Microfluidics Lithography 4: How to Use PDMS Microfluidics Chips (with pictures)

Seyfullah Yilmaz, C. Yunus Sahan, Serhat Sevli

Abstract

Nehir Biyoteknoloji Ltd. www.nehirbt.com

This protocol explains the usage of PDMS microfluidics with an application example of analysis by microscope. Interpretive pictures are added.

Citation: Seyfullah Yilmaz, C. Yunus Sahan, Serhat Sevli Microfluidics Lithography 4: How to Use PDMS Microfluidics Chips (with pictures). **protocols.io**
dx.doi.org/10.17504/protocols.io.g4xbyxn
Published: 18 Feb 2017

Protocol

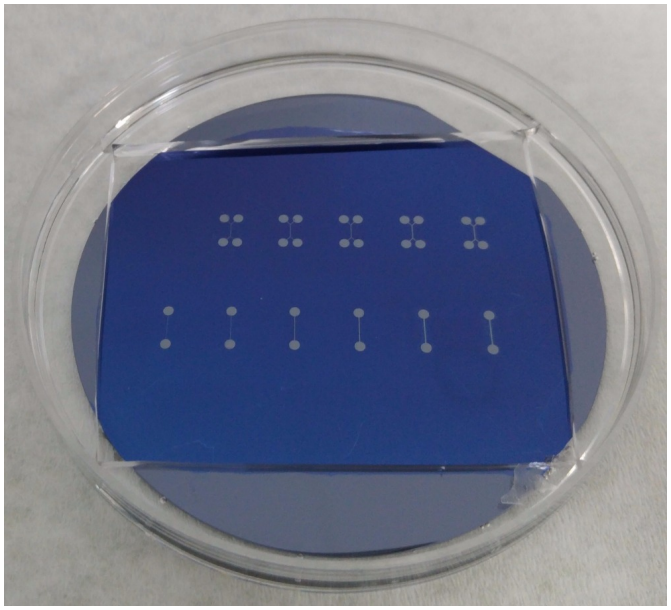
Microchannel molds prepared by SU8 photoresist on Si wafer.

Step 1.

The previous protocols of this series explains the lithography steps for SU8 mold fabrication in detail.

In summary, the suitable SU8 photoresist was coated on Si wafer and and UV exposed regarding the microchannel structures.

After some chemical development processes, microchannels were obtained as shown in Picture-1.



Picture-1: Various microchannel structures formed by SU8 on Si wafer and ready for PDMS curing.

.

.

