Supporting Information

Desktop-Stereolithography 3D-Printing of a Poly(dimethylsiloxane)-based Material with Sylgard-184 Properties

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Supplementary Figures

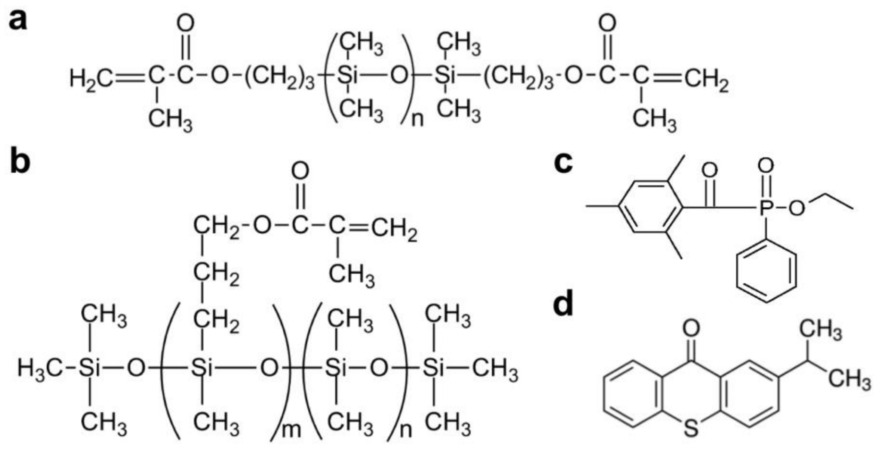
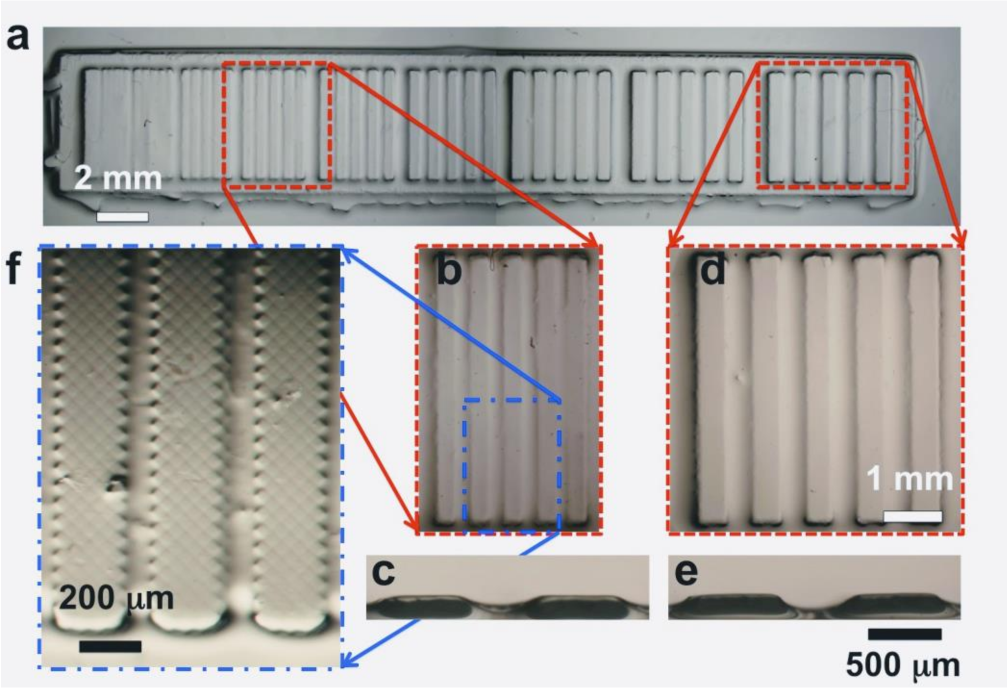


Figure S1: Resin Components. Chemical formulae of the resin components – (a) Macromer 1: end-terminated methacryloxypropyl poly(dimethyl siloxane), (b) Macromer 2: copolymer of methacryloxypropyl poly(dimethyl siloxane) and poly(dimethyl siloxane), (c) Photoinitiator: ethyl (2,4,6-trimethylbenzoyl) phenyl phosphinate (TPO-L) and (d) Photosensitizer: isopropyl thioxanthone (ITX).



