Norland Optical Adhesive (NOA) Microfluidic Devices at SNF

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Introduction

Typically microfluidic devices are made out of PDMS at the prototype stage due to its convenience and ease to work with. For users who desire stiffer prototype microfluidic devices, enhanced biocompatibility, organic solvent compatibility, or a way to make replicas of optical components, Norland Optical Adhesive is a good choice.

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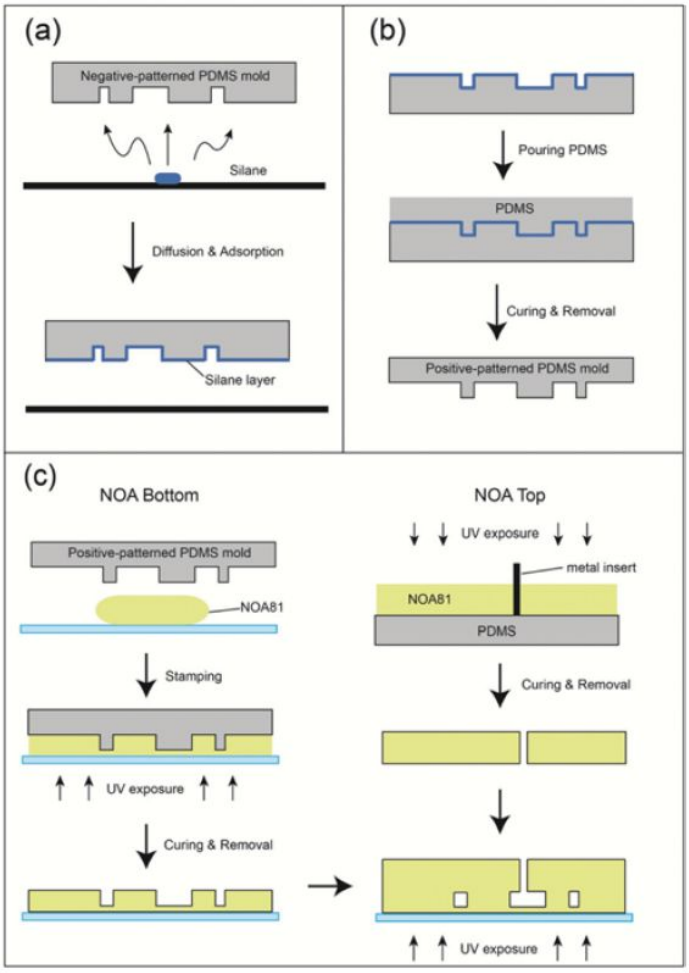


Protocol assumptions

- Read PDMS protocol that is part of this set of documents or know how to work with PDMS
- Access to UV lamp and NOA ($30 per bottle)

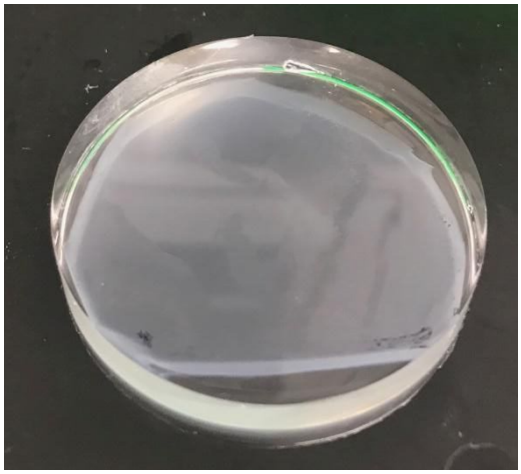
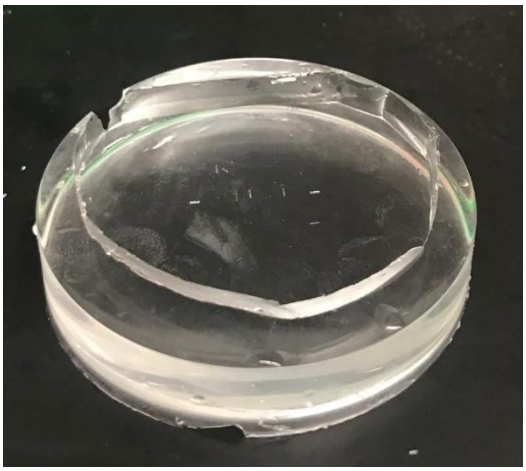
Alternatives to NOA

