Electronic Supplementary Information (ESI)

Parameter investigation of an organic-inorganic hybrid resin for a 3D-printed microchannel heat exchanger

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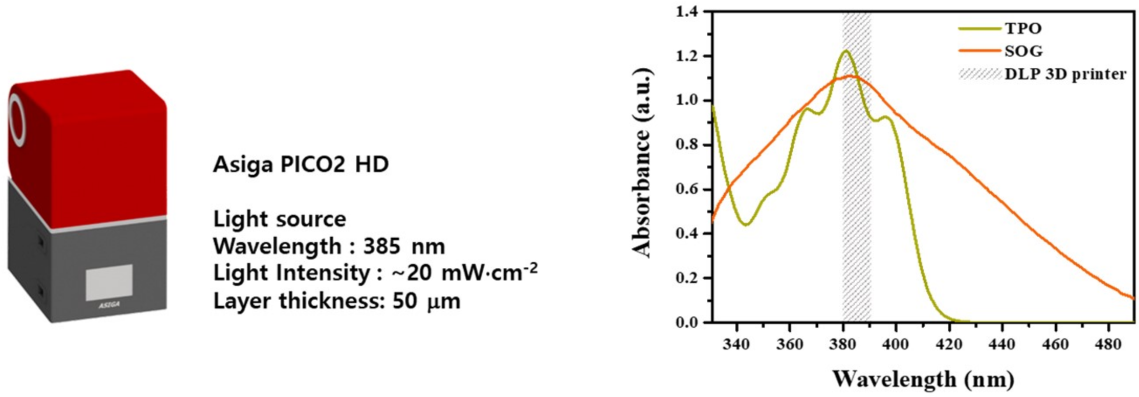

Fig. S1 Specifications of commercial DLP type 3D printer. Absorption spectra of additives and emission spectrum of DLP type 3D printer's UV light source.