<u>Figure S2</u>: XY-Resolution Characterization of 3DP-PDMS-S. Spatial (XY) resolution of SL-printing using 3DP-PDMS-S (with 0.6% TPO-L and 0.3% ITX): (a) Sets of five 200 µm tall lines with the following widths and separations (from left to right) – 50, 100, 150, 200, 250, 300, 350, 400, 450 and 500 µm. Magnified top (b) and cross-sectional (c) views of the 500 µm wide lines separated by 500 µm. Magnified top (d) and cross-sectional (e) views of the 250 µm lines separated by 250 µm. (f) Higher magnification micrographs of the SL-printed 250 µm lines showing imprints of the projected pixel borders of the DLP system.

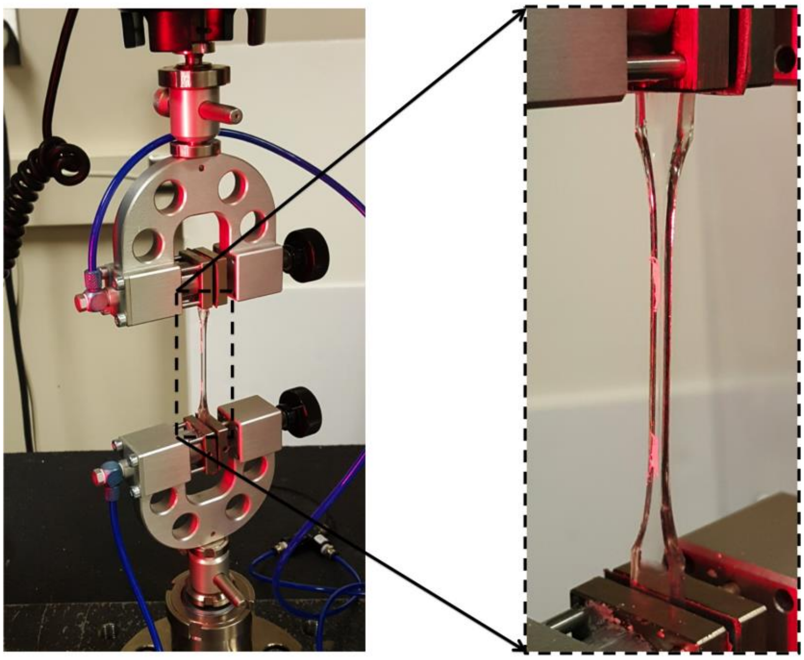


Figure S3: Material testing of dog-bone shaped 3DP-PDMS specimens using an Instron 5584H Load Frame equipped with a 50 N load cell to measure the Young's modulus and the elongation-at-break. (Inset) Magnified image of a specimen made of 3DP-PDMS with an E:S = 14 and TPO-L = 0.8% being subjected to tensile stress using the Instron 5584H Load frame.

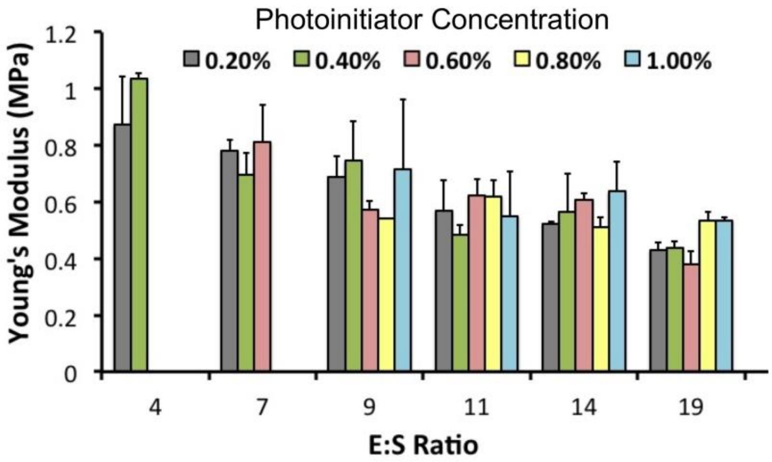


Figure S4: Young's modulus of 3DP-PDMS prepared with different ratios of end group and side-chain macromers, and different photo-initiator (TPO-L) concentrations. Error bars are standard deviations.