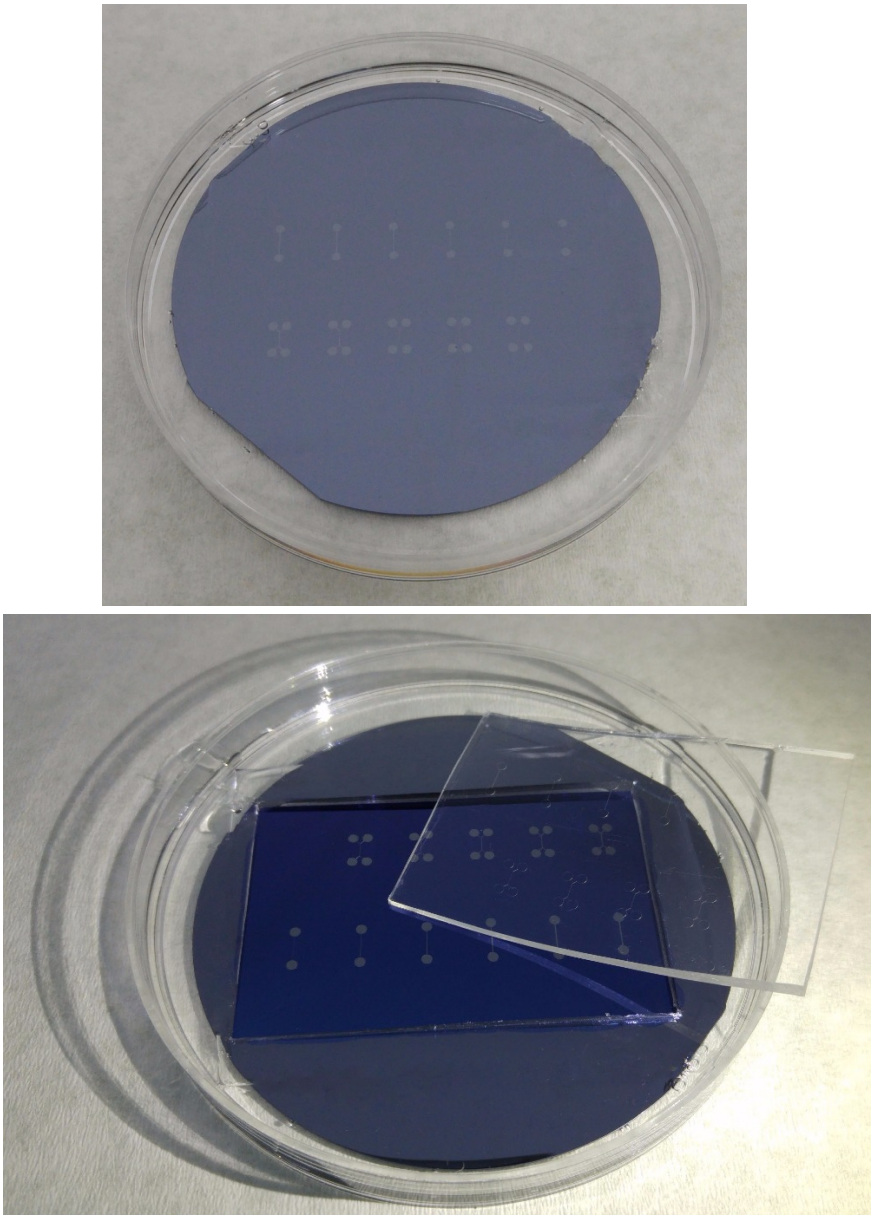
PDMS curing and chip formation on glass

Step 2.

PDMS is a mixture of two components; one is epoxy based material and the other is a curing agent.

After mixing these components 10:1 ratio, bubbles were removed by a short centrifuging and poured on microchannel mold.

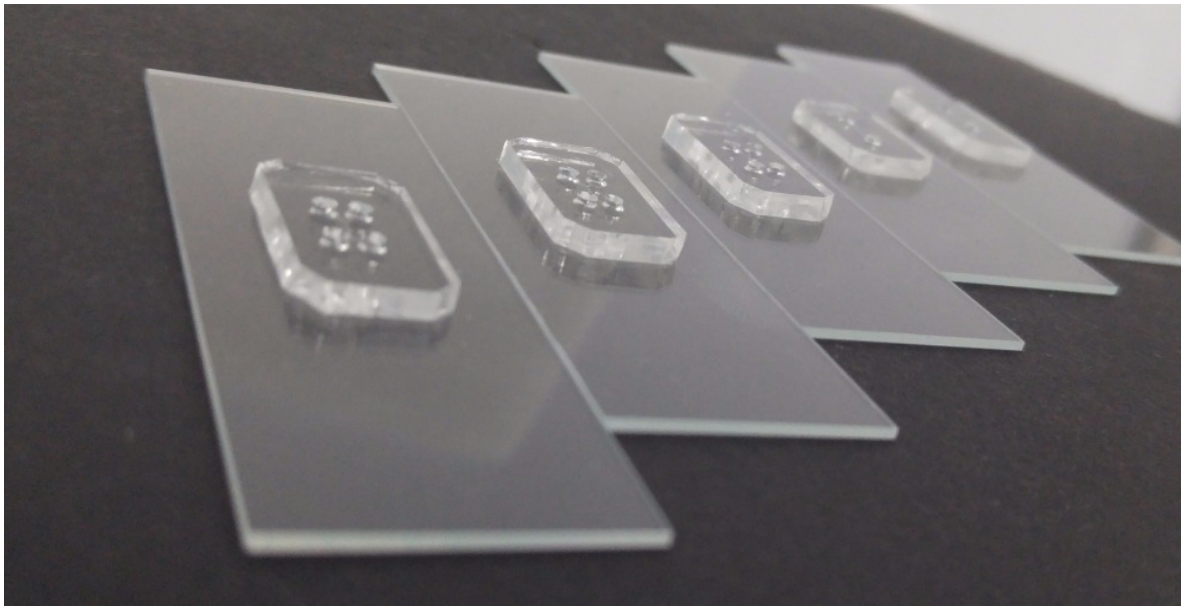
Heated for setting and removed by cutting as shown in Picture-2.



Picture-2: A) Poured PDMS on mold inside petri dish. B) Cutting structures for chip formation

After PDMS channels are cut and holes are punched, They are bonded on glass by oxygen plasma exposure.

