

Fabrication and Functionalization of 3D Printed Polydimethylsiloxane-Based Microfluidic Devices  
Obtained through Digital Light Processing

*Original*

Fabrication and Functionalization of 3D Printed Polydimethylsiloxane-Based Microfluidic Devices Obtained through Digital Light Processing / Gonzalez, Gustavo.; Chiappone, A.; Dietliker, K.; Pirri, C. F.; Roppolo, I.. - In: ADVANCED MATERIALS TECHNOLOGIES. - ISSN 2365-709X. - 5:9(2020), p. 2000374. [10.1002/admt.202000374]

*Availability:*

This version is available at: 11583/2851260 since: 2020-11-06T08:48:51Z

*Publisher:*

Wiley-Blackwell

*Published*

DOI:10.1002/admt.202000374

*Terms of use:*

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

*Publisher copyright*

Wiley preprint/submitted version

This is the pre-peer reviewed version of the [above quoted article], which has been published in final form at <http://dx.doi.org/10.1002/admt.202000374>. This article may be used for non-commercial purposes in accordance with Wiley Terms and Conditions for Use of Self-Archived Versions..

(Article begins on next page)

Supporting Information

# **Fabrication and Functionalization of 3D Printed Polydimethylsiloxane-Based Microfluidic Devices Obtained through Digital Light Processing**

*Gustavo Gonzalez, Annalisa Chiappone, Kurt Dietliker, Candido Fabrizio Pirri, Ignazio Roppolo\**

G. Gonzalez, Dr. A. Chiappone, Prof. C. F. Piri, Dr. I. Roppolo

Dipartimento di Scienza Applicata e Tecnologia, Politecnico di Torino, C.so Duca degli Abruzzi  
24, 10129, Turin, Italy

PolitoBIOMed Lab, Politecnico di Torino, C.so Duca degli Abruzzi 24, 10129, Turin, Italy

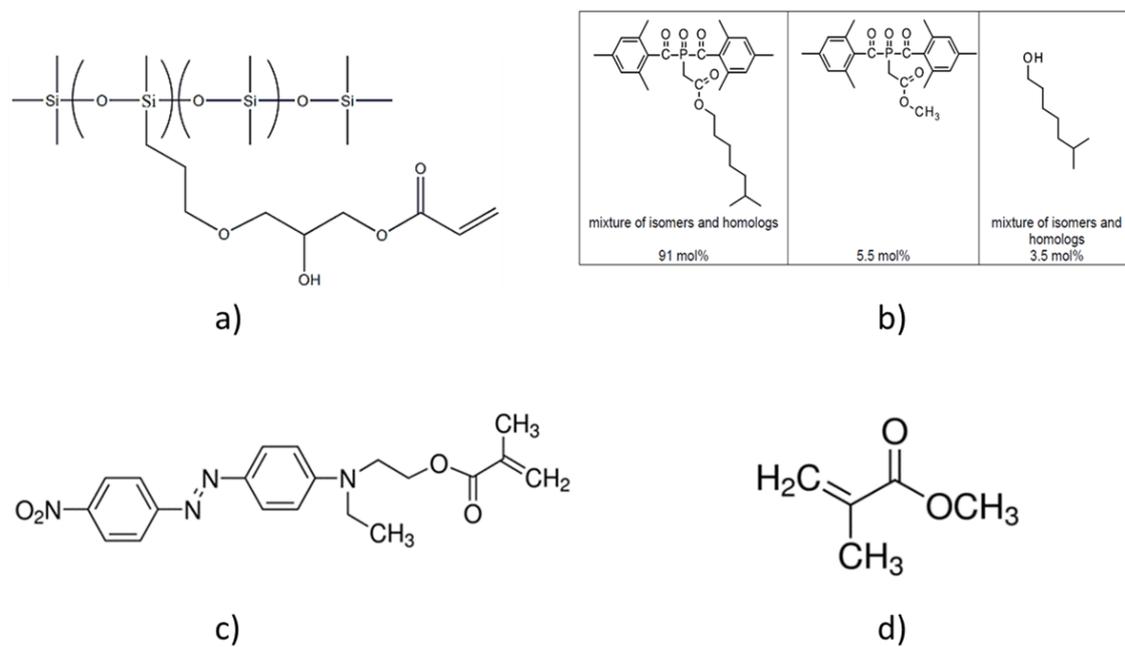
E-mail: [ignazio.roppolo@polito.it](mailto:ignazio.roppolo@polito.it)

