

Smoothcast Fabrication of Master Replicas at SNF

Protocol version: 1.2

Date updated: 9/24/2019

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Special thanks to: Swaroop Kommera, Alison Bick, and Ming Pa



Adapted from reference: Plastic masters-rigid templates for soft lithography. [Lab Chip](#). 2009 Jun 7;9(11):1631-7.

Reagents and instruments

- Original Si master with photoresist that has been silanized
- PDMS: Sylgard 184
- Smooth-cast 310 (slow setting polyurethane)
<https://www.smooth-on.com/products/smooth-cast-310/>
- Mass balance
- Plastic cups
- Pressure pot hooked up to air
- Red rubber Kitchen mold for PU mold
(<http://www.amazon.com/Freshware-SL-116RD-3-Cavity-Silicone-Custard/dp/B004GJ8QSY/t=lotuszero-20;>
<http://www.amazon.com/Silikomart-SF045-Silicone-Classic-Collection/dp/B002ZIDY26/t=lotuszero-2>

Introduction

The purpose of this protocol is to create polyurethane replicas of microfluidic device masters made either through traditional SU-8 lithography or with the NanoScribe. Masters made out of polyurethane with this protocol are much sturdier and more difficult to break than masters made out of photoresist on a Si wafer; this is particularly true for NanoScribe masters, which tend to break after 2 or 3 PDMS pours. This protocol can also be used when many of the same device need to be made, as polyurethane master replicas are nearly identical to the original masters (within 2% or so).

Protocol assumptions

This protocol assumes that the user already has a fully prepared original master mold that they want to replicate to make PDMS microfluidic devices.



Required setup for Smoothcast molds

Making the polyurethane master replica from PDMS

- Material: SmoothCast 310, 20 minutes pot time; clear plastic cup; spatula; PDMS puncher.
- Place the PDMS with surface feature up in a red, silicone kitchen mold, which is placed on a big petri dish. Push the PDMS stamp to adhere to the kitchen mold.
 - a. The entire top side (without features) must be completely flat or else it won't properly stick to the silicone mold.
 - i. It can be helpful to use the first mold poured on the original master to create the polyurethane replica, as this will typically have a very flat top
 - ii. Alternatively, cutting the PDMS all the way around the master, pouring PDMS, and using that can also help to achieve a flat top
- Weight 45 g SmoothCast component A in a cup, weight 40 g component B in another plastic cup (equivalent to 1:1 by volume). Mix two components by pouring between two cups till the mixture becomes clear (about 12 times). This is enough to make 1 mold.
 - a. This step is messy and should be done over a trash can in a well-ventilated room
- Quickly pour the mixed SmoothCast to the silicone mold. The pot time of the mixed SmoothCast is about 20 minutes.

- Carefully place the rubber mold into the pressure pot and close and lock the pot.
- Turn on the air and open or close the manual valve on the pressure pot until the pressure stabilizes between 20 – 40 psi. Keep the mold in the pressure pot for about 3 hours.
 - a. Curing under high pressure helps to remove bubbles from the mold
 - b. If you will be gone (e.g. doing this step overnight) then you should not leave the air valve open, to avoid accidentally increasing the pressure too high. Instead, you can close the valve on the pressure pot completely with the pressure at about 40 psi. Air will slowly leak out of the pot, but the mold will cure during this time.
- Depressurize the pressure cooker and take out the mold.
- Use the tip of a spatula to insert into the edge between the PDMS stamp and the mold. Loosen the PDMS by moving the tip around the entire mold. Take out the PDMS stamp.
- Weigh the PDMS used to make the mold and write down the mass on the polyurethane master replica using a sharpie.
 - a. When pouring the mold, you should not use more PDMS than the original PDMS used to make the mold

Additional notes

- The polyurethane mold doesn't need to be treated by silane
- A spatula, rather than a scalpel, should always be used to demold the PDMS from the polyurethane channels
 - a. A scalpel may stick into the soft(ish) polyurethane and cause you to lose control and stab yourself. Injuries (and ER visits) have occurred using a scalpel with these molds, so always use a spatula!