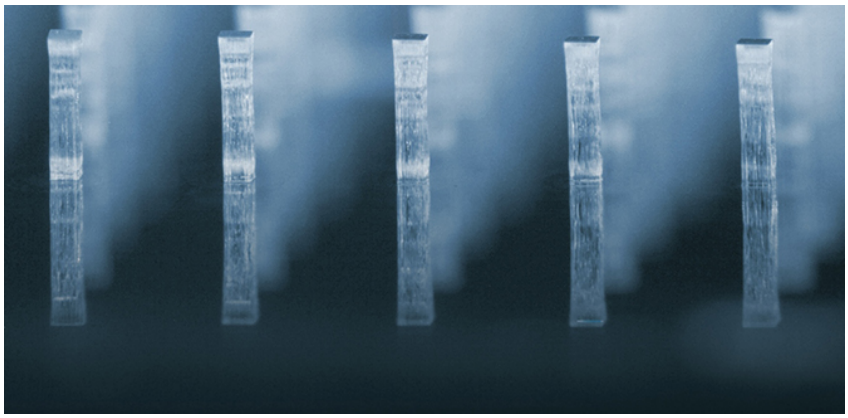
Ostemer® 220 Litho



Overview

Name	Ostemer® 220 Litho
Description	A single cure polymer (UV) optimized for good lithographic structuring and easy covalent surface modification.
Primary uses:	• Photopatterning of 10-500 µm structures, at thicknesses ranging from < 10 µm to > 2mm. • Can be directly surface modified using active thiol-groups after patterning, e.g. to achieve desired wetting properties. • Can also be structured by various UV molding processes.
Storage	Can be stored in room temperature. For optimal shelf life, store in a refrigerator. If crystallized (not uncommon for component A), heat the component up to 60°C. Mixing can be done while hot, but room temperature is recommended.
Handling	Read the MSDS before use. Work in fume hood when mixing the components. Use gloves.

Process compatibility

Micro/nano structuring	• UV-Lithography • UV-casting/molding • UV Reaction injection molding (UV-RIM) • Nano imprint lithography
Post-processing	• Dry bonding to a few materials (Gold, Nickel, semi-cured Ostemer® 322, Ostemer® 324, and Ostemer® 325; and fully cured Ostemer® 221 (available from Mercene Labs by request) • Direct surface grafting (surface treatment can be performed long after the device is manufactured as long as it is kept in a clean and inert environment)

Material specifications

Curing process

Curing	One-step UV cure
UV wavelength	365 nm (i-line) - Hg lamp or LED at 365nm wavelength
UV curing dose	Exposure time depends on thickness, typically 200 µm requires 10 sec with 10 mW/cm2.
Note for Lithography:	The film is not dry and will stick to the mask. Flexible plastic masks can be peeled off. Make sure to use either a slightly flexible bottom substrate or a flexible plastic mask to be able to peel of device and mask from each other (for areas larger than a few square centimeters). The uncured monomer can after UV-cure be rinsed away with Acetone.

Material properties

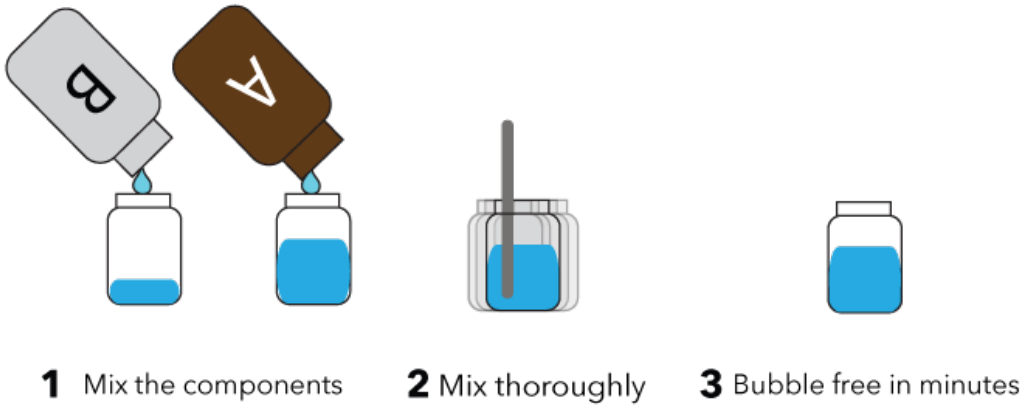
Shrinkage during cure	< 1%
Optical property	Transparent, slight yellow tint
Auto-fluorescence	Low > 450 nm
Young's modulus (MPa)	10-30 MPa
Losses 450-830 nm	0.1 – 0.2 dB/cm (due to scattering), similar to COC
Solvent resistance	Isopropanol, Ethanol and Methanol. Swells slightly from Acetone and Butyl Acetate
Surface chemistry after first cure	SH- groups (thiol groups)

