HÁSKÓLI ÍSLANDS

Microfluidics Procedure

Summer 2011

Tools and equipment

1. **You'll need access to these devices in the cleanroom, book them in advance:**
   - Spinner and hotplate
   - Mask aligner
   - Profilometer
   - Microwave
2. **Other equipment include:**
   - Scale
   - Mask, defining the microchannels
   - Blunt needles and surgical blade
   - Syringes and tubes
   - Plastic cups
   - Container for containing PDMS on the master mold
   - Pipettes
3. **List of materials, found in cleanroom:**
   - 2 in Silicon wafer
   - SU-8 2035 photoresist from Microchem Corp.
   - mr-Dev 600, SU-8 developer from Micro Resist Technology
   - Sylgard 184 silicone base elastomer and curing agent
   - CYTOP (CTX809AP2) from Asahi glass comp.
   - APTES (aminopropyltriethoxysilane) from Sigma-Aldrich – found in changing room cooler.
   - Glass slides

Procedure

2.1 Master mold

This is a procedure description for making the master mold for casting a microfluidic device using SU-8 2035. The aimed thickness was 60μm. Measured thickness was in the range of $35 - 45\mu$m. If another thickness is desired check the datasheet from MicroChem; http://www.microchem.com/Prod-SU82000.htm

1. **Spin SU-8 2035:** Ramp up to 500rpm in 5s and keep for 5 s. Then ramp up to 2000rpm in 5 s and keep for 30 s.
   - SU-8 is too thick to be dispensed with a pipette. You can either cut the tip of a pippett, using the wider part or use a disposable beaker to dispense the SU-8 since it is very hard to clean off.
   - Apply approximately 1 ml for each inch of substrate diameter.
2. **Soft bake** on hotplate at 65°C for 130s and then at 95°C for 7 min.
3. **Expose** with dosage of $150 - 215\,\mathrm{mJ/cm^2}$.
4. **Post Exposure Bake (PEB)** should take place directly after exposure. Bake on hotplate at 65°C for 60s and 95°C for 6 min.
   - A visible latent image on the film should be seen within 5–15s after being placed on hotplate.
5. **Develop** in SU-8 developer (MR–Dev 600) for 6 mins and then rinse with IPA. Dry off IPA with N_2 gas.

PDMS

3.1 Preparing the PDMS

1. PDMS is mixed with curing agent at a weight ratio of 10:1.
   - For 10 grams of Sylgard base silicone elastomer you add 1 gram of Sylgard curing agent.
   - Place the PDMS in vacuum for 10 min to help remove air bubbles.
2. Place the containing frame on the master and pour the PDMS carefully over the master.
3. Cure the PDMS by letting it stand overnight.
   - Curing time can be shortened to under 2 hours by baking at 65°C in oven.
4. Carefully lift the PDMS off the master.
   - If required, carefully cut the PDMS to desired pieces with a surgical blade.
5. Using blunt needles punch holes in the reservoirs.
   - Be sure to remove all excess PDMS from the holes.
6. Blow away excess debris with N_2 gas.

3.2 Bonding PDMS to glass

1. Clean glass cover slip with acetone, IPA and methanol and dry with N_2 gas.
2. Put the glass slide and the PDMS face up in the microwave.
3. For plasma treatment follow the microwave procedure.
    - The plasma exposure time should be adjusted to 30s so cooling water is not needed.
    - Adjust both Ar and O_2 to 4 SCFH air flow.
4. Place the glass and the PDMS in contact with each other as soon as possible after the plasma is turned off to get a stronger bond.
5. Let stand for 5 minutes.

Extra notes:

- After a few minutes, the hydrophilicity of the device will decrease making it more difficult for the liquid to enter the channels.
- If the plasma treatment is successful the PDMS should be irreversibly bonded to the glass.

3.3 Bonding PDMS to Cytop

1. Put a clean CYTOP sample in plasma for 1 min. For plasma treatment follow the microwave procedure.
2. Spin coat APTES 5% solution onto sample at 3000rpm for 30s.
3. Bake at 80°C for 30 mins.
4. Put both CYTOP and PDMS samples in plasma for 30s.
5. Combine PDMS and CYTOP samples as soon as possible after removing them from plasma.
6. Let samples stand for 1 hour.
    - The long wait is to reduce the effect of the plasma treatment. If a needle is punched through the holes in the PDMS right away the reservoir ceiling will collapse and bond with the CYTOP.
7. Place the glass and the PDMS in contact with each other after the plasma is turned off.
8. Place in oven shielded with Pyrex glass for 30 min at 100 C.