Electronic Supplementary Material (ESI) for Lab on a Chip.

Supplementary Information for

A simple method for production of hydrophilic, rigid, and sterilized multi-layer 3D integrated polydimethylsiloxane microfluidic chips

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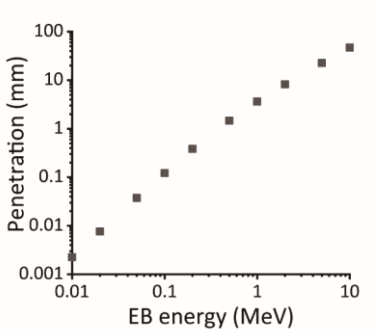

Fig. S1 Electron beam penetration in polydimethylsiloxane (PDMS) (assumed atomic composition: C_2H_6OSi; assumed density: 0.97 g/cm^3) as a function of energy, simulated using the Monte Carlo simulation code EGS5.[1]

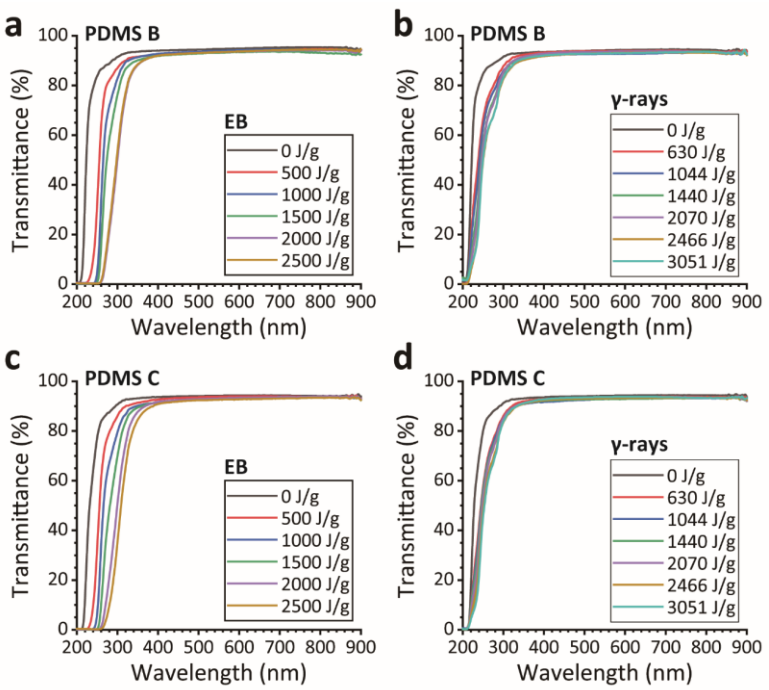

Fig. S2 Ultraviolet–visible (UV-vis) spectra of (a, b) PDMS B and (c, d) PDMS C substrates (thickness: 0.7 mm) before and after irradiation with (a, c) a 1 MeV electron beam (EB) and (b, d) ^{60}Co γ-rays.