Processing guidelines

The Ostemer® 220 consist of two components: A and B. The mixing ratio is always specified on the bottle of the B component. After A and B components are mixed the pot life is at least 24 hours before significant viscosity increase. During this window the mixture can be patterned by lithography or UV-casted or to form micro patterned articles. For lithographic patterning the resin is poured on a flat substrate, height defined by spacers when a teflon treated chromium/glass mask is applied with slight pressure, followed by photopatterning by UV. For features >50 µm plastic photomasks also works. After exposure, the uncured components are rinsed off with aceton, small high aspect ratio features require shaking or ultrasonication. The cured polymer can now be directly surface modified or bonded using thiol-chemistry.

Mixing

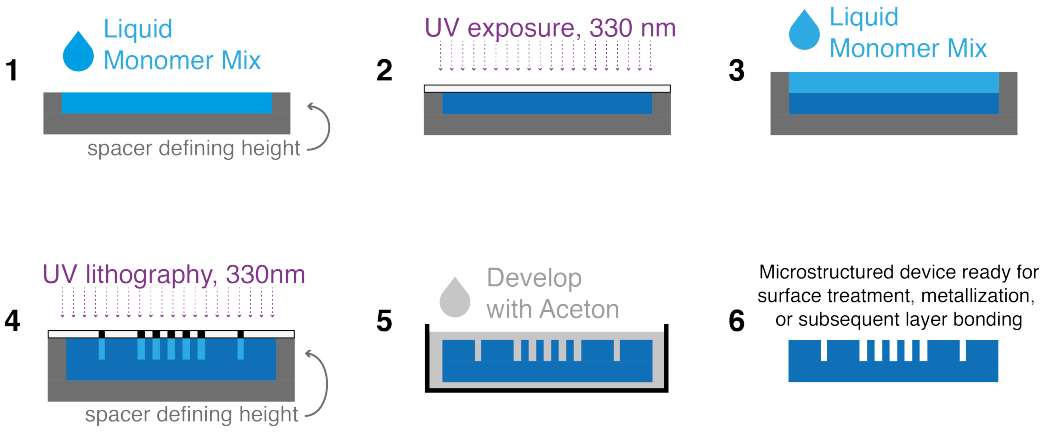
Be in a well-ventilated area when handling the liquid resin. Component A has a distinct smell which may be unpleasant but is not dangerous. After first the first cure the smell disappears.



- **NOTE: Component A can easily crystallize in room temperature.** If crystallized, heat the components up to 60°C for a few hours or 40°C overnight. Mixing can be done while hot, but room temperature is recommended.
- If component B has not been used for a long time stir it with a spatula
- Mix component A and B according to ratio stated on component B, be sure to mix well or the resin may not cure properly.
- Large bubbles disappear by themselves after 10-15 minutes if you let the bottle stand in a dark place. For complete bubble free, degas the prepolymer in a vacuum chamber or speed mixer.
- A mixed solution can be kept in a cool dark place for more than 24 hours pot-life.

Lithography

Direct lithographic patterning of Ostemers® is a good way for rapid prototyping in the lab. The mixed resin can be patterned through most types of masks including chromium/glass masks and plastic transparency masks. As photopatterning of Ostemer® is generally done with the mask in contact with the mask (at least for structures >10 µm), chromium/glass masks should ideally be Teflon treated for best structure release.