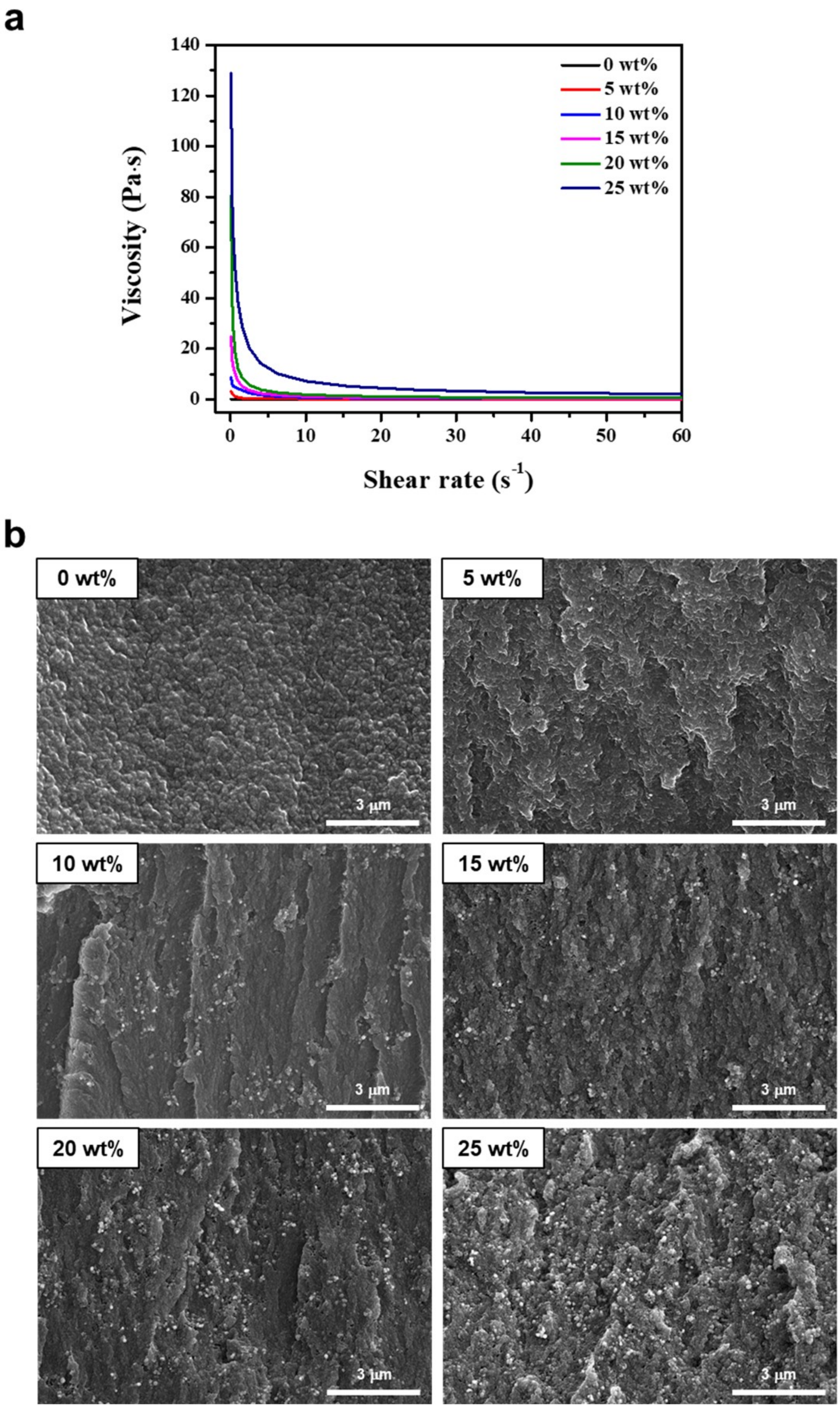

Fig. S2 (a) Viscosity of organic-inorganic hybrid resin containing 0.5 wt% of TPO and 0.02 wt% of SOG at different concentration of fumed silica. (b) Cross-sectional SEM images of the 3D-printed films at different concentration of fumed silica.