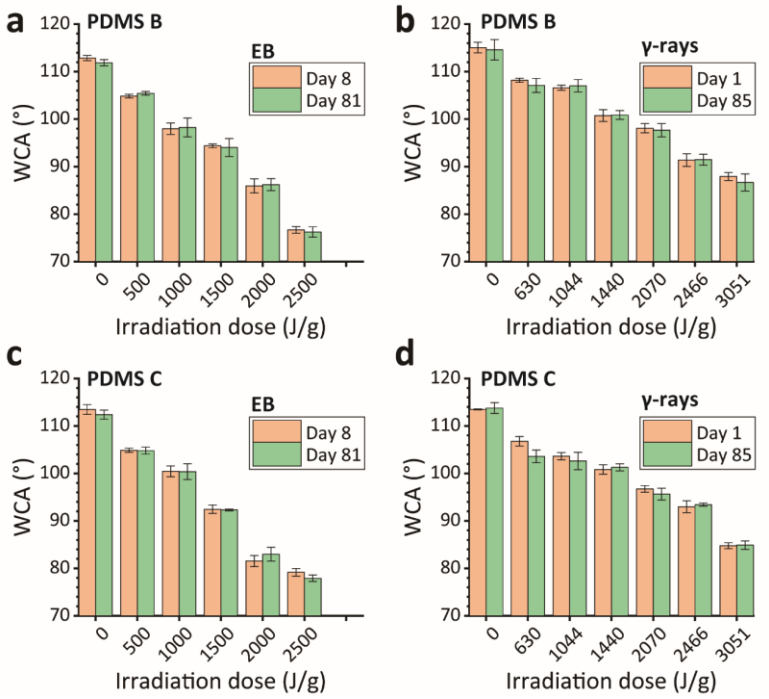

Fig. S3 Durability of hydrophilicity evaluated in terms of water contact angles (WCAs) of the (a, b) PDMS B and (c, d) PDMS C samples after irradiation with (a, c) a 1 MeV electron beam (EB) or (b, d) ^{60}Co γ-rays. The samples were stored in ambient air at room temperature (~20 °C). Error bars show the standard error of the mean for n = 3.

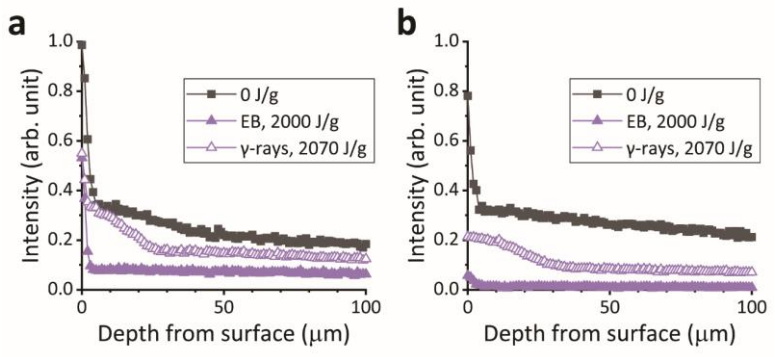

Fig. S4 Distribution of rhodamine B evaluated in terms of the image intensity of fluorescent images in non-irradiated, 1 MeV electron-beam (EB) irradiated (2000 J/g), and ^{60}Co γ-ray-irradiated (2070 J/g) PDMS A substrates evaluated after (a) soaking in rhodamine B for 60 min and (b) subsequent soaking in ultrapure water for 10 min.