For the base layer, spacers are placed on a microscope glass slide and Ostemer 220 is poured onto the microscope glass, Fig 2a. The polymer is squeezed by a top lid consisting of another microscope glass and a transparency film in between. The layer is UV cured (Collimated Hg-lamp, OAI, Millpitas, USA) for 60 sec at 10 mW/cm^2 at 365 nm for base layer thicknesses of up to 500 µm. Fig. 2b. The top transparency film and microscope glass is removed, leaving a flat UV cured Ostemer 220 surface.

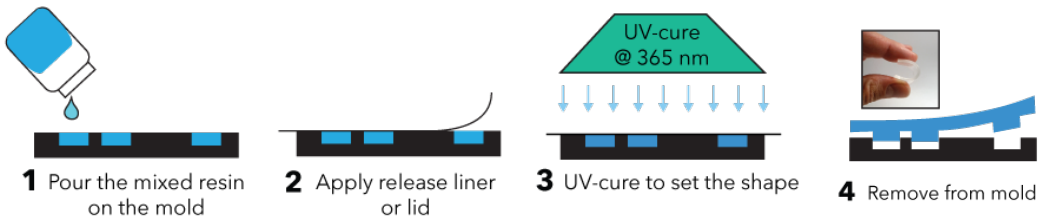
Spacers defining the pattern thickness are placed on the cured Ostemer 220, and Ostemer 220 resin is poured on top (step 3). Both layers are now squeezed by a photomask consisting of a microscope glass with a repro- printed transparency film. The photomask can be protected by a Teflon film to avoid stiction of the polymer to the mask. The entire stack is placed on top of black paper during UV exposure (365 nm) to avoid reflection. The stack is UV exposed for 60 sec, (step 4). The photomask is removed and the polymer stack is developed in an acetone (or butyl acetate for a milder development) bath with ultrasonic agitation for 3 min (step 5). The Ostemer device can be flood cured to ensure that all patterns are fully cross-linked. The finished Ostmer 220 device has free thiol (SH-) groups that can be used for surface grafting, metallization, or layer bonding.

A specific version of this can be found in this reference:

S. Rahiminejad et al., "Rapid manufacturing of OSTE polymer RF-MEMS components," in 2017 IEEE 30th International Conference on Micro Electro Mechanical Systems (MEMS), 2017, pp. 901–904.

Casting

Casting OSTEMER is a good way for rapid prototyping in the lab. The mixed resin can be UV-casted and releases from most types of molds including PDMS (or preferably sturdier ones like Quantum Silicones QM260), milled aluminum, PTFE or Teflon treated silicon/SU8 masters.



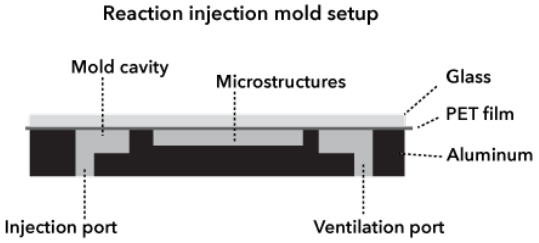
First pour the mixed resin on the mold and apply a release liner. Most plastic transparencies will work together with Ostemer 220, however surface coatings of release liners can sometimes be transferred to the Ostemer surface. Press a glass or UV-transparent flat plastic piece on top to ensure flatness during UV-cure. The exposure time will depend on what lamp you have and how thick device you have. The finished Ostmer 220 device has free thiol (SH-) groups that can be used for surface grafting, metallization, or layer bonding.

UV Reaction injection molding

The Ostemer® 220 can be structured by RIM just like Ostemer® 322, however Ostemer® 220 is more limited in the number of substrate materials for subsequent bonding.

UV Reaction Injection Molding (RIM) is the best way if you would like to produce a higher number of copies with high repeatability. The Ostemer resins are particularly suited for filling tiny mold cavities thanks to its low viscosity and the low shrinkage stress enables very good feature replication, down to nanometer. RIM molds are closed molds, typically one side precision milled in aluminumand the other a UV-transparent lid.

