Technische Universiteit
Eindhoven
University of Technology

iGEM TU/e 2014
Biomedical Engineering

Eindhoven University of Technology
Room: Ceres 0.04
Den Dolech 2, 5612 AZ Eindhoven
The Netherlands
Tel. no. +31 50 247 55 59
2014.igem.org/Team:TU_Eindhoven

Protocol Photolithography

This is a photolithography protocol for the production of a silicon wafer with channel heights of 16 µm. It has been composed with the use of scientific resources and improved by trial and error during the experiments. The silanization step is optional. It simplifies the PDMS treatment, though.

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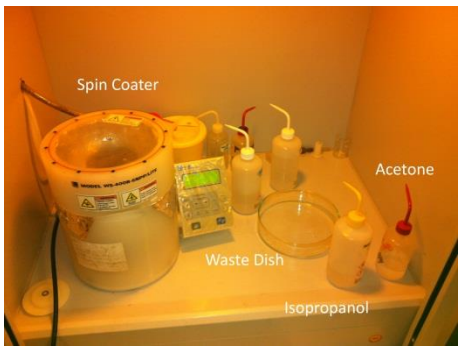
Table of contents

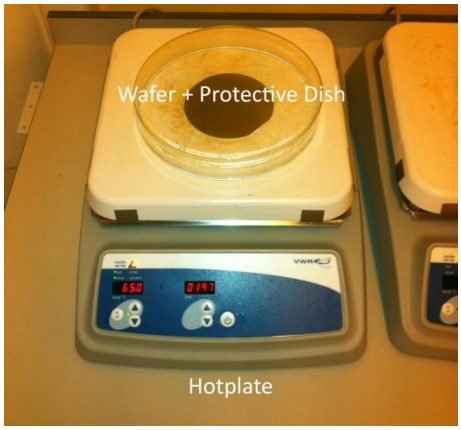
Title
Photolithography

1 Spin Coating



- Connect the vacuum pump to the spin coater.
- Cover the spin coater with aluminum foil to keep the inside clean.
- Clean a pair of tweezers (1) with isopropanol and then (2) with acetone. Blow dry the tweezers with pressurized nitrogen (N_2) gas.
- Clean the silicon wafer by rinsing it with isopropanol, then with acetone and finally blow dry the silicon wafer with pressurized nitrogen gas. Heat the wafer at 140°C for 2-5 minutes on the hot plate to vaporize any leftover solvent.
- Let the wafer cool down to room temperature for ± 5minutes and place the wafer (shiny side up) in the center of the spin coater. Engage the vacuum pump in order to attach the wafer to the spin coater.
- Dispense 1 ml of SU-8 2010 per inch or wafer diameter in the center of the wafer. Avoid trapping of air bubbles.
- Ramp up the rotational speed to 500 rpm at 110 rpm/s and hold for 10 seconds. Ramp up to 1450 rpm at 330 rpm/s and hold for 30 seconds. These rotational speeds create slightly higher channels than 16 µm. This is a “buffer” for the degradation due to baking in later stages.
- Remove edge beads by using a tissue and gently rub over the edges of the wafer removing the excess layer of resist.
- Turn off the vacuum pump and remove the wafer from the spin coater.
- Allow the wafer to relax for ± 10 minutes at room temperature.

2 Soft Bake

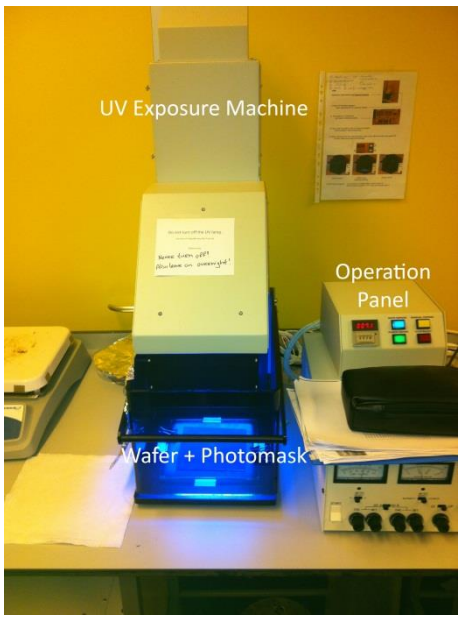


- Pre-bake the wafer on a hotplate at 65°C for 1 minute.
- Soft bake the wafer at 95°C for 2 minutes. If air bubbles still present, gently tap with needle tip to remove them.
- Turn off the hot plate, leave the wafer on the hot plate and let the wafer cool down to room temperature.