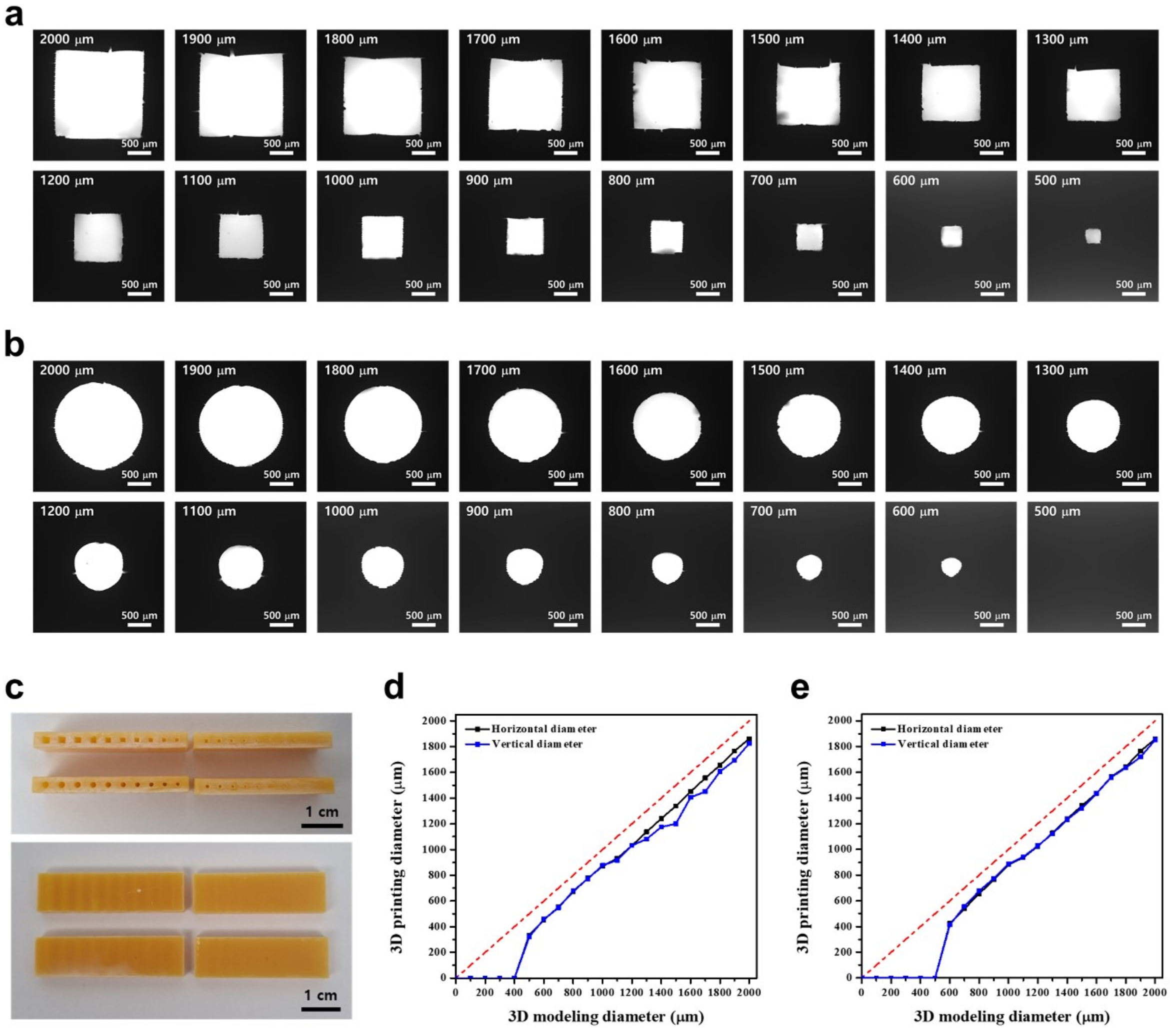

Fig. S3 Microscopy images of (a) 3D-printed square channels and (b) 3D-printed circular channels from 100 μm to 2000 μm. (c) Photographs of 3D-printed channels with hybrid 4, having square and circular channels with various diameter of 10 mm length. Dimensional errors between 3D modeling and 3D printing diameter for (d) square channels and (e) circular channels.

