OSTEmerX™ 322 Crystal Clear

Updated Feb 12, 2014

Name: OSTEmerX 322-40 Crystal Clear
Type: Two-component thiol-ene-epoxy.
Primary use: Rapid manufacturing of thermoset micro-plastic components and assemblies.
Storage: Can be stored in room temperature. For optimal shelf life store the A component in a cool dark place, reheat to room temperature before use.
Handling: Always use gloves and work in a well-ventilated space. Read the MSDS.

Features

The OSTEmer 322 is a dual cure polymer with high transparency and minimal color. After mixing the components in the ratio stated on the B component, the prepolymer is first UV-casted to a rubbery micro-patterned plastic article with built-in epoxy glue. The polymer will stiffen and bond at room temperature but is preferentially accelerated by a thermal treatment. The OSTEmerX 322 can bond to most substrates that standard epoxy glue can bond to.

UV wavelength at first cure:	365 nm (Hg lamp or LED at 365nm wavelength)
Recommended temperature for second cure:	RT to 110°C
Mold shrinkage at first cure:	< 2 % (injection-reaction molding with a liquid prepolymer reservoir can reduce this to almost 0%)
Shrinkage at second cure:	Not measurable
Young's modulus:	First curing step: 60 MPa (not far from PDMS) Fully cured: 1.5 GPa (similar to PMMA thermoplastics)
Glass transition temperature:	75 °C
Outgassing:	Begins at 320 °C
Color/transmission:	Optically clear, light transmission between 370 nm to 1200 nm
Refractive index:	1.57-1.58
Losses 400-830 nm:	0.1-0.2 dB/cm (due to scattering), similar to COC.
Bond energy (untreated Si to untreated Si):	20±5 J/m^2
Bonds to (after second cure) (ISO 2409):	Glass, metals, metal oxides, plasma/corona treated polymers, novolac photoresists etc
Acid resistance:	10% H_2SO_4 more than 1 month
Solvent resistant to:	Toluene, Water, Acetone, DMSO, Ethanol and Methanol (tested so far)
Water vapor transmission rate (ASTM E398):	0.15g/(mm*24hrs*m^2)

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Instructions of use

The OSTEmer 322 consists of two components: A (hardener) and B (base). Depending on the stiffness of the final polymers different B blends can be obtained, which will have different mixing ratios. The mixing ratio is always specified on the bottle of the B component. When A and B are mixed a slow curing of the thiol-epoxy is initiated with a pot life of about 6 hours before significant viscosity increase. During this processing window the mixture can be UV-casted to form micro patterned soft stickers that can be assembled before the final hardening/bonding, which is done in oven for less than an hour or at room temperature for 24-36 hours depending on the room temperature.

Mixing

Be in a well-ventilated area when handling the liquid prepolymers. The thiol component of 322 has a strong smell, which is unpleasant but not dangerous. After the complete cure the smell completely disappears. Mix well, use a vortexer if available or stir vigorously with a spatula. If the components are not mixed properly the prepolymer may not cure. Large bubbles disappear by themselves after 10-15 minutes, if you let the bottle stand in darkness. For perfect results, degas the prepolymer in a vacuum chamber.

Micro-molding and bonding

The mixed prepolymer can be UV-casted into a geometrical shape on most types of soft-lithography molds including PDMS, aluminum, PTFE or Teflon treated silicon/SU8 masters. For thick samples (> 1 mm), aluminum molds with a large thermal mass is preferential. If the polymer is very hot after the first cure the sample may bend or the epoxy-reaction starts too early. If it happens use active cooling with a Peltier element and/or reduce the exposure dose. The OSTEmerX 322 can be UV cured to a maximum thickness that is depending on the power of your UV-lamp, but is usually in the 0.5-1 cm thickness.

To achieve a flat surface of the top part of the polymer, a thin plastic sheet, such as Xerox transparency films or PET films, can be applied before UV-exposure. Make sure the cover is transparent at 365 nm (PET films and glass plates work, but not PMMA or polycarbonate). Carefully release the polymer from the cover after the first cure, or use the cover for easier handling of the rubbery polymer film. PET films and transparency films can be peel it off after complete cure (not glass plates!). Injection of the prepolymer with a syringe in molds with a transparent top can give very nice and reproducible results.

