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Supporting Information

A Novel High-Refractive Index Episulfide-Thiol Polymer for Nanoimprinting Optical Elements

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KEYWORDS

High refractive index; episulfide-thiol; ring-opening polymerization; microlens; nanoimprint lithography

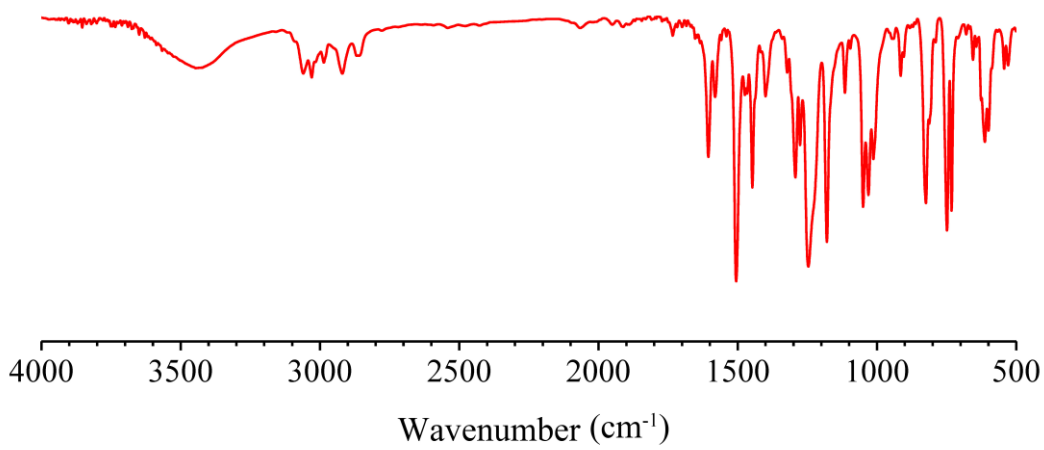


Figure S1. FT-IR spectrum of EGF.

FT-IR, ν(cm^{-1}): 3060, 3030, 2925, 2921, 2860, 1605, 1505, 1447, 1246, 1180, 1030, 825, 750, 732, 612.

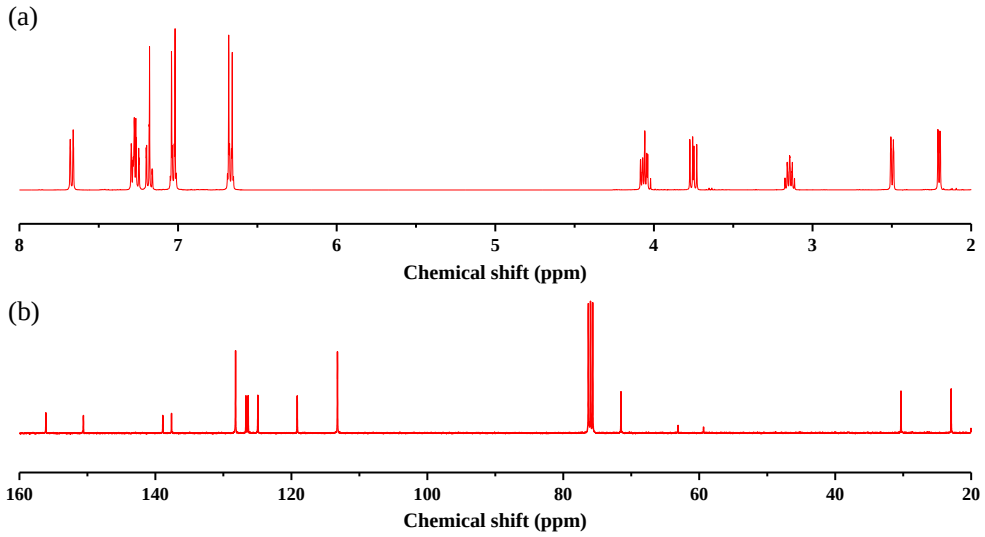


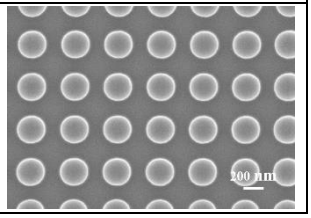
Figure S2. (a) ^{1}H NMR and (b) ^{13}C NMR spectra of EGF.

