Supporting Information

3D printing of tough double-network hydrogel and using it as scaffold to construct tissue-like hydrogel composite

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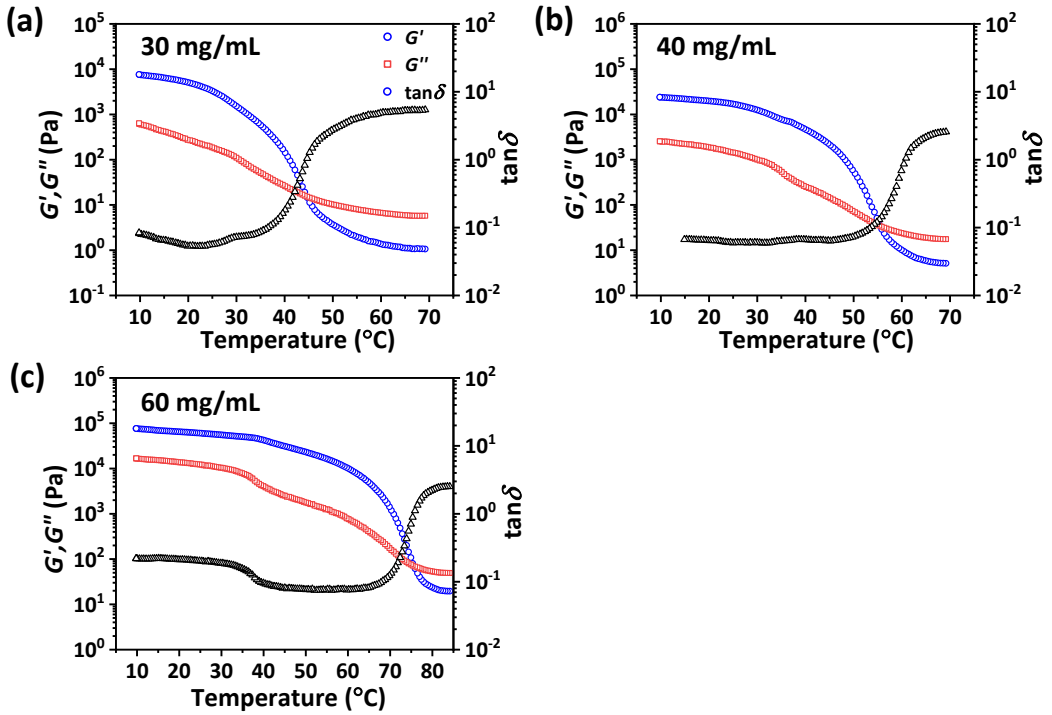

Fig. S1 Variations of storage modulus (G'), loss modulus (G''), and loss factor (tanδ) of the ink with C_{CG} of 30 mg/mL (a), 40 mg/mL (b), and 60 mg/mL (c) during the temperature sweep with a ramp rate of 5 °C/min, a frequency of 1 Hz, and a strain amplitude of 5%.

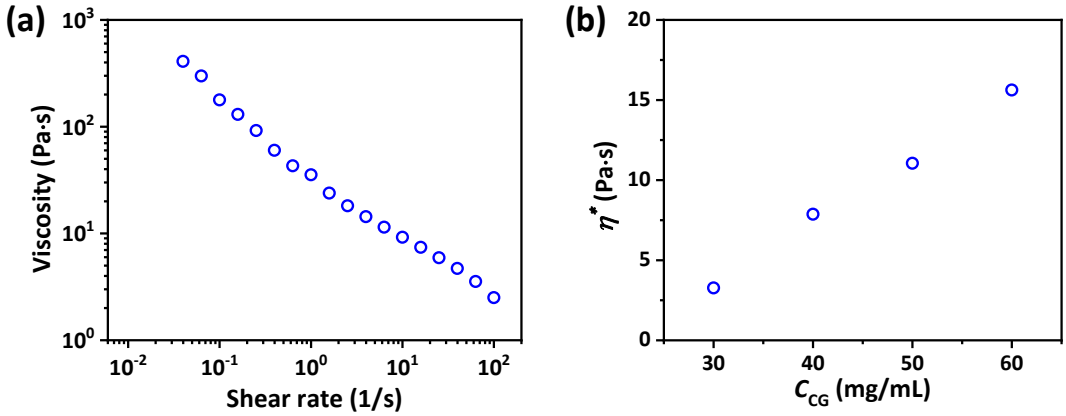

Fig. S2 (a) Viscosity versus the shear rate of the ink with C_{CG} of 50 mg/mL at 70 °C. (b) The complex viscosity at the gelation point ($G' = G''$) of the ink with different C_{CG}.

