Supporting information

Biomimetic Jagged Micropatterns Templated from Photoswitchable Liquid Crystal Topography for Energy Harvesting and Sensing Applications

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1. Generation Information

Materials

Polydimethylsiloxane (PDMS) precursor was purchased from Dow Corning. Photocurable fluorocarbon resin oligomer, B-864 was purchased from Guangdong Bossin Novel Materials Technology Company. Dodecylfluoroheptyl methacrylate, G04 was purchased from Harbin Xuejia fluorosilicone Company. Liquid crystal monomer C6M, RM23 and RM105 were purchased from Bayi Space LCD Company. Photoinitiator, Irgaure 819 was purchased from BASF Company.

Characterization and Measurement

The surface topography of liquid crystal (LC) template and fluorocarbon resin PB-864 was characterized by SOHIO 3 Dimensional Confocal Microscope Phase Shift MicroXAM-3D in National Laboratory for Tribology, Tsinghua University. The contact angle of PB-864 was measured by OCA20 Contact angle measuring instrument. The output performance of FC-TENG, DFC-TENG, and CFC-TENG was measured by Keithley 2450 SourceMeter. FC-TENG and DFC-TENG output performance test is powered by linear motor.

2. Preparation of multi-domain LC template

As shown in Figure S1, two pieces of clean glass substrates were used to construct a glass cell with 20 μm spacer and one of the substrates was treated by silane coupling agent before. Materials 1, 2, 3, 4, 5, 6, 7 (Figure S2) were mixed in a weight percent of 30%, 44%, 15%, 2%, 5%, 2%, 2% in dichloromethane solvent. Then, the mixture was stirred for 5 min and it was kept in a vacuum for 10 hours to remove solvent. After that,

the mixture sample was injected into the glass cell on 80 °C hot stage based capillarity. Finally, the sample was irradiated upon the visible light for 15 minutes to initiate polymerization. After polymerization, the top substrate was removed, and the LCN coating was obtained.

The LC template with jagged relief patterns could be directly obtained from the above multi-domain LC network polymer through ultraviolet (UV) light irradiation, the intensity of ultraviolet light irradiation is 20 mW/cm^2, and the illumination time is 60 s. After the irradiation was completed, it could be observed that the microstructure generated due to the isomerization of azobenzene molecules in the multi-domain LC template. By changing the content of the fluoride monomer G04 in the multi-domain LC template, a plurality of multi-domain LCNs with different surface morphologies were obtained.
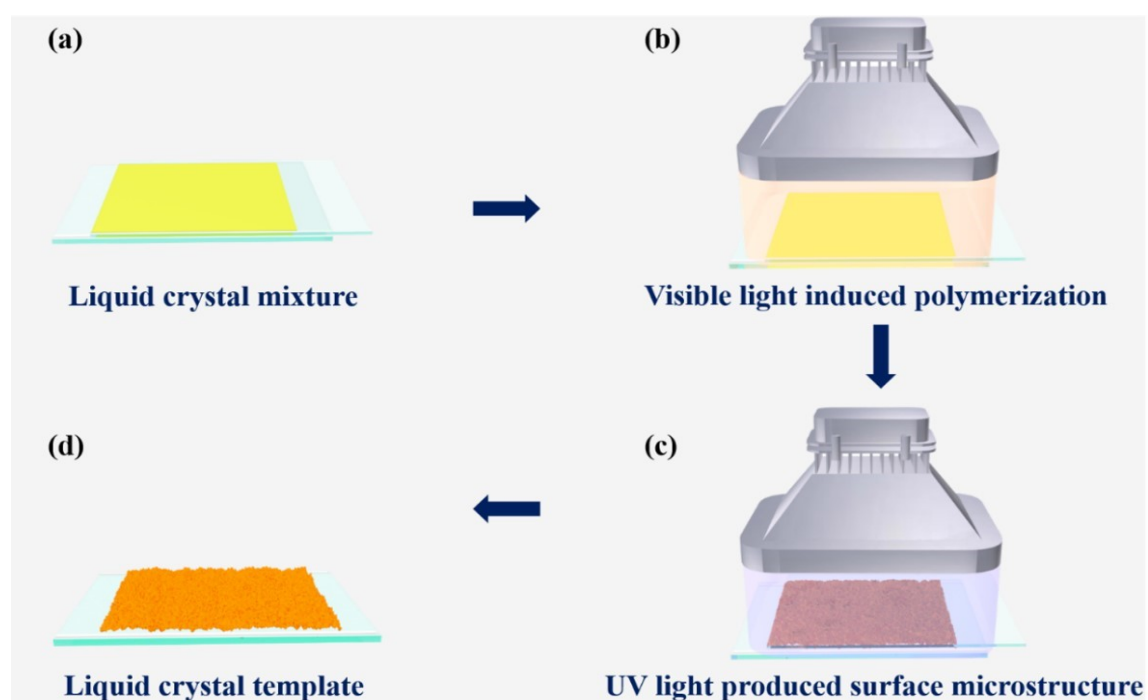