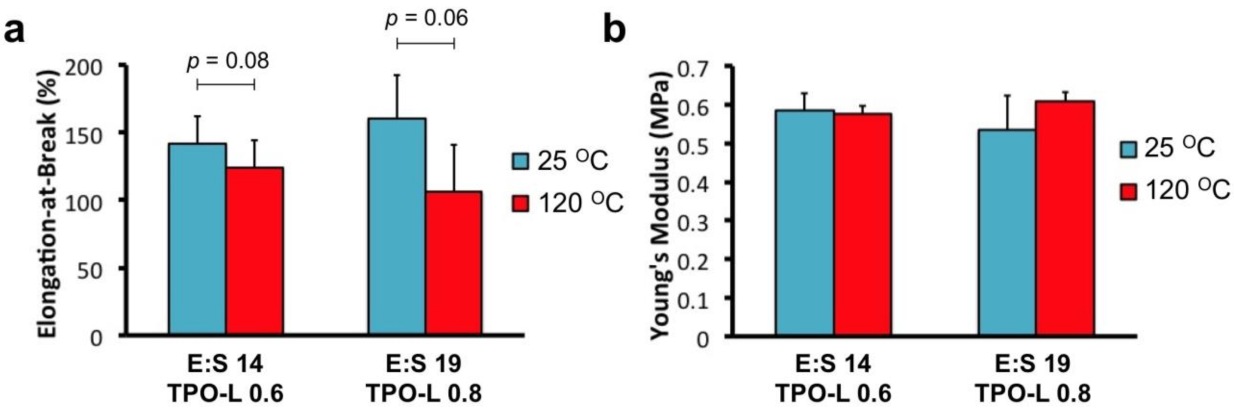


Figure S5: Thermal Stability of 3DP-PDMS pieces: (a) Elongation-at-break values and (b) Young's modulus of 3DP-PDMS dog-bone structures prepared with the two optimized Sylgard-184-like E:S blends and heated to 120 ^{o}C for 12 hrs. Error bars are SEM (n ≥ 5). Unpaired two-tailed Student's t-test did not show any significant difference between the elongation-at-break and Young's modulus means at 25 ^{o}C and 120 ^{o}C in either of the two E:S blends tested (*p* > 0.05).