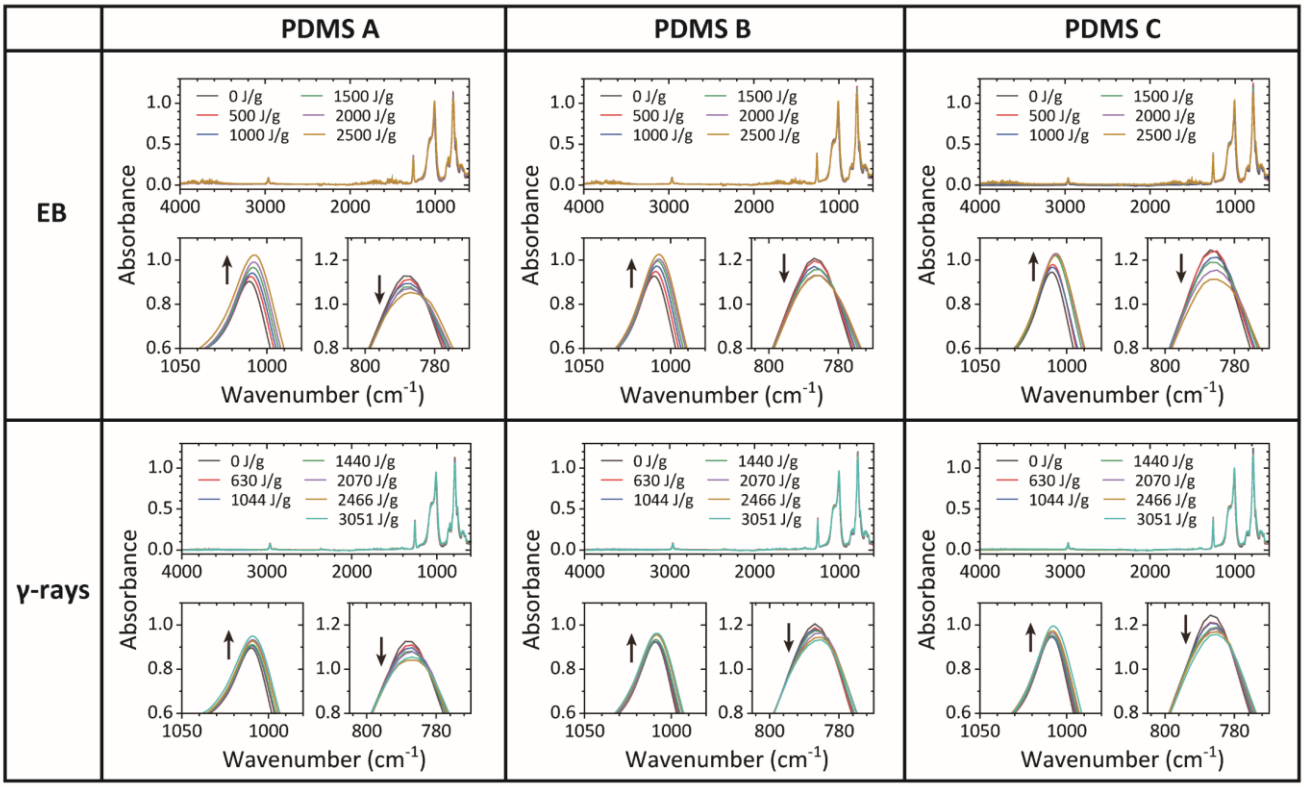

Fig. S5 Fourier transform infrared (FT-IR) spectra (full and expanded) of non-irradiated and 1 MeV electron beam (EB) and ^{60}Co γ-ray-irradiated PDMS substrates. The spectra of EB-irradiated PDMS A are the same as those given in Fig. 7 and are shown here for comparison with the other data.

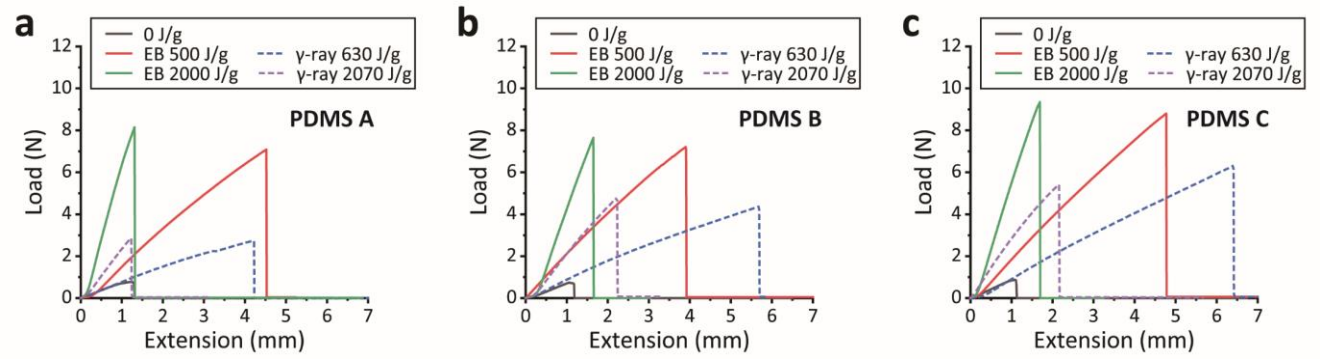

Fig. S6 Shear load–extension curves for non-irradiated and 1 MeV electron beam (EB) and ^{60}Co γ-ray-irradiated PDMS substrates.