(a) Liquid crystal mixture

(b) Visible light induced polymerization

(c) UV light produced surface microstructure

(d) Liquid crystal template

Figure S1. Schematic diagram of the preparation process of LC template.

Figure S2. Materials used for photosensitive LC template: materials 1-3 (C6M, RM23 and RM105) are LC monomers; material 4 is fluoride monomer (G04); material 5 is azobenzene monomer and material 6 is photoinitiator (Iragure 819).

Fig. S3 shows the FT-IR spectrum of the photocurable resin PB-864. The wavenumber at 1728 cm^{-1} is the stretching vibration peak of the C=O double bond, and the C=O double bond comes from the acrylate functional group in PB-864. Wavenumbers ranging from 900 to 1300 cm^{-1} are in the fingerprint area of the infrared spectrum. The wavenumbers in this area are 1240 cm^{-1}, 1178 cm^{-1}, and 1114 cm^{-1}, which come from the C-F bond. The functional group region has two absorption peaks with wavenumbers of 2970 cm^{-1} and 3384 cm^{-1}. Theoretically the absorption peak at 2970 cm^{-1} comes from C-H and the absorption peak at 3384 cm^{-1} comes from hydroxyl group.
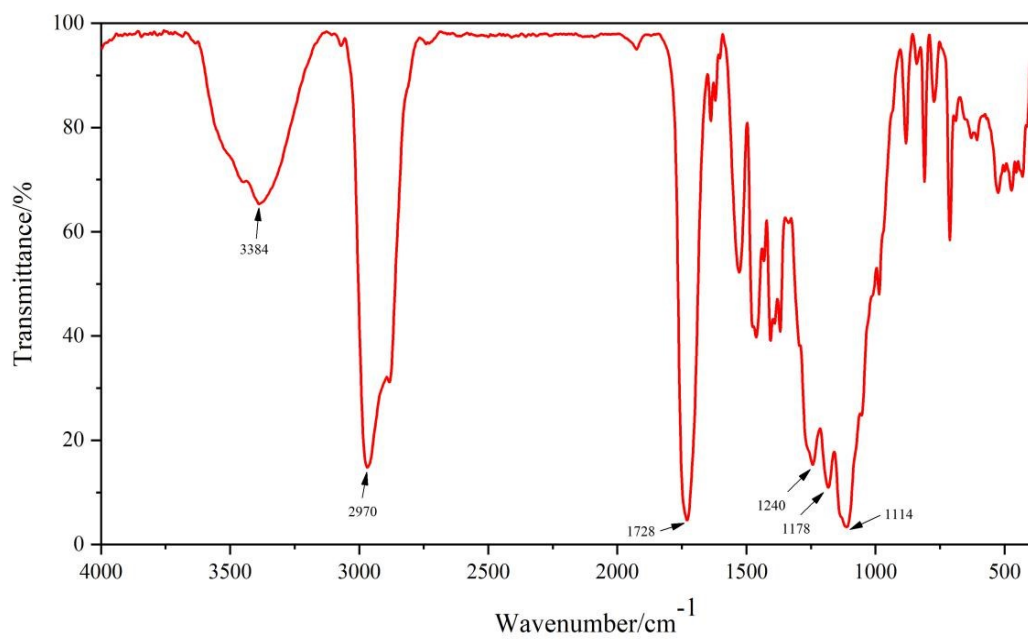
