Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Rewritable and highly stable photonic patterns for optical storage and display enabled by direct-pressure programmed shape memory photonic crystals

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Fig. S1 Optical image of the prepared sample exhibiting flexibility.

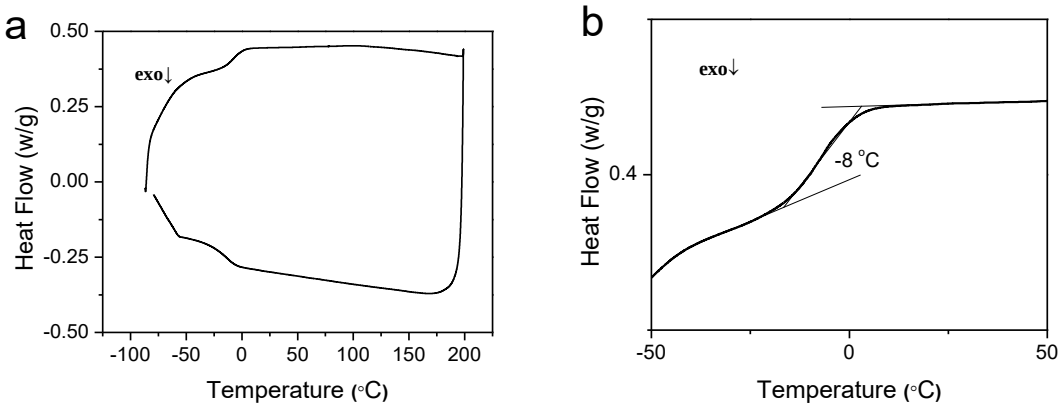

Fig. S2 Cyclic DSC plots of PEGDA-co-TAPU copolymer with a weight ratio of 1:5.

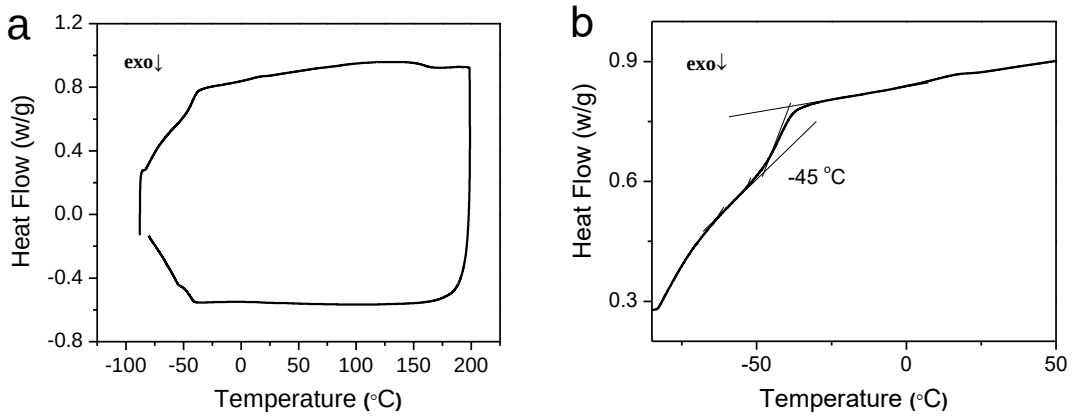

Fig. S3 Cyclic DSC plots of pure PEGDA polymer.

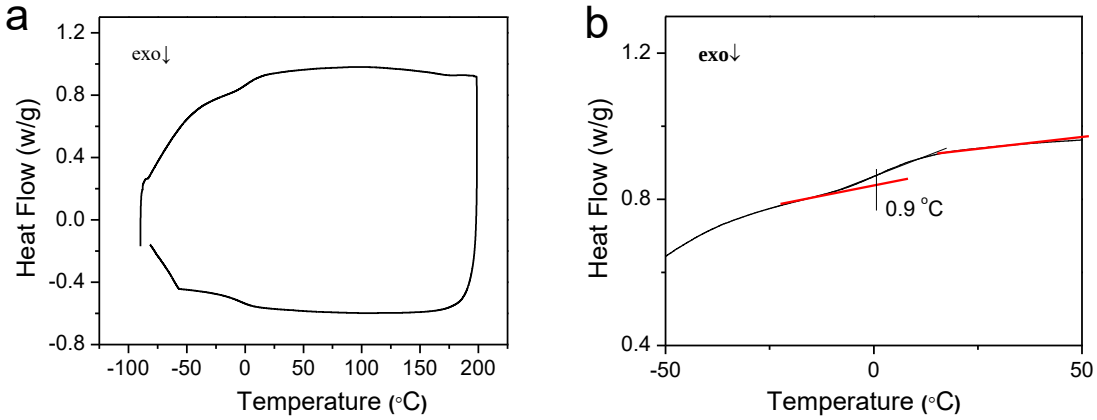

Fig. S4 Cyclic DSC plots of pure TAPU polymer.