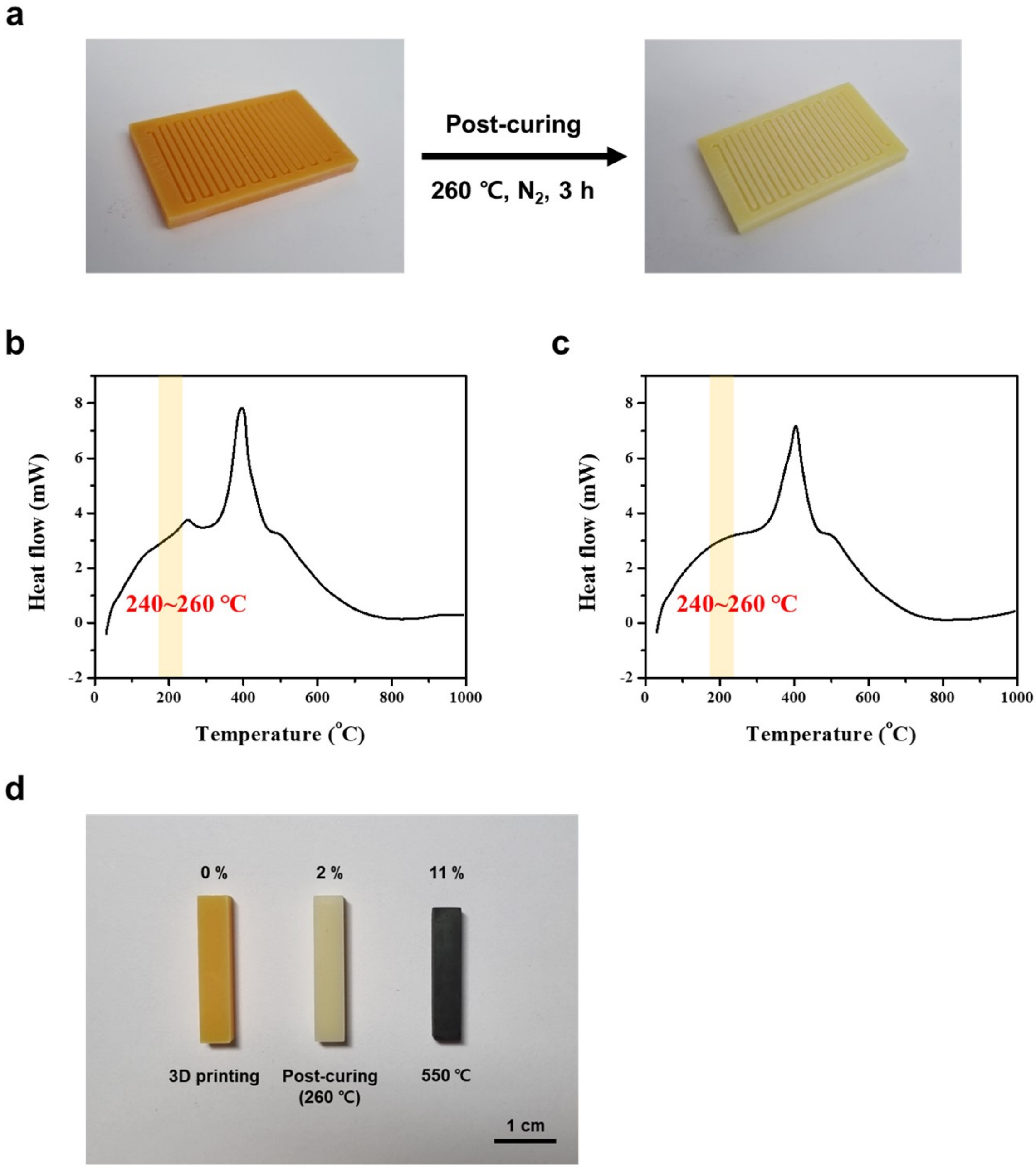

Fig. S4 (a) Post-curing process at 260 ℃ for 3 h in N_2 of 3D-printed hybrid 4 microchannel device (49 x 29 x 4 mm^3, 1 x 1 mm^2 square channel of 544 mm length). DSC curves of (b) 3D-printed hybrid 4 and (c) post-cured hybrid 4. (d) Dimensional shrinkage of 3D-printed hybrid 4 rectangular bar (5 x 5 x 25 mm^3).

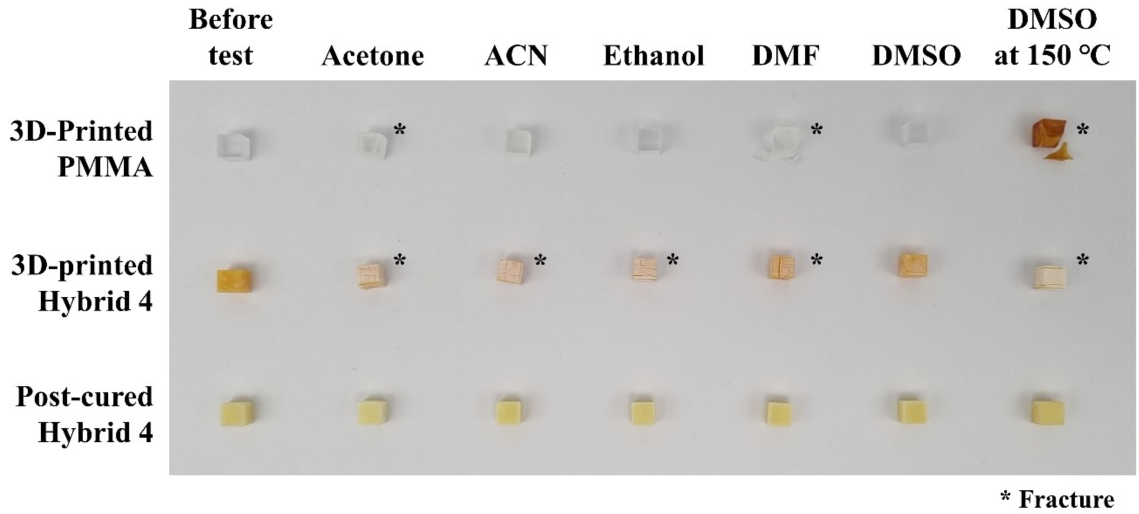

Fig. S5 Photograph of samples for chemical resistance of 3D-printed PMMA, 3D-printed hybrid 4, and post-cured hybrid 4.