PDMS channels are ready for analysis as shown in Picture-3.



Picture-3: Final view of PDMS microfluidics chips.

.

.

.

.

.

.

.

.

.

.

.

.

.

.

Usage of PDMS microfluidics chips

Step 3.

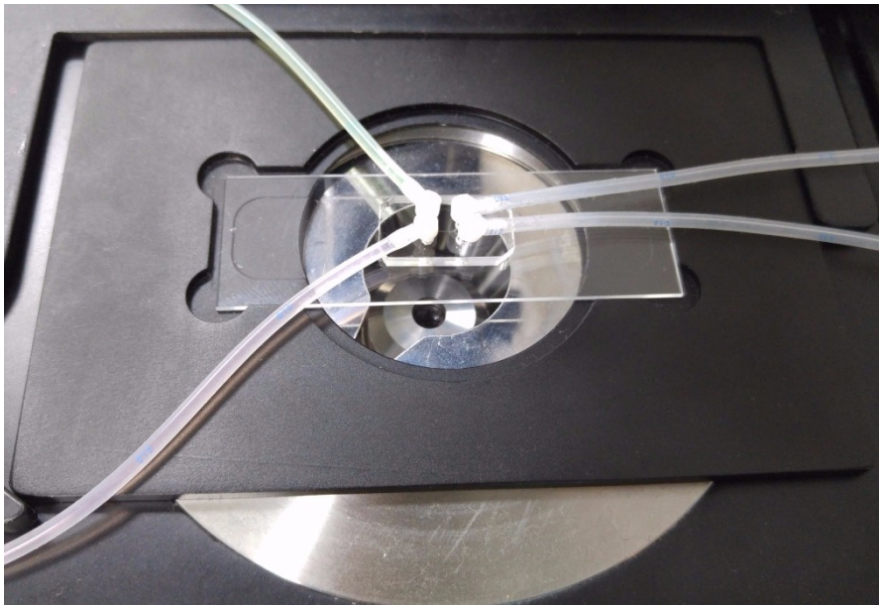
Inlet and outlet ports can be used by fitting parts.

In NehirBT, we produce fitting parts by 3D printing and have various different design according to specific needs.

Before use of microfluidic chips the inner channel air must be removed by high flow rate of dH2O or any suitable liquid. Any air bubble inside microchannels, fittings or tubings negatively affect the laminar flow.

This can be achieved by filling a syringe with any suitable liquid without any air bubbles in and injecting liquid through tubing and microchannels. The remaining air bubbles inside microchannel can be checked by microscope and air bubbles in dead ends of channels can be removed by continuously injection because PDMS is air permeable, do not worry.

While removing the air bubbles inside microfluidic channels, only single inlet should be used and other holes should be open for quick solution. After removing of all air bubbles inside microchannels other inlets/outlets tubing are attached. Finally, whole system is air-free and ready for analysis as shown in Picture-4.



Picture-4: Microfluidic set-up is ready and air-free.

.

.

.

.

.

.

.

.

.

.

.

.

.

.

.

.

.

.

Pumping the liquid inside microfluidics

Step 4.

There are various ways of pumping liquid inside microfluidics and mostly we prefer is syringe pumps.

The most important thing is that both syringe pump and microfluidics must be at the same level and tubings must be as short as possible.