G. Gonzalez, Prof. C. F. Pirri

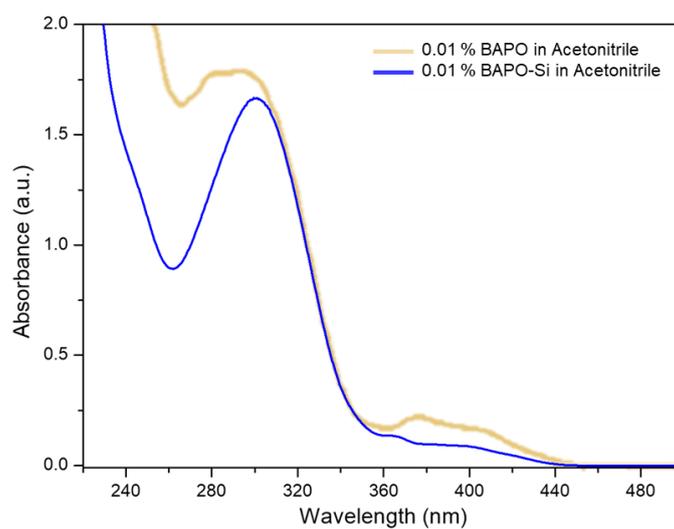
Center for Sustainable Futures @Polito, Istituto Italiano di Tecnologia, Via Livorno 60, 10144,  
Turin, Italy.

Dr. Kurt Dietliker

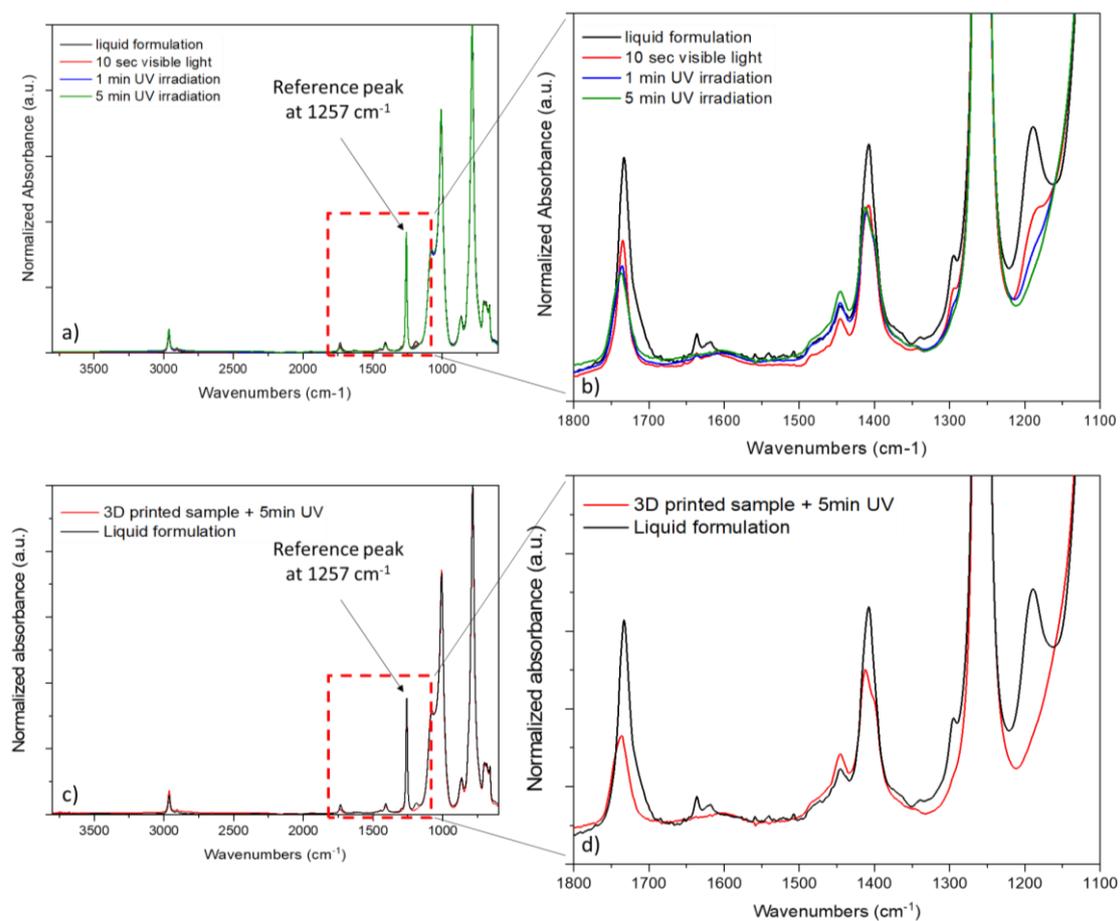
Department of Chemistry and Applied Biosciences, ETH Zurich, Vladimir-Prelog-Weg 1, 8093  
Zurich, Switzerland.