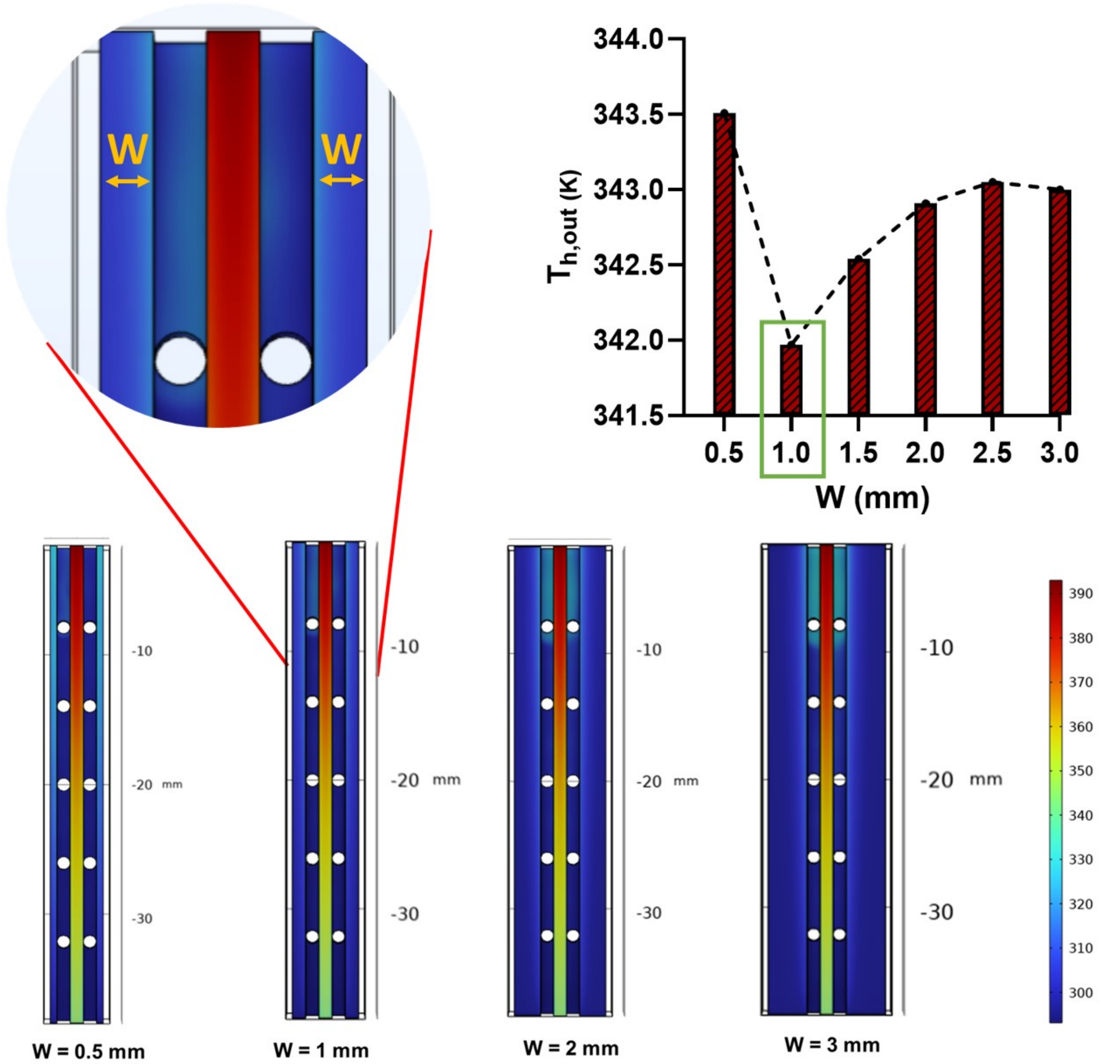

Fig. S6 The parameter study for determination of the width of the narrow channel in the side channels of the TMHE, achieved by CFD simulations.

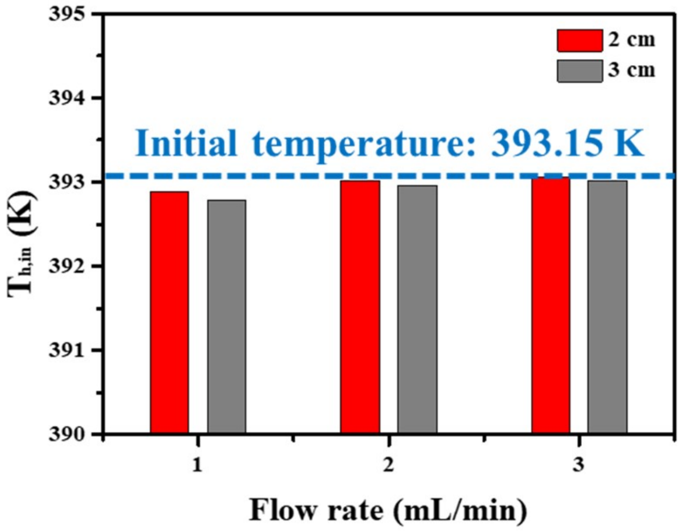

Fig. S7 The CFD simulation on the heat loss prediction of hot fluid, depending on flow rate and channel length between hot sand bath and heat exchanger inlet.