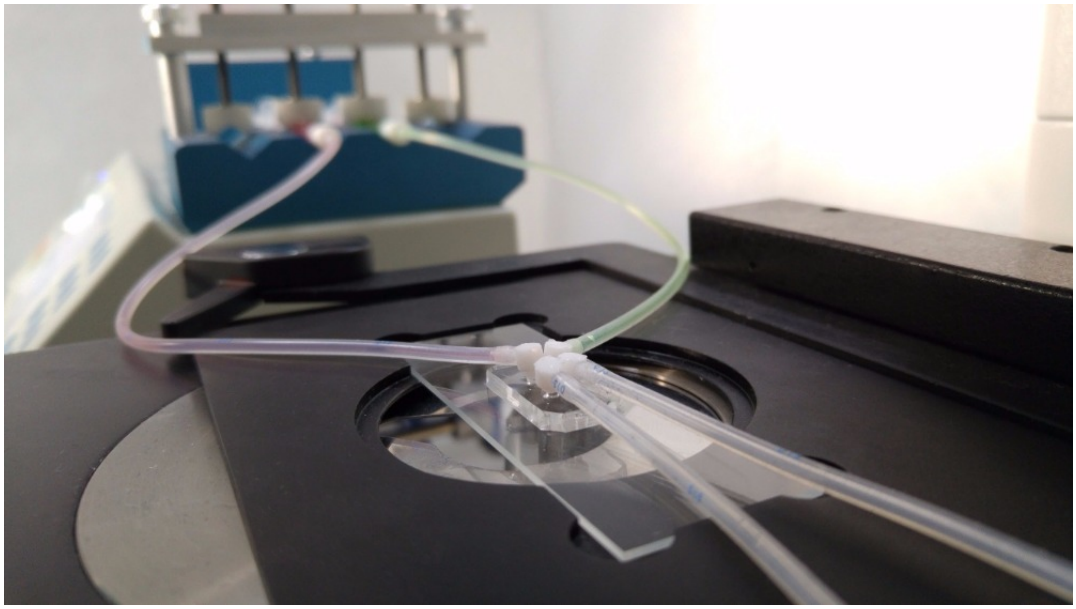
We prefer ID (inner dimension) 1 mm silicon tubings and 1,5 mm fittings with 1,5 mm holes on microfluidics.

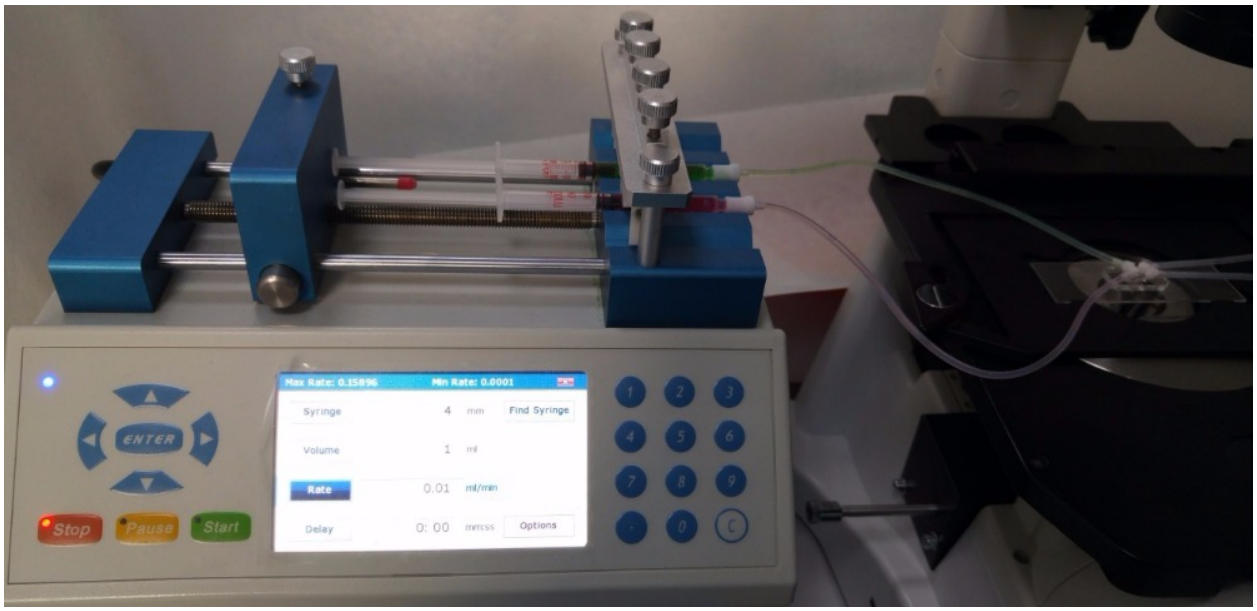
Syringe to tubing fittings are also necessary and whole system must be leakproof. The 3D printed materials are good enough at this.

Picture-5 shows the colorful analysis liquids pumped at suitable flow rates inside microfluidics. Very

high flow rates provides rish of leakage between PDMS and glass layers and max flow rate must be optimised according to experiment.

Minimum flow rate depends on the sensor (optical camera fps and electrical signal acquisiton rate) and the resistance of whole microfluidic system. So, there is a minimum pressure required for obtaining laminar flow inside microchannels which should be optimized according to experiment.





Picture-5: A) Microfluidcs field of view B) Syringe pump field of view.

.

.

.

Warnings

* All the related steps must be done in a suitable laboratory with required equipments.