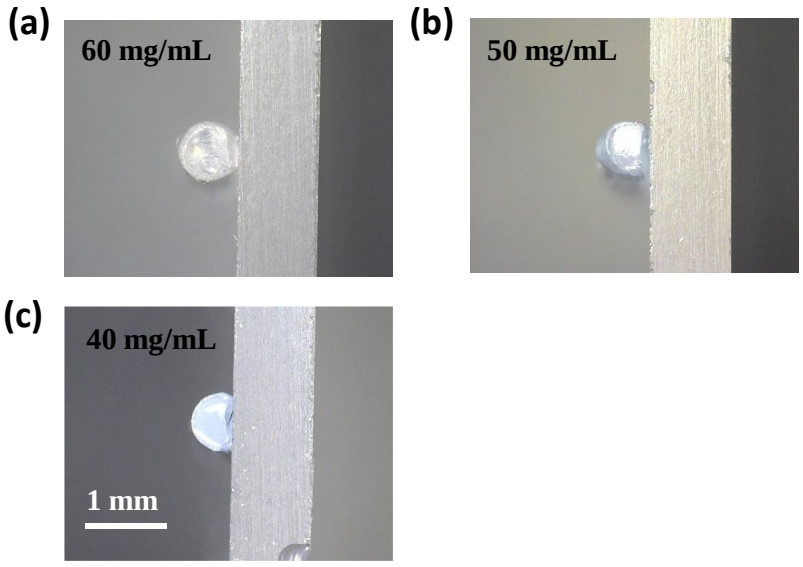

Fig. S3 Micrographs of the cross section of fibers printed with C_{CG} of 60 mg/mL (a), 50 mg/mL (b), and 40 mg/mL (c).

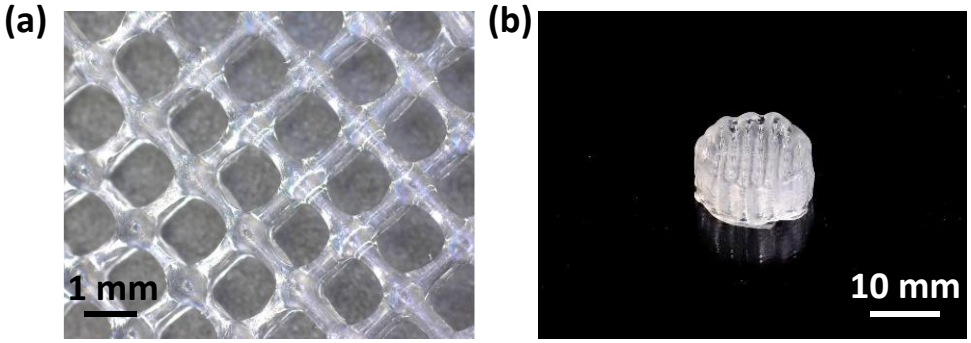

Fig. S4 (a) Micrograph of the printed grid with fiber diameter of ~500 μm. (b) Digital photo of a cylindrical grid with 20 layers of printed gel fibers.

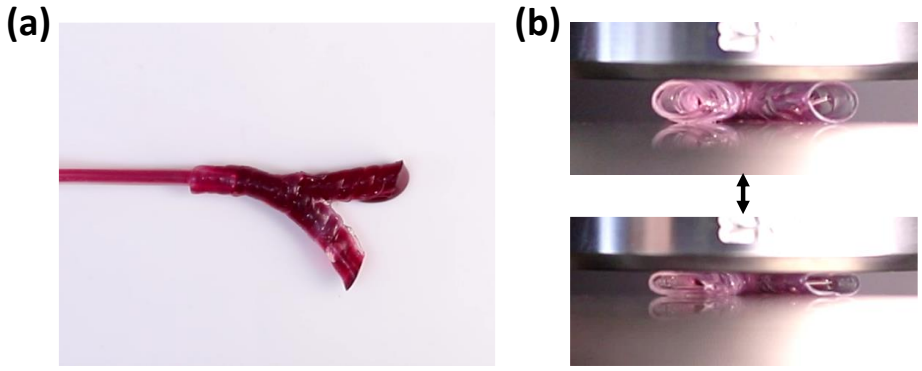

Fig. S5 Photo of printed artificial branched blood vessel with water flowing through it (a) and under cyclic compression (b).