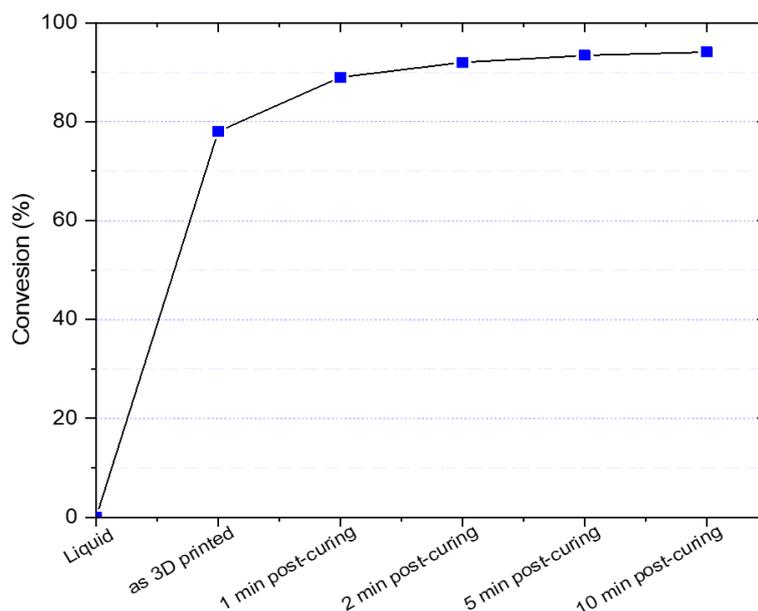
**Figure SI 1.** Chemical structure of TegoRAD 2800 a), BAPO-Si b), dispersed red one methacrylate c) and methyl methacrylate d).



**Figure SI 2.** Absorbance spectra of BAPO-Si photoinitiator compared to photoinitiator BAPO 819, commonly used for 3D printing applications.