Once UV-cured and released from the master your polymer articles can be aligned and bonded to each other or to most other materials thanks to the epoxy groups. You might want to accelerate this process by lightly clamping (not always necessary) the pieces and putting them in oven/hotplate for 1 h at 110 °C. Be sure to clean the substrates you attempt to bond to with alcohol, as fat and any dirt will cause a poor bond. Do not wait more than a couple of hours between UV-exposure and bonding. If you wait too long the bond will be worse as much of the epoxy groups will have already reacted.

Let the assembly cool down to room temperature before trying the bond strength or evaluate the stiffness. At temperatures > 80 °C the polymer will always be rubbery.

Temperature	Approximate curing time for the second cure
Room temperature	24-48 h
75 °C	6 h
110 °C	1 h

Spinning

The OSTEmer 322 may be spun on wafers. Handle it as a SU-8 resist and be sure to clean the spin cup with acetone or isopropanol after spinning. Thicknesses down to 10-20 µm can be achieved undiluted. For thinner layers consider diluting with Toluene, but wait for the Toluene to evaporate before exposure (at room temperature).

Direct lithography

Direct lithography, similar to SU-8, is possible. The main difference being that there is no pre-baking step and as the pre-polymer is sticky before the UV-exposure, we recommend using proximity mode for exposure. Plastic masks can be used in contact mode and peeled off after exposure. The development can be done with SU-8 developer or butylacetate. A quick dip or rinse in acetone may also improve the quality of development.

If you would like to use the layer as a structural layer you may now consider using the latent epoxy groups for bonding on an additional cover layer (glass, silicon, OSTEmer 322, OSTEmer 321 etc., metal). First align, then bond using heat and light pressure. Best results are achieved in a bonder under vacuum to avoid air pockets.

Exposure

NOTE: Curing times can be VERY different depending on the UV-lamp you use. Generally Hg mask aligner lamps require 60 – 100 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 13 mW/cm^2 Hg-lamp, need roughly 60 seconds. LED-lamps with 365 nm wave length also work.

Quick trouble-shooting

1. **Component A smells bad when opening the bottle**
   Its normal. It is trace amounts of contaminants from the thiol monomers that we use that smell. It is not dangerous but unpleasant. Work in a fume hood. After curing the polymer is completely odorless.
2. **The resin is still liquid after UV-exposure**
   Check that the two components are properly mixed! Make sure your UV-lamp has enough intensity. Normal tabletop mercury UV-glue lamps should work fine as well as mask aligners used in silicon processing. UV chambers are generally too weak. Try exposing for longer times and make sure you are not using any UV-absorbing material between the resin and the lamp (such as PMMA or PC). Clean the mold with isopropanol to remove the unpolymerized monomers.
   If you are using a top cover during the first cure, is it transparent to 365 nm? If you can not change cover, you can use OSTEmerX 321 instead which cures at 395 nm, but is slightly yellowish after complete cure.

3. **The polymer becomes stiff after second cure but do not bond**
   Make sure the substrate you want to bond to is clean and make sure that you do not wait too long after you have mixed the components before you contact them (i.e. that the lithography step is not too long). Thick pieces may also generate so much heat during the thiol-ene polymerization that the thiol-epoxy cure is significantly accelerated. If it is hot after cure, reduce the dose. Try cooling the mold, using an aluminum mold or exposing in shorter doses, use a filter (e.g. thick polycarbonate) to slow down the mechanism.
4. **The polymer article is bent and discolored after the UV-cure**
   The polymer is probably very thick and the exothermal will cause the polymer article to warp. Reduce exposure and/or use a cooled (peltier) aluminum mold.
5. **Component B is solid after taking it out from the refrigerator**
   Slowly heat the bottle in water bath or in oven (max 60 deg) until liquid.

NOTE ON USE: The OSTEmerX 322 is for research and evaluation use only. 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 please contact Mercene Labs AB for a license.

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

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