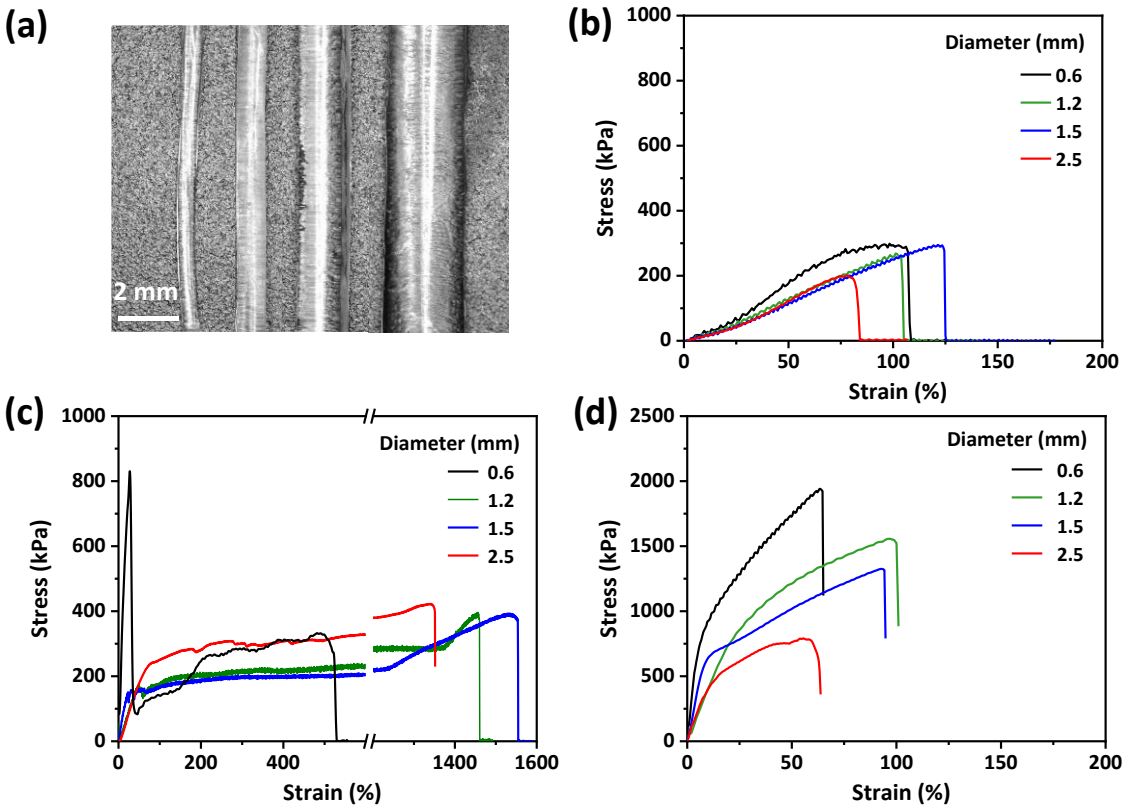

Fig. S6 (a) Micrograph of printed fibers with various diameters. (b-d) Tensile stress-strain curves of SN gel fiber (b), DN gel fiber (c), and DN gel fiber reinforced by Zr^{4+} ions (d) with various diameters.