- DiCarlo paper

NOA Device protocol

Preparing the PDMS mold for NOA

- Make original PDMS mold from device master
- Optional: draw line around edge of PDMS mold so that it is easier to see
    - Sometimes the silane will change the color of the original PDMS, so this step is optional
- Silanize PDMS with TCMS
    - Creates very thin silane layer on PDMS surface which allows making an inverse PDMS mold from the original piece of PDMS.
    - This inverse PDMS will act as the master mold for NOA
    - Work in fume hood – silane is very toxic and corrosive
    - In dessicator:
        - 7 drops of silane from glass pipette onto glass slide next to PDMS mold
            - PDMS mold should be device side facing up so that the device side gets silanized
        - Close dessicator and turn on vacuum
        - Leave under vacuum > 4 hours
- Put silanized PDMS into petri dish slightly bigger than the diameter of the PDMS
    - Make sure top side is completely flat so it sticks to petri dish surface
    - Devices should have the top side exposed for PDMS to replicate the features
- Pour PDMS on the silanized PDMS mold
    - Follow the normal steps for processing PDMS
    - See PDMS protocol if needed

- After curing, carefully use a scalpel to cut around the edge of the silanized PDMS mold to help free the sides from the new PDMS mold
- Characterize device if desired
- Using the side of the scalpel, remove the silanized PDMS mold from the surface of the new PDMS mold for NOA
    - Can use ethanol to decrease the surface tension between the PDMS molds if desired (recommended)
    - Squirt a large drop of ethanol at the edge between the two PDMS molds so that it will enter in between the two molds, where the devices are located, upon lift-off of the PDMS
    - Air-dry both molds with a cleanroom-quality air blower
- Cut out the rest of the new PDMS mold so that it is flat on both sides

Making NOA devices from the PDMS mold

- Put a large drop of NOA on a glass slide larger than your device mold
- Using the PDMS mold as a stamp, push the PDMS down on the NOA drop until the NOA forms a thin layer between the glass slide and the entire PDMS device mold
    - Using a thinner layer will help it UV cure more quickly
- Desiccate the NOA under vacuum to remove all bubbles
- Partially cure the NOA under UV light
    - The time to partially cure greatly depends on the strength of the UV source
        - 1 second to 30 minutes depending on the UV lamp power

    - Want to partially cure so that it can further cure against another piece of NOA to form the full channel
    - If just need to make non-enclosed features out of NOA, you can fully cure the mold at this step
- Carefully remove the PDMS from the NOA to avoid tearing the PDMS mold
- The channels are now made in NOA and just need to be enclosed on the top side to make the final channels
- Align a flat piece of PDMS to the NOA device and mark where the inlets and outlets will go on the PDMS with a sharpie or indentation
- On a silicone surface, hole punch the inlets and outlets in the PDMS
- Turn the PDMS upside down and insert the plastic tubing you will use when you run the microfluidic device
    - Makes tubing align with NOA mold when pouring NOA for the top of the device
    - NOA will stick to glass and metal (to a lesser extent)
    - Once the NOA is fully cured the tubing will be liquid-tight in the hole
- Pour NOA and spread it around so it will cover the entire top of the device
    - Should be at least a few mm thick so that the tubing can be inserted comfortably into the final device without having any leakage at the inlets and outlets.
- Partially cure the NOA top
    - This may take longer than before since it will be thicker
    - You can lightly touch the NOA to see if it is cured
- Remove the NOA from the PDMS and remove the tubing
- Take the NOA top and align it to the device NOA so the inlets and outlets and positioned correctly
- Push down and adhere the two pieces of NOA
- Fully cure the NOA
    - Can take overnight with a weaker UV source
- Use!