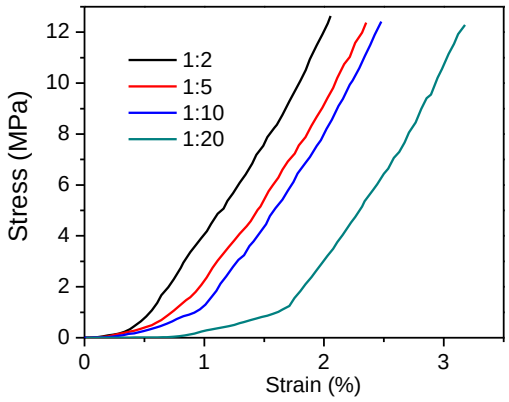

Fig. S5 Tensile curves of PEGDA-co-TAPU copolymer prepared with various weight ratios of PEGD:TAPU.

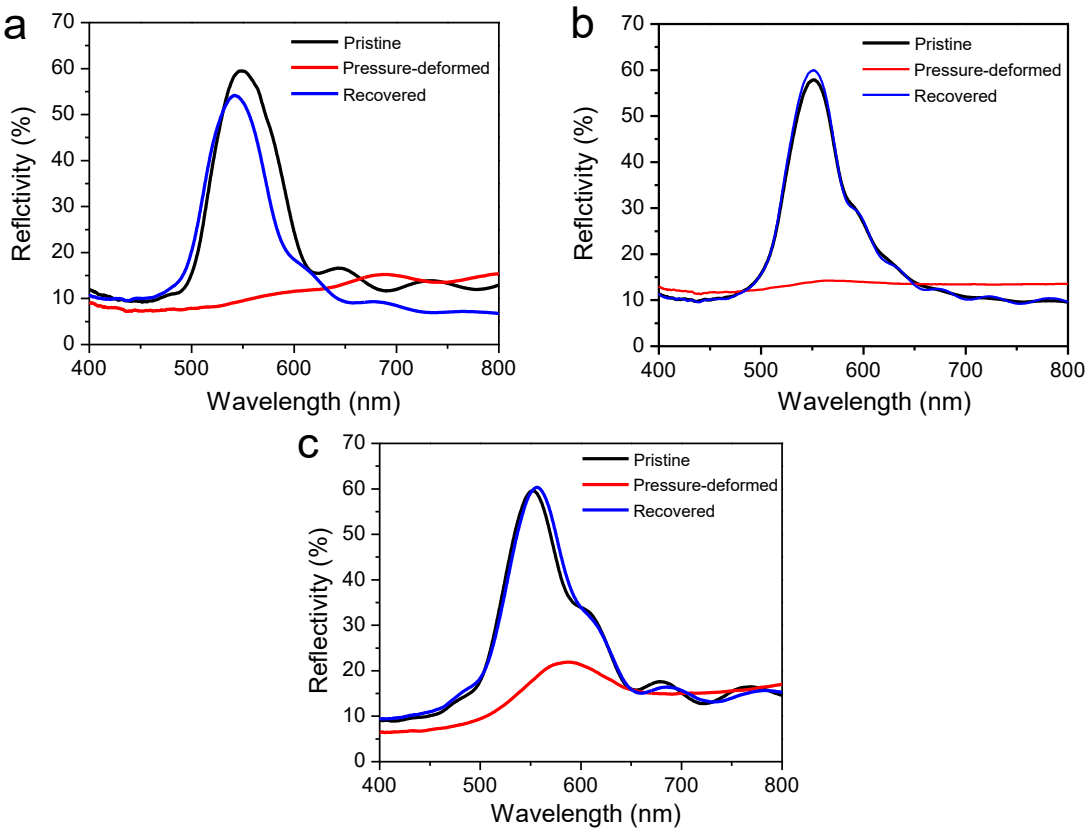

Fig. S6 Normal-incidence optical reflection spectra showing the pristine, direct-pressure deformed, and recovered states of the 300 nm macroporous PEGDA-co-TAPU copolymer photonic membranes prepared with various ratios of PEGDA:TAPU. (a) 1:2, (b) 1:10, (c) 1:20.