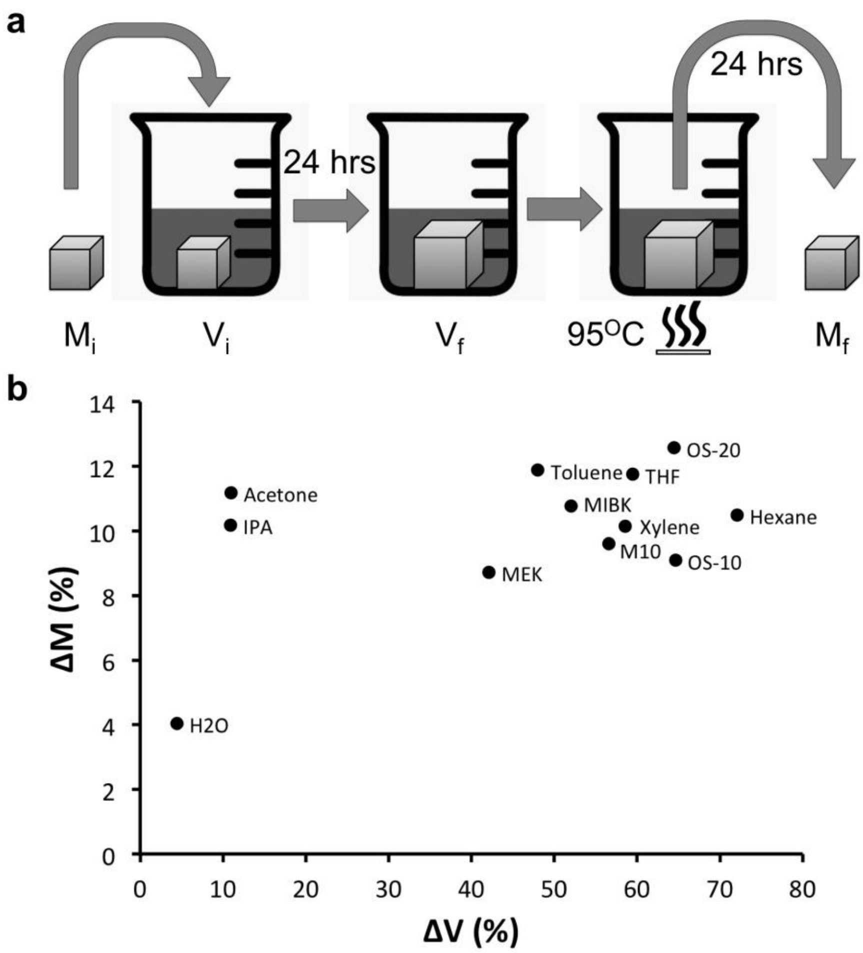
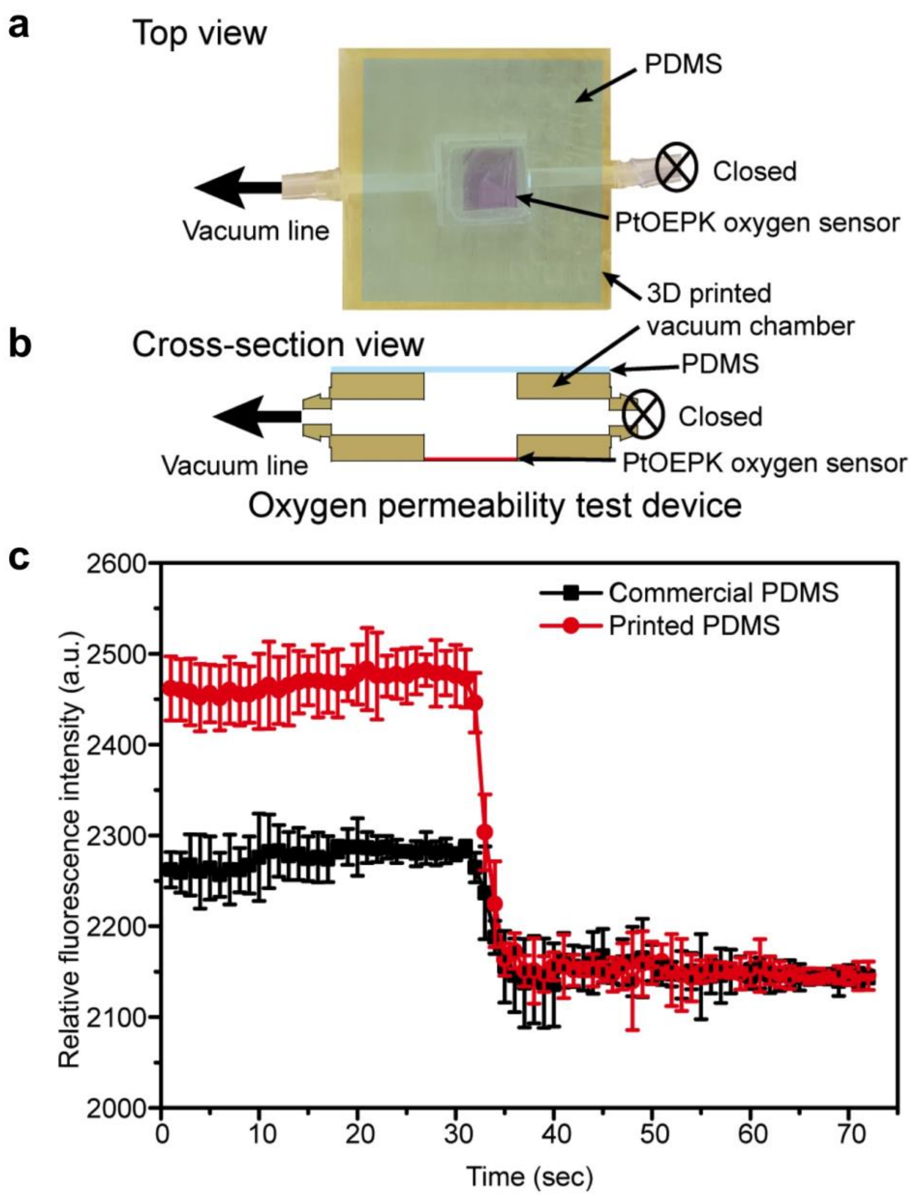


Figure S6: Solubility of 3DP-PDMS-S in Organic Solvents. (a) Schematic for measuring the swelling ratio and concomitant mass loss of 5 mm 3DP-PDMS-S cubes in different organic solvents. (b) Scatter plot of the change in mass (due to extraction) and the change in volume (due to swelling) of 5 mm 3DP-PDMS-S cubes in different organic solvents.