3 Ultraviolet Exposure

- Place the wafer on a glass slab.
- Clean the photomask with pressurized nitrogen gas and place the mask on the wafer with the printed side down.
- Place a second slab of glass on top of the photomask and use clamps to seal the wafer and photomask between the two glasses.
- Put the construction underneath in the UV light chamber with the photomask on top.

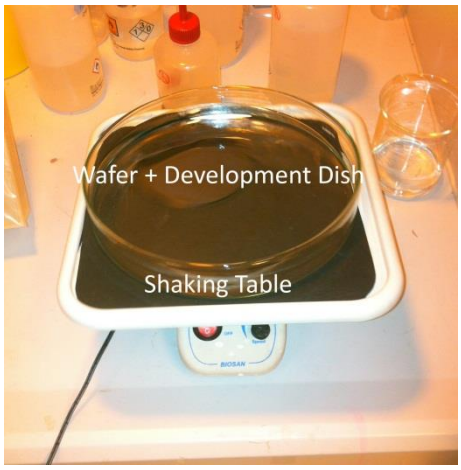
- Expose the wafer with UV-light with an intensity of 160 mJ•cm^{-2} for 7 seconds. The UV light used has an intensity of 11.4 mW cm^{-2}. Therefore an exposure time of 98 seconds was needed. Do not expose the wafer longer than 30 seconds. The exposure time of 98 seconds was divided into three times 30 seconds (neglecting the remainder 8 seconds) with 1 minute rest between each exposure.



4 Post Exposure Baking

- Place the wafer on a hot plate and post exposure bake it at 65°C for 1 minute.
- Ramp up the hot plate to 95°C and continue baking for 2 minutes.
- Ramp down to 65°C and leave it for 1 minute. Rapid cooling can cause thermal stress which results in cracks in the resist.

5 Development



- Clean a crystallizing dish with isopropanol and then acetone and place it on a shaking table in the fume hood.
- Put the wafer in the crystallizing dish and pour SU-8 developer (MR600) in the crystallizing dish until the wafer is fully covered.
- Turn on the shaking table and wait for 5 minutes to allow the developer to wash the wafer.
- Pause development and clean the wafer with isopropanol. Blow dry with pressurized nitrogen gas. Do not rinse it with acetone.
- Inspect wafer under a microscope. If white residue is present, repeat previous steps with washing for 2 minutes.
- When almost no white residue is present, clean the wafer using isopropanol. Finally blow dry the wafer with pressurized nitrogen gas.

6 Hard Baking

- Put the wafer on a hot plate at 65°C.
- Ramp up the temperature to 150°C and hold for 5 minutes.

- Ramp down to 65°C.
- Remove the wafer and let it cool to room temperature.

7 Height Measurement

- Measure the height of the channels with the Dektak® 150 Surface Profiler.
- Tower down to 0 position (stylish up)
- Scan parameters for routine window
- Set Hills, Meas Range to 65,5 µm and Stylus force to 2,0 mg
- Run currently at the border of a channel.

8 Silanization

- Pipette 3-4 droplets of trichloro(1H,1H,2H,H2-perfluoro-ocyl)silane into a glass vial.
- Put both the glass vial and the wafer in a desiccator.
- Open the desiccator valve and pull vacuum for 5-10 minutes.
- Close the valve and leave the desiccator closed for 1-2 hours.
- Open the valve and dispose the glass vial. Put the completed master mold into a petri dish for storage.

9 References

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