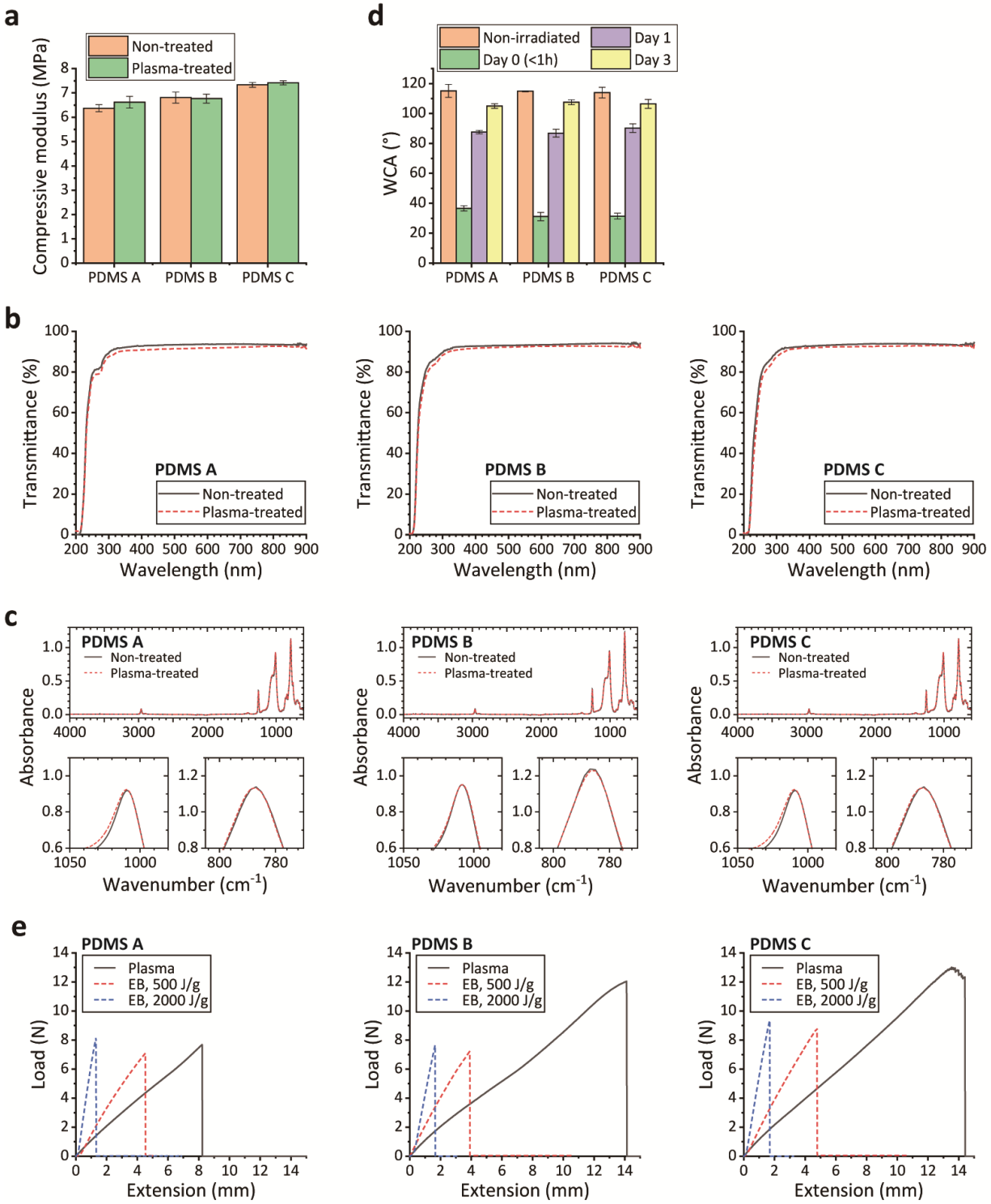

Fig. S7 Compressive modulus of PDMS samples (a), ultraviolet–visible (UV-vis) spectra (b), and Fourier transform infrared (FT-IR) spectra (full and expanded) (c) before and after air-plasma treatment. Durability of hydrophilicity was evaluated in terms of the water contact angles (WCAs) of PDMS samples after plasma treatment and storage in ambient air at room temperature (~20 °C) (d). Shear load-extension curves for PDMS samples bonded by plasma and 1 MeV EB (e). The curves of EB-bonded samples are the same as those given in Fig. S6 and are shown here for comparison with the other data.