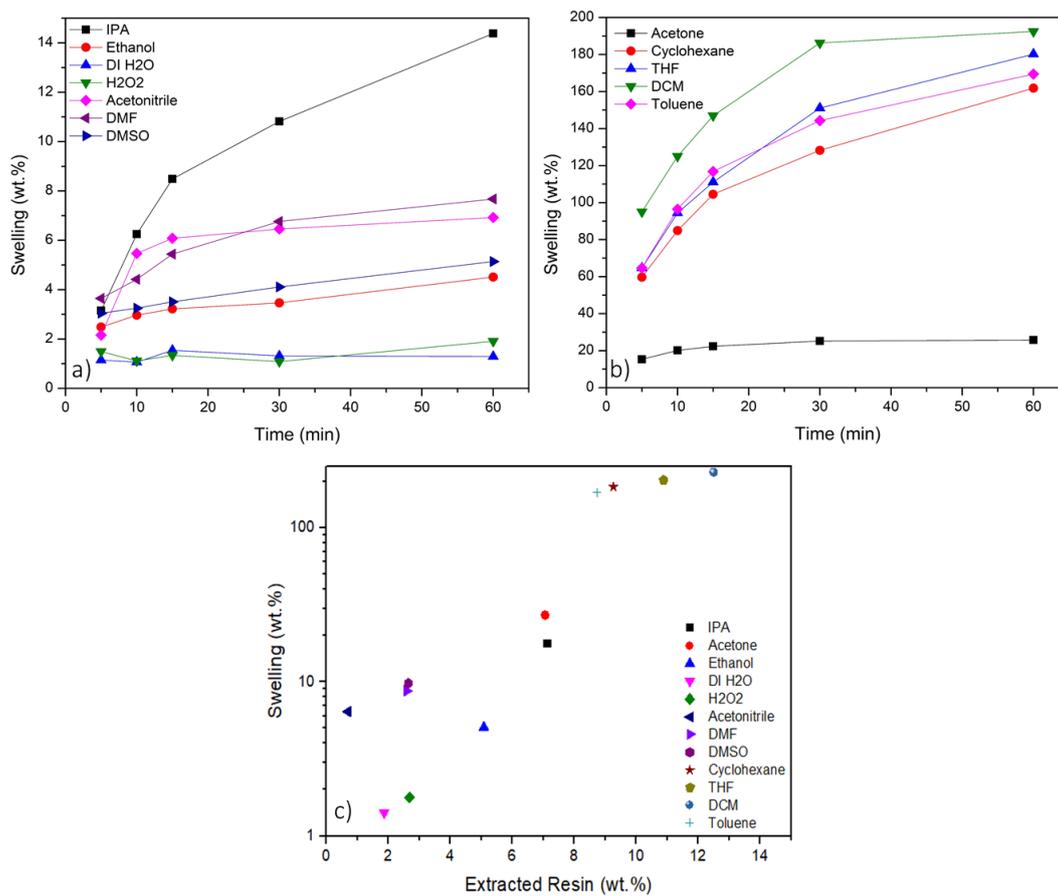


**Figure SI 3.** a) Full normalized ATR-FTIR spectra recorded on liquid TRAD formulation and after different irradiation conditions, and b) zoomed in the region between 1800-1100 cm<sup>-1</sup>. c) Full normalized ATR-FTIR spectra of 3D printed TRAD samples and after 5 min of UV post-curing treatment compared to liquid formulation, and d) zoomed in the region between 1800-1100 cm<sup>-1</sup>.

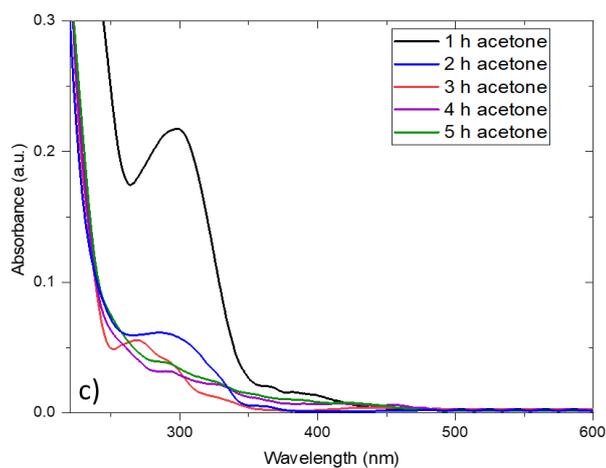


**Figure SI 4.** Acrylate double-bond conversion (%) after different UV post-curing times (in air), obtained by following the decrease of the peak at  $1196\text{ cm}^{-1}$ , whose vibration is modified by the opening of acrylate double bonds after photopolymerization <sup>[R1]</sup>.