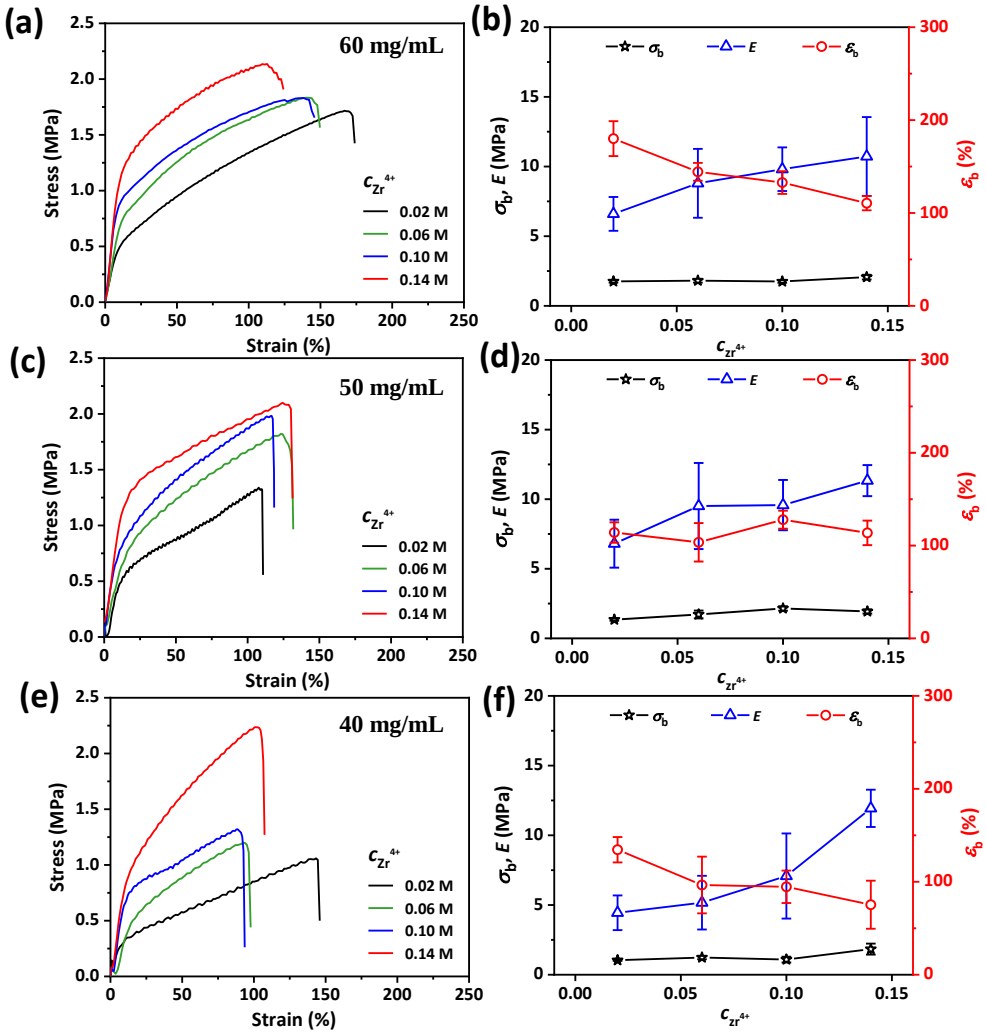

Fig. S7 Tensile stress-strain curves (a,c,e) and corresponding mechanical properties (b,d,f) of the fibers printed with C_{CG} of 60 mg/mL (a,b), 50 mg/mL (c,d), and 40 mg/mL (e,f) and reinforced by soaking in solution with different concentration of Zr^{4+} ion, C_{Zr4+}.

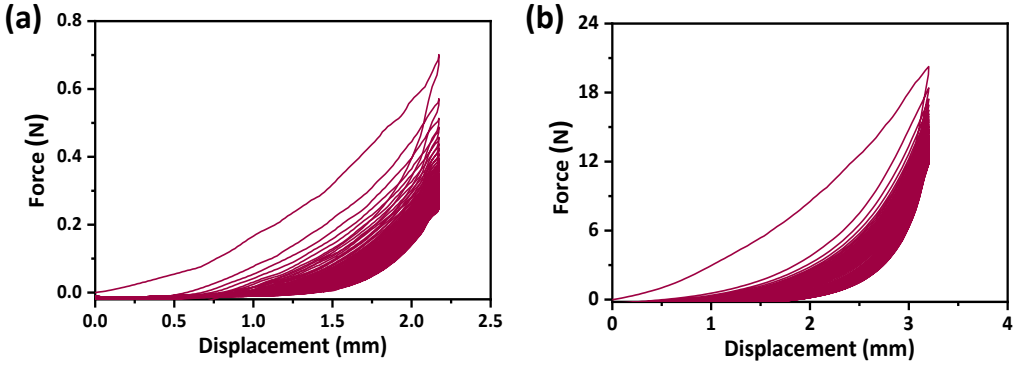

Fig. S8 Variations of the loading force during the cyclic compression of a fibrin gel (a) and Zr^{4+}-reinforced DN gel scaffold (b) with a maximum compression strain of 40%.

Table S1 Printing parameters for the fabrication of printed hydrogel constructs.

Parameter	Value
Extrusion pressure (kPa)	40
Nozzle moving speed (mm/min)	600
Nozzle inner diameter (mm)	0.4
Substrate temperature (°C)	20

Movie S1. Liquid flow through the printed artificial blood vessel. The printed artificial vessel is connected with a silicon tube, and 0.2 wt% neutral red is added to water for better visualization.

Movie S2. Cyclic compression of the printed artificial blood vessel. The printed artificial vessel is compressed with a maximum strain of 50% and constant speed of 50 mm/min.