<u>Figure S7</u>: Gas Permeability Measurements. (a) Top view of the vacuum chamber device used for measuring the gas permeability of PDMS membranes. (b) Fluorescence intensity values measured every 1 sec as the chamber is allowed to equilibrate to atmosphere after being subjected to vacuum for 30 sec. Measurements were taken at 5 different positions on the sensor. The error bars denote standard deviation.

Supplementary Movies

Movie S1: Transparent hollow cubes printed with 3DP-PDMS-S (with 0.6% TPO-L) being compressed.

Movie S2: Transparent and flexile dog-bone shaped elastomeric specimen SL-printed with 3DP-PDMS (E:S ratio = 14 and TPO-L = 0.8%) being bent and twisted.

Supplementary Tables

Table S1: Molecular properties of commercially-available silicone methacrylate macromers

	Gelest Catalog #	Viscosity	MW	# methacr groups per molecule
3DP-PDMS-S	RMS-033	1000-2000	31300	5
	RMS-044	7000-9000	57500	16
	RMS-083	4000-6000	38000	16
3DP-PDMS-E	DMS-R31	900-1000	25000	2
	DMS-R22	125-250	10000	2

Table S2: Penetration depths of different 3DP-PDMS-S resins with different concentrations of TPO-L and ITX

TPO-L (%)	ITX (%)	h_p (μm)
0.6	0	331.9
0.6	0.1	281.1
0.6	0.2	253.2
0.6	0.3	212.5
0.8	0.4	207.4
1.0	0.5	178.0

Most transparent resin mixture

Most absorptive resin mixtures

Table S3: Comparison of properties of different commercial and published elastomeric SL-resins

Elastomeric SL-Resins		Young's Modulus (or UTS *) (MPa)	Elongation at Break (%)	Transparency	Resolution of unsupported structures	Biocompatibility
Company or Lab	Resin Name					
Formlabs	Flexible[1]	3.3 – 3.4 (UTS)	75 - 85	Translucent Gray, Opaque Black	not shown	unknown
Stratasys	TangoPlus[2]	0.1 – 0.3	218	Translucent White	not shown	unknown
Spot-A	Elastic[3]	12	65	Opaque Red	not shown	unknown
Carbon	EPU40[4]	10.2 (UTS)	310	Opaque Black	not shown	cytocompatible [a]
Carbon	SIL30[5]	3.4 (UTS)	330	Translucent White	not shown	cytocompatible [a]
Boydston	SilOHFlex[6]	1.02 (UTS)	338	Translucent, Colored (prints) [b]	~ 1 cm	unknown
Magdassi	SUV[7]	0.58 - 4.21	220 – 1100	Transparent to Translucent [c]	~ 1 cm	unknown
Folch	3DP-PDMS	0.52 – 0.94	140 - 160	Transparent	~500 μm	cytocompatible
Dow	Sylgard-184	1.3 (10:1)	140	Transparent	~1 μm	cytocompatible

* UTS = Ultimate Tensile Strength

[1] https://formlabs.com/media/upload/XL-DataSheet.pdf (accessed: February 2017)
[2] http://usglobalimages.stratasys.com/Main/Files/Material_Spec_Sheets/MSS_PJ_PJMaterialsDataSheet.pdf (accessed: February 2017)
[3] http://spotamaterials.com/wp/wp-content/uploads/2017/06/Spot_E_TDS_1115_0517.pdf (accessed: February 2017)
[4] https://www.carbon3d.com/materials/epu-elastomeric-polyurethane/ (accessed: February 2017)
[5] https://www.carbon3d.com/materials/silicone/ (accessed: February 2017)
[6] PDMS dimethacrylamide (9%), butyl acrylate (27%), hydroxyethyl acrylate (56%) – note that the other elastomeric resins reported in the paper are hydrogels
[7] Blend of epoxy aliphatic acrylate and aliphatic urethane acrylate with 33% isobornyl acrylate

[a] Evaluated in accordance with ISO-10993-5 (cytotoxicity) and ISO-10993-10 (irritation)
[b] Thin SilOHFlex pieces appear translucent, but the printed parts shown in the paper are pigmented (possibly for increasing resolution and ensuring printability)
[c] The more stretchable polymers are translucent (30-50% transmittance at 550 nm), whereas the less stretchable polymers are more transparent (80-90% transmittance at 550 nm)