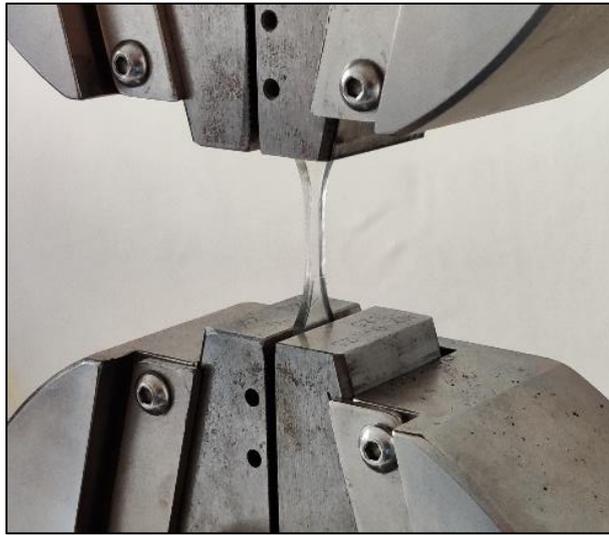
ATR-FTIR experiments were performed on 3D printed TRAD samples (5mm x 5mm x 1mm, *lwh*) as printed and after different UV post-curing times. To better represent the evolution of the curing reaction, the printed samples were post cured exposing only their upper side to UV light. ATR spectra were then collected on the lower side that was not directly exposed to UV. As observed, 5 minutes of post curing were enough to reach the maximum possible conversion of the acrylic double bond (all curing experiments in air). The acrylate double bond conversions was evaluated by following the decrease of the peak area of the single carbon-oxygen bond of acrylates moieties at  $1196\text{ cm}^{-1}$ , whose vibration is modified by the opening of acrylate double bonds after photopolymerization. [R1] The area of the acrylate peak was normalized by a constant signal in the spectra centered at  $1257\text{ cm}^{-1}$  corresponding to methyl siloxane stretching vibrations. [R2]



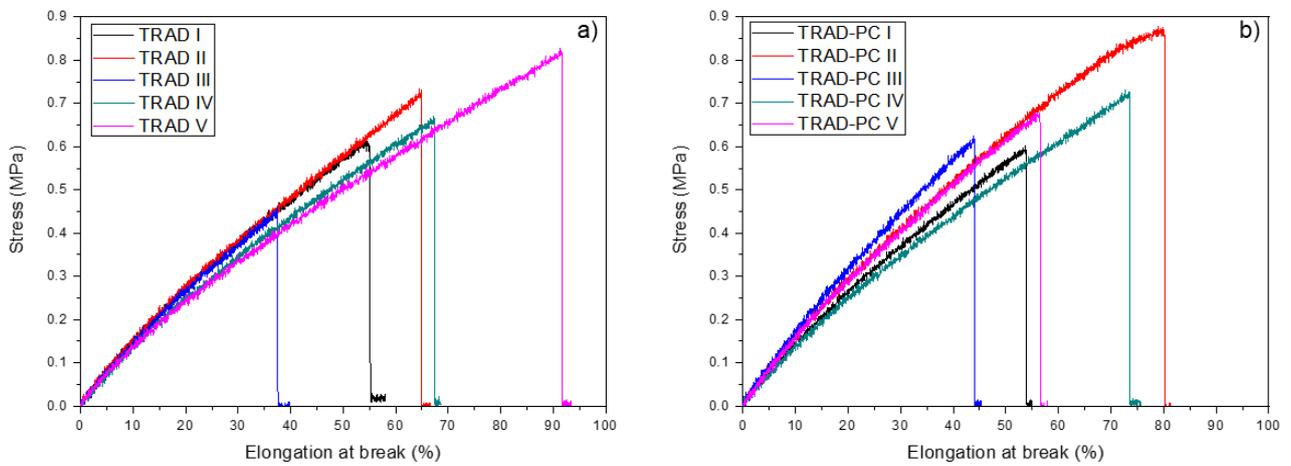
**Figure SI 5.** a,b) Swelling percentage (wt.%) vs time (min) curves for 3D printed TRAD samples after immersion in different solvents, c) Scatter plot of the swelling percentage (wt.%) vs extracted resin percentage (wt.%) for 3D-printed TRAD samples after 24-hours of immersion in different solvents.