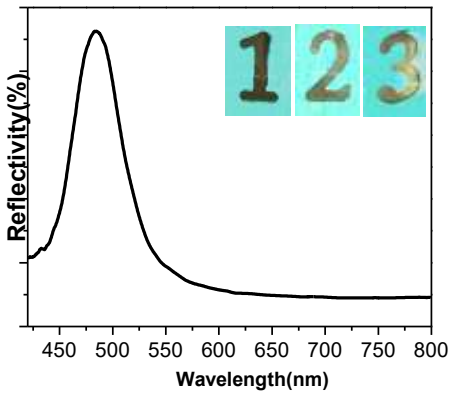

Fig. S7 Reflective spectrum of the photonic crystal membrane with diffractive peak centered at 495 nm. The insects depict the photonic patterns after imprinting-lithography.

Generally, the pressing procedure would cause the blueshift of the stopband. For example, the thermal compression (thermal annealing at 40 °C) of SU-8 inverse opals would result in a blueshift in the stop band position (*Joon Seok Lee, Kwanghwi Je, Shin Hyun Kim, Adv. Funct. Mater., 2016, 26, 4587*). This is because the entire framework of inverse opal subject to uniform compression in the vertical direction under thermal treatment. Such uniform compression along vertical direction led to the reduction of interlayer spacing and (from d_0 to d), therefore, a blueshift in the stopband position.

In contrast, the contacted pressure would result in the collapse/deformed structure and color's disappearance in the present work, there is no apparent blueshift of diffraction peak. This may be due to the framework of inverse opal subject to non-uniform pressure in the vertical direction. When the sample was subject to external pressure, the topmost layers of the inverse opal contacted with stamp, which firstly suffered compressive force. Since the PEGDA-co-TAPU cross-linked copolymer was in rubbery state at room temperature (T_g −8.0 °C), the topmost layers were deformed rather than whole backbone, thus leading to the lower reflection amplitude compared with the initial control sample, as displayed in Fig. S8. As a result, the relative intensity of reflective peaks decreased monotonically while the stopband position maintained with increasing the applied compressive stresses from 0 to 1.5 MPa (*Y. Fang, Y. Ni, S. Y. Leo, C. Taylor, V. Basile, P. Jiang, Nat. Commun. 2015, 6, 7416*).

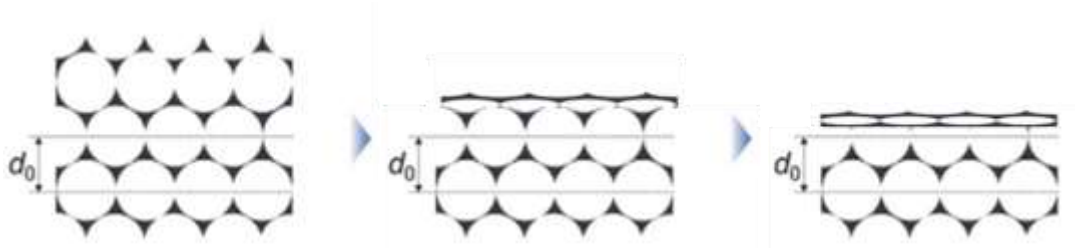

Fig. S8 Schematic illustration showing the imprint mechanism of the inverse opal in this work.

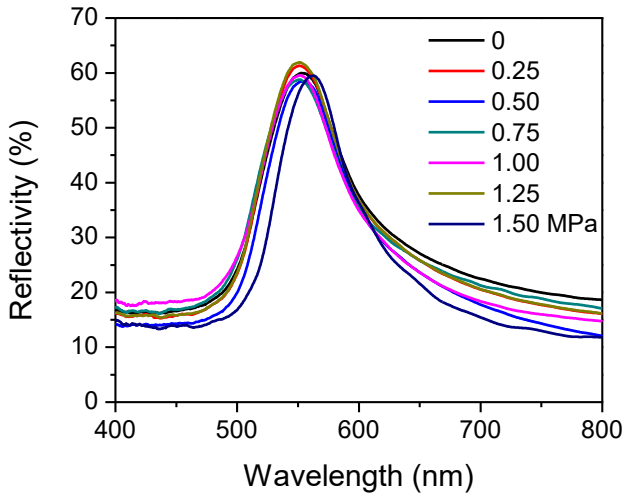

Fig. S9 Reflection spectra of the recovered PEGDA-co-TAPU photonic crystals compressed under various pressures.