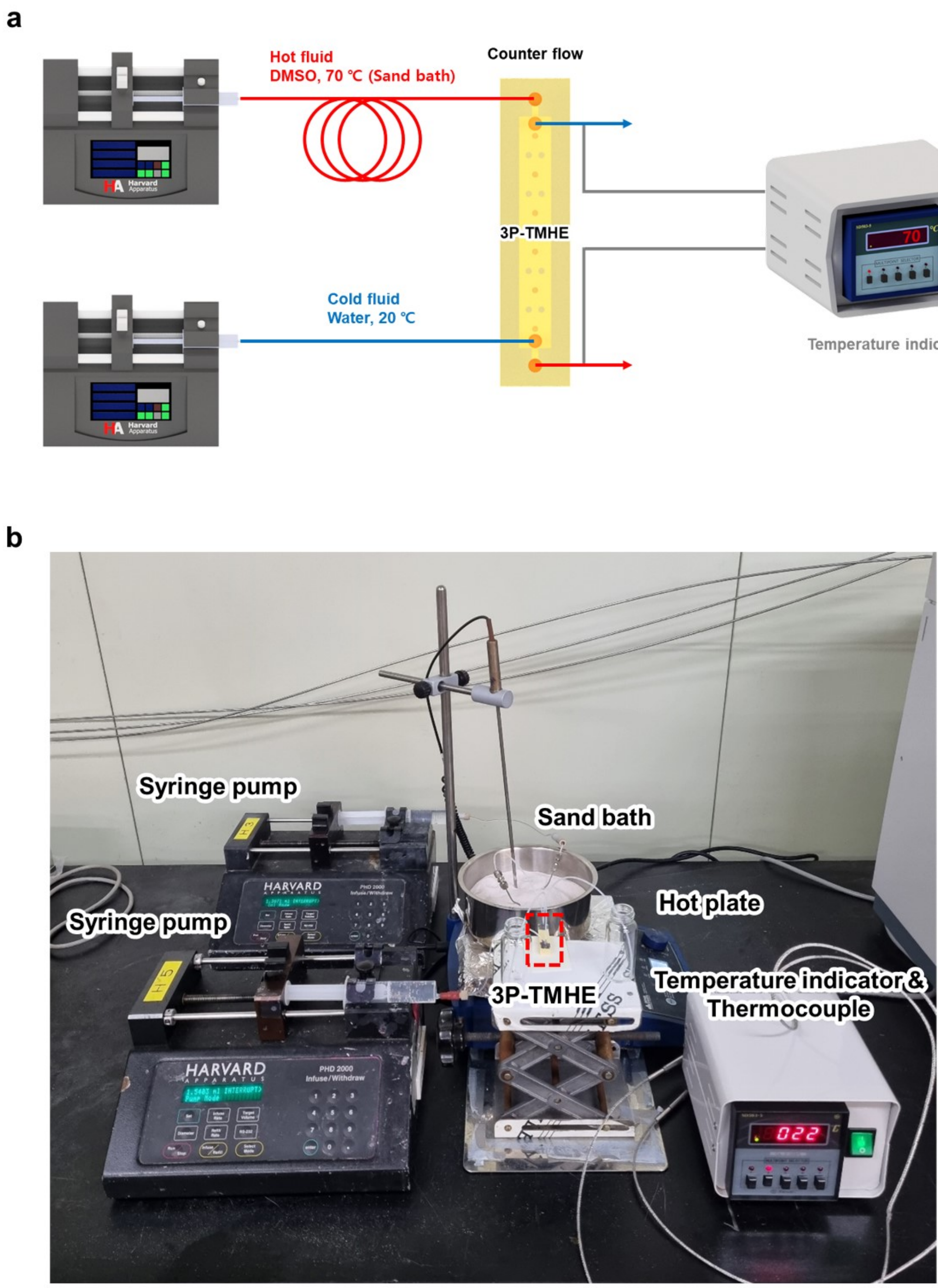

Fig. S8 (a) Schematic illustration of the 3P-TMHE system. (b) Actual platform to evaluate the heat transfer of the 3P-TMHE.

Table S1 Thermo-physical properties of 3D-printed PMMA, 3D-printed hybrid 4, and post-cured hybrid 4.

	Thermal diffusivity ($mm^2 \cdot s^{-1}$)	Specific heat ($J \cdot g^{-1} \cdot K^{-1}$)	Bulk density ($g \cdot cm^{-3}$)
3D-printed PMMA	**0.110**	**1.533**	**1.176**
3D-printed Hybrid 4	**0.115**	**1.514**	**1.144**
Post-cured Hybrid 4	**0.140**	**1.39**	**1.196**