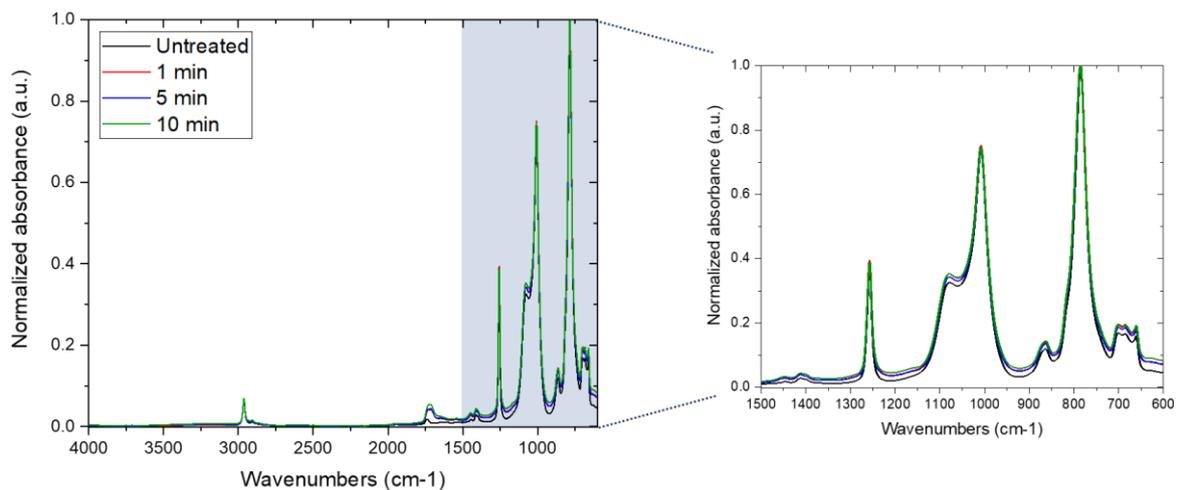
**Figure SI 6.** UV-VIS spectra of acetone used to extract unreacted material from 3DP TRAD samples.



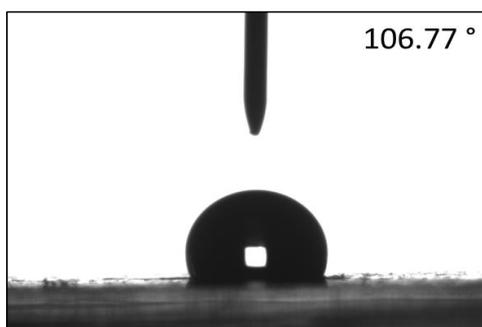
**Figure SI 7.** 3D printed TRAD dog-bone samples (with a gage length of 20 mm) during dynamo mechanical test.



