface.

PARTS LIST

Item	Size	Description	Vendor	Part number	Manufacturer	Notes
PDMS Sylgard 184	500kg	PolyDimethylsiloxane	Krayden, Inc	DC4019862	Dow Corning	Bonds to glass
Microscope slides	75 X 50 mm	Glass	Fisher	2947	Corning	Bonds with PDMS
Sigmacote	100ml	Releasing agent	Sigma Aldrich	SL2-100ml Sigma		Prep Si wafer for easy removal
Epoxy	3.7 oz. Kit	2 Part epoxy kit	Fisher		Miller Stephenson	
Syringe 1ml lure lok	1ml	Same	VWR	309628	BD	Load sample into device
Needles dispensing	30 ga 2"	Blunt SS needle	McMaster Carr	6710A38	Manufacturing Components Supplies	
Needle dispensing	25 ga	blunt SS needle	McMaster Carr			Epoxy
Silastic Tubing	.012id .025od	Stretcy	Fisher	11-189-14	Dow Corning	Dow Corning #2415496
Dawn Dish Detergent	Polar and non-polar properties				Procter & Gamble	clean slides and Si wafer
Exacto Knife	4-7/8"	Precision knife	McMaster Carr	35435A11		cut PDMS
Scissors				Cut tubing		
Elmer's Glue				Color dots		
Food Coloring				Color dots		
Silicone pigment	4 oz.	Assorted colors		Smooth-on.com		color writing in pdms

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