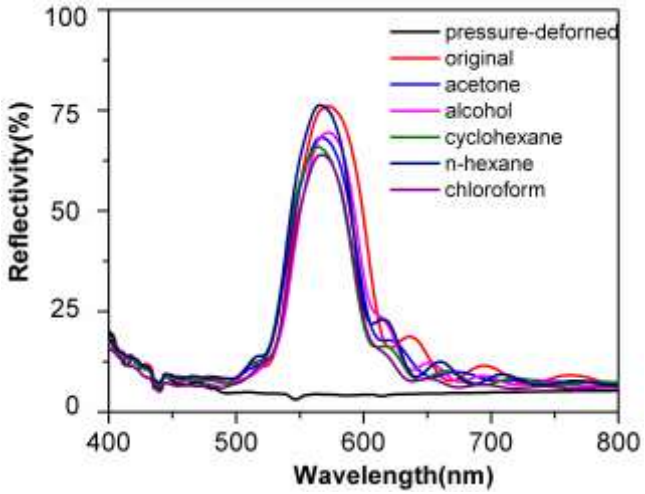

Fig.S10 Normal-incidence optical reflection spectra of the sample after recovered from a series of solvents.

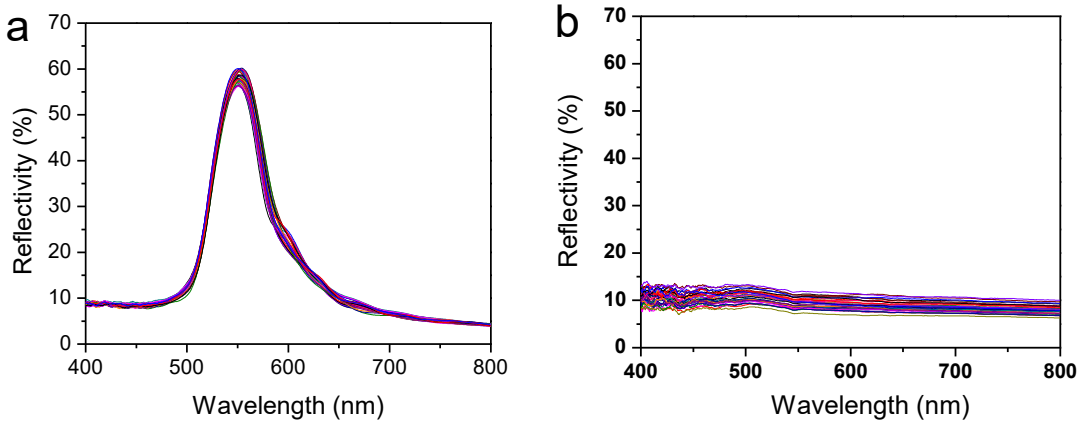

Fig. S11 Reflective spectra of (a) the pristine state and (b) the direct pressure-deformed state of PEGDA-co-TAPU membrane measured continuously for 30 days.

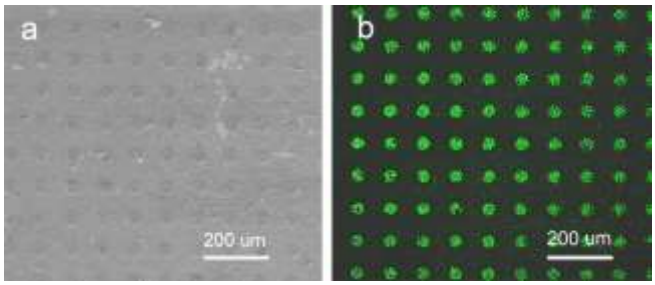

Fig. S12 (a) SEM and (b) microscopically optical image of photonic patterns obtained at low magnification.

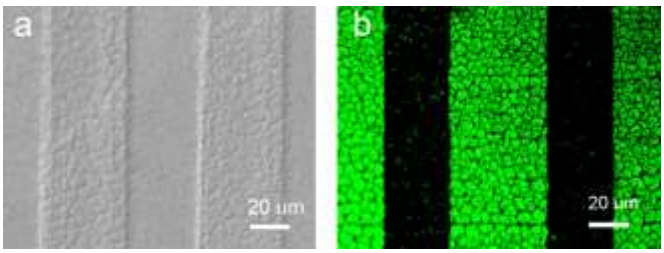

Fig. S13 (a) SEM and (b) microscopically optical image of linear photonic patterns obtained at high magnification.