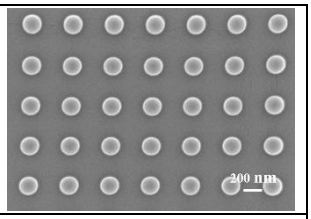
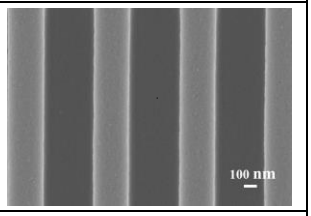
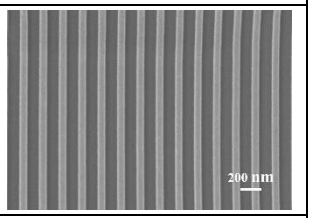
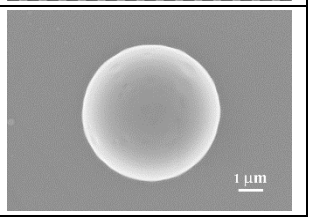
Shrinkage of episulfide-thiol resin.

The shrinkage of the developed polymeric resin induced by the crosslinking process was determined. Initially, the calculation was performed measuring the trench of the OrmoStamp mold and the line width of the corresponding imprinted episulfide-thiol resin. The mold with 690 nm pitch was used for this purpose and SEM pictures were taken for the measurements. Unfortunately, as both the mold and the imprinted sample are polymers, the electron beam of SEM induces additional shrinkage on the patterned structures during the imaging process which makes this method unsuitable for accurate measurements. The best approach to calculate the shrinkage was by ellipsometry as explained in the experimental section.

Characteristics of the molds used in the imprinting process.

Table S1. Dimensions of the molds used for the nanoimprinting experiments.

Mold type	Shape	Parameters	SEM image
Photonic crystal mold 1	Pillars	Diameter: 280 nm Depth: 120 nm Period: 418 nm	

Photonic crystal mold 2	Pillars	Diameter: 200 nm Depth: 100 nm Period: 400 nm	
Sub-micron size grating mold	Gratings	Linewidth: 290 nm Depth: 360 nm Pitch: 690 nm	
High-resolution grating mold	Gratings	Linewidth: 56 nm Pitch: 190 nm	
Microlens mold	Microlens	Diameter: 5.5 μm	

Experimental confirmation of episulfide-thiol crosslinking.

Patterned films were immersed in DCM and DMF solvents for 10min in order to evaluate if the episulfide-thiol material is fully crosslinked after curing for 150 min. The patterns were imaged before and after solvent exposure. It can be seen in Figure S3 that the imprinted pattern is stable to these solvents which is an indication of the material high degree of crosslinking.

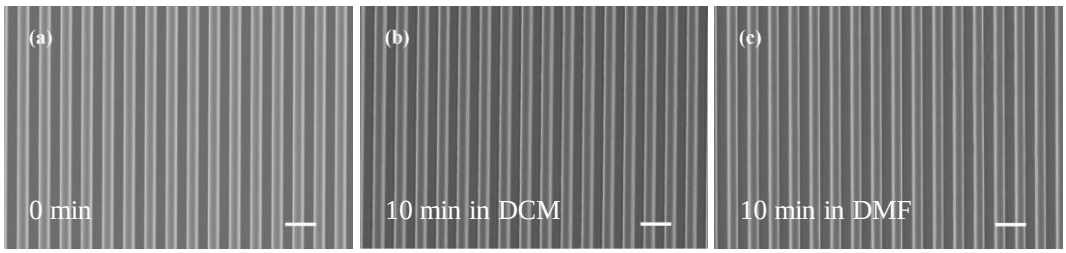


Figure S3. SEM images of the final nanoimprinted gratings (linewidth: 290 nm, depth: 360, pitch: 690 nm) before (a) and after immersing in DCM (b) and DMF (c) for 10 min. Scale bar is 1 μm.