It has one injection port and one ventilation port for resin filling. The resin will not stick to the aluminum during the first cure, but we recommend to surface treat the aluminum with either fluorinated silanes or Teflon AF.



Ask our support for details!
A RIM mold can contain milled structures and/or an inset with micro or nanostructures.

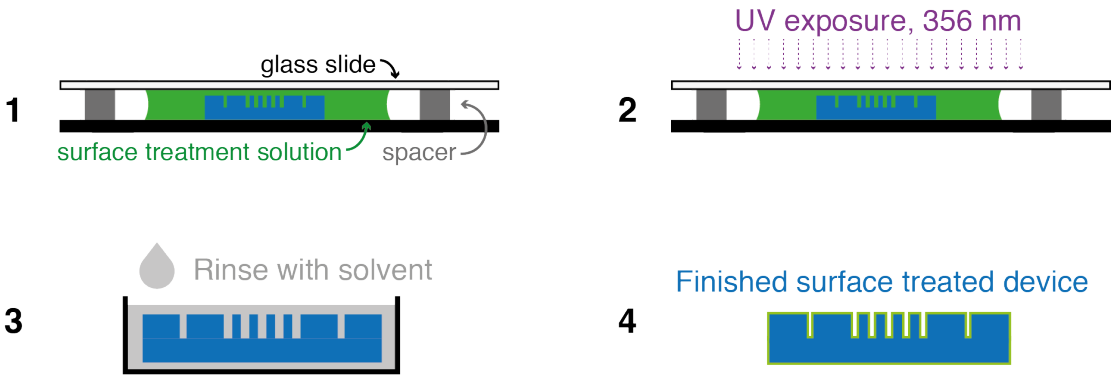
NOTE ON EXPOSURE: Curing times can be VERY different depending on the UV-lamp you use. Generally Hg mask aligner lamps require 10 – 60 seconds. If you have a plastic cover on your mold the curing time can be longer.

You might have to try different exposure times, as a comparison a 12 mW/cm^2 Hg-lamp, need roughly 10 seconds. LED-lamps with 365 nm wave-length will also work.

Covalent surface treatments

Ostemer® 220 (native contact angle of ~70°) can easily be surface treated covalently by grafting hydrophilic (20°-50°) or hydrophobic (100°-120°) polymers to the thiol groups.

For your convenience, Mercene Labs can provide readily prepared Surface treatment solutions upon request (email support@mercenelabs.com). For the patient, approximate recipes are provided below.



Incubate the device in the surface treatment solution, covering the solution with a glass slide or other transparent layer in order to prevent oxygen inhibition during grafting. Expose to UV, approximately 300s for 10 mW/cm^2. Rinse with the same solvent used in the surface treatment solution (normally isopropanol for hydrophilic treatments, and toluene for hydrophobic treatments. Dry in air or by airgun.

Recipe hydrophilic Surface treatment solution:
1% w/w hydroxylated methacrylate (2-Hydroxyethyl methacrylate)
0.05% w/w benzophenone
0.05% w/w TPO-L
in Isopropanol

Recipe hydrophobic Surface treatment solution:
1 % w/w fluorinated methacrylate (3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Heptadecafluorodecyl methacrylate
0.05% w/w benzophenone
0.05% w/w TPO-L
in Toluene

If bonding is necessary after surface treatment, also Allyl glycidyl ether at an equimolar concentration to the methacrylate. This will provide epoxy groups to the surface treatment.

NOTE ON USE: The Ostemers® are for research and development use. It may not be used in implants or in direct or indirect with human tissue. Always wear protective gloves and splash goggles, work in a ventilated environment and avoid contact to skin and eyes. If exposed on skin, clean with large amount of water and soap. If exposed in the eyes clean with water for at least 15 min. If swallowed get medical assistance.

For incorporation in commercial products contact Mercene Labs AB for bulk orders and to register a commercial license for your specific product. Ostemer polymers are patent protected (US8927664, EP 2622002 and several patents pending).

For more information and continuously updated instructions of use and MSDS, please check www.Ostemers.com. If you have questions or feedback about the processing do not hesitate to mail support@mercenelabs.com we are always eager to help!

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