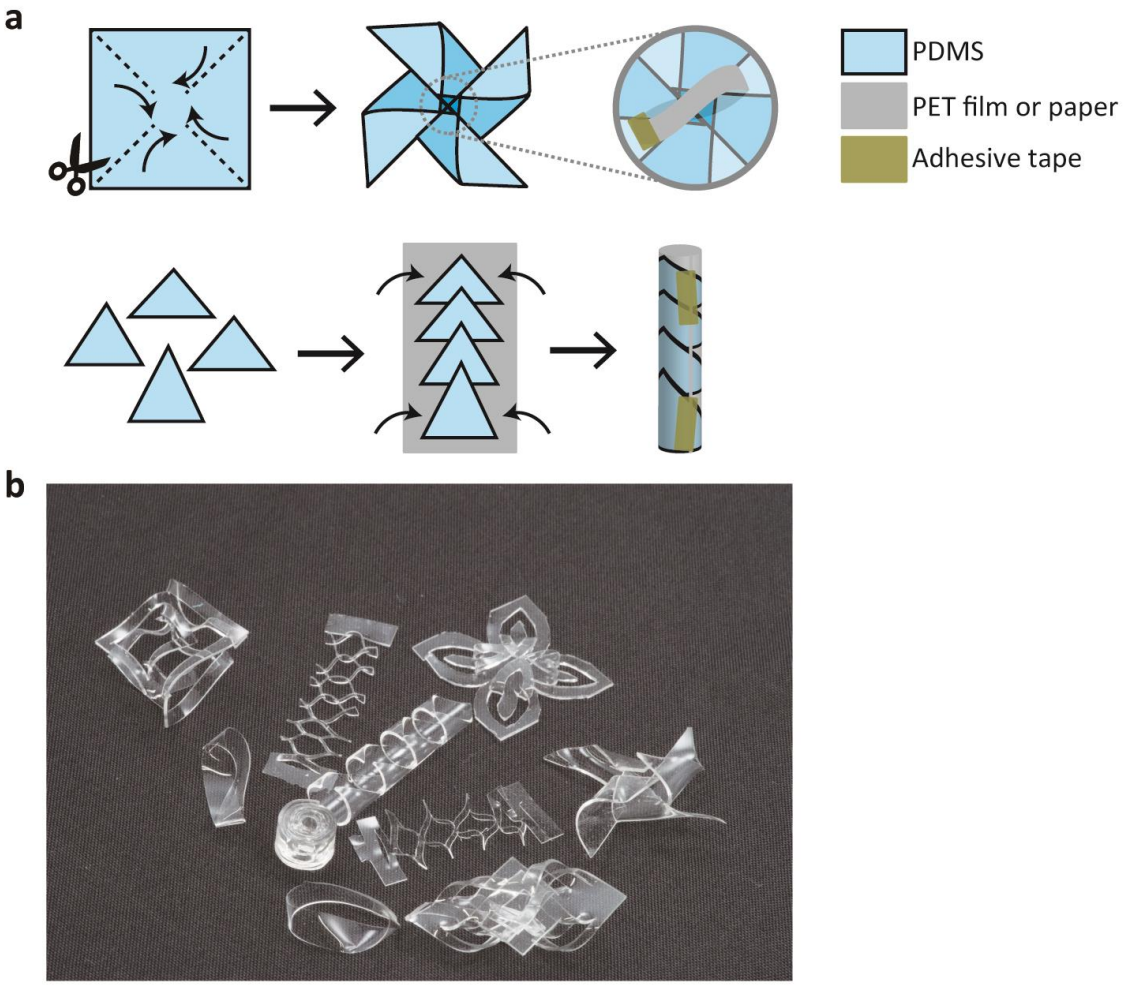

Fig. S8 Schematic of preparation of 3D structures with complex shapes (a). PDMS substrates were cut, bent, and overlapped before irradiation. Some overlapped parts were tied with polyethylene terephthalate (PET) films or paper with adhesive tapes. 3D structures produced by the proposed method (b). PDMS C films were integrated into structures with complex shapes by the hardening and bonding effects induced by a 2 MeV EB.

Reference

1. H. Hirayama, Y. Namito, A. F. Bielajew, S. J. Wilderman and W. R. Nelson, The EGS5 Code System, SLAC Report number SLAC-R-730 and KEK Report number 2005-8; 2005.