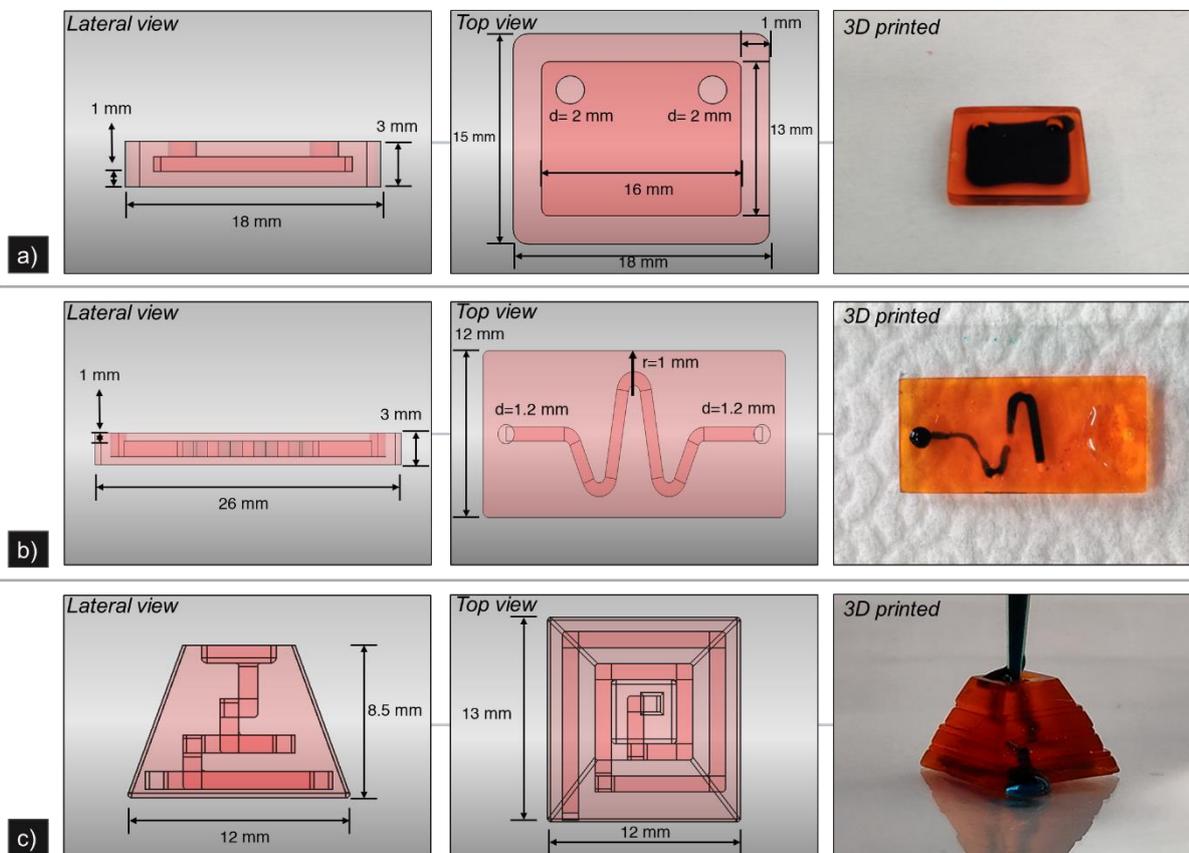
**Figure SI 8.** Curves of stress (MPa) vs elongation at break (%) for a) just 3D printed TRAD samples and b) 5 min post-cured TRAD samples



**Figure SI 9.** Normalized spectra recorded on TRAD samples after different UV-induced grafting polymerization times. The spectra were normalized using the  $790\text{ cm}^{-1}$  band corresponding to the Si-C asymmetrical bending or rocking vibration.



**Figure SI 9.** Contact angle measurement for 3D printed sample with functionalization process performed after post curing-step.



**Figure SI 11.** CAD designs and photographs of a) 3D printed chip with an internal cavity ( $16 \times 13 \times 1 \text{ mm}^3$ ) used for UV-induced grafting polymerization filled with green colored water, b) 3D printed chip with a s-shaped microchannel ( $1 \times 1 \text{ mm}^2$ ) used for UV-induced grafting polymerization filled with green colored water and silicon oil and c) 3D printed trapezoidal microfluidic device with a dye liquid passing through its channel ( $1 \times 1 \text{ mm}^2$ ).

## Reference

- [R1] F. Masson, C. Decker, S. Andre, X. Andrieu, *Prog. Org. Coatings* **2004**, 49, 1.
- [R2] J. Palaganas, A. C. de Leon, J. Mangadlao, N. Palaganas, A. Mael, Y. J. Lee, H. Y. Lai, R. Advincula, *Macromol. Mater. Eng.* **2017**, 302, 1.

