

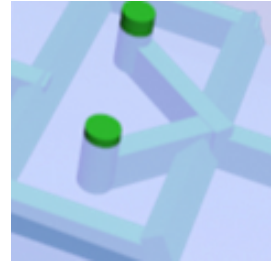
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🌐 PDMS Microfluidic Device Fabrication

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Dr Ziyi Yu¹

¹University of Cambridge

OpenPlant Project



Steven J Burgess

University of Illinois at Urbana-Champaign

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Abstract

A protocol used to generate a PDMS microfluidic chip. Work was funded by Cambridge Synthetic Biology Strategic Research Initiative (SRI) SynBio Fund.

<http://www.synbio.cam.ac.uk/synbiofund>

Guidelines

Materials

- SU-8 photoresist (MicroChem, SU-8 2025)
- Propylene glycol monomethyl ether acetate (PGMEA; Sigma-Aldrich, cat. no. 537543)
- Poly(dimethyl siloxane) (PDMS) and curing agent (Dow Corning, Sylgard 184)
- Silicon wafers (3-inch diameter, Type-P, 1S polished; University Wafer, cat. no. S3P01SP)
- Isopropanol (Sigma-Aldrich, cat. no. 278475)
- 1H,1H,2H,2H-Perfluorododecyltrichlorosilane (Sigma-Aldrich, cat. no. 729965)
- HFE-7500 (3M, cat. no. 98-0212-2928-5)
- Pico-Surf (TM) 1, 10ml, 5% in Novec 7500 (Dolomite, cat. No. 3200214)
- Miltex® BIOPSY PUNCH WITH PLUNGER 1.0mm (Williams Medical Product Code D6345 Mfg. Code SCH-33-31AA-P)
- Hamilton gas-tight syringe, 0.5 ml (Hamilton, cat. no. 201300)
- TUBING,POLY,20PE,30m (Harvard apparatus, cat. no. 59-8324)
- Petri dishes (100 mm diameter × 15 mm)
- Glass slides (75 × 50 mm)
- Scalpel
- Sharp tweezers

Before start

1. Use AutoDesk AutoCAD to design the microfluidic pattern printed on a photolithography mask.
2. Order photolithograph masks from Microlitho Services (<http://www.microlitho.co.uk/>)




- 1 Use SU8 2025 for the master of the microfluidic device. To make the microfluidic device with 50 μm deep channel, follow the manufacturer's processing guidelines available online (http://www.microchem.com/Prod-SU8_KMPR.htm).

- 2 Place the wafer into the spin coater and dispense ~ 5 ml of SU-8 2025 onto the centre of the silica wafer.


- 3 Start the spin coater with the following program: 5 s at 500 rpm and thereafter 40 s at 1450 rpm.


- 4 Prebake the spin-coated silica wafer by placing it on a 65 $^{\circ}\text{C}$.

- 5 Bake the silica wafer at 95 $^{\circ}\text{C}$.
 00:06:00


- 6 Leave the silica wafer substrate to cool to room temperature.

- 7 Place the photolithograph mask on top of the substrate and expose the silica wafer with UV light from MJB4 for 7.5s (exposure energy $\sim 10 \text{ mJ cm}^{-2}$).


- 8 Incubate the silica wafer substrate on a 65 $^{\circ}\text{C}$ hot plate.
 00:01:00

- 9 Transfer the silica wafer substrate to a 95 $^{\circ}\text{C}$ hot plate and incubate.
 00:03:00

- 10 Leave the silica wafer substrate to cool to room temperature.

- 11 Immerse the wafer into the PGMEA liquid and make sure it is completely covered by developer.
 00:04:00


- 12 Rinse the wafer with isopropanol and then dry the silica wafer with nitrogen.
- 13 To improve the adhesion of SU-8 to the silica substrate, place the silica wafer on a 170 °C hot plate.

 00:05:00

- 14 Place the completed master silica wafer in a plastic Petri dish.
- 15 Weigh 30 g of PDMS base and 3 g of curing agent (10:1 ratio) and mix well.

- 16 Pour the PDMS mixture into the Petri dish about 6 mm deep and place the Petri dish in a vacuum desiccator to remove the bubbles.

- 17 Bake the PDMS in a 65 °C oven.


 04:00:00

- 18 Cut PDMS slab with a scalpel and gently peel the PDMS from the silicon wafer.

- 19 Use a biopsy punch to create hole for the fluid inlet and outlet.


- 20 Place the PDMS slab and the glass slide in the plasma chamber with the channel side facing upward.

- 21 Using the following settings to treat both PDMS slab and the glass slide with oxygen plasma.
power = 1

 00:00:10

- 22 Gently bring plasma-treated slab and the glass slide together so that all parts are sealed to the glass.

- 23 Place the microfluidic device in a 110 °C oven.


 02:00:00

24 Leave the microfluidic to cool to room temperature.

25

Use 1% (vol/vol) perfluorododecyltrichlorosilane in Novec 7500 solution to fill the microfluidic channel.

26 Place the microfluidic device in a 65 °C oven.

 12:00:00

27 Leave the microfluidic to cool to room temperature and cover with Scotch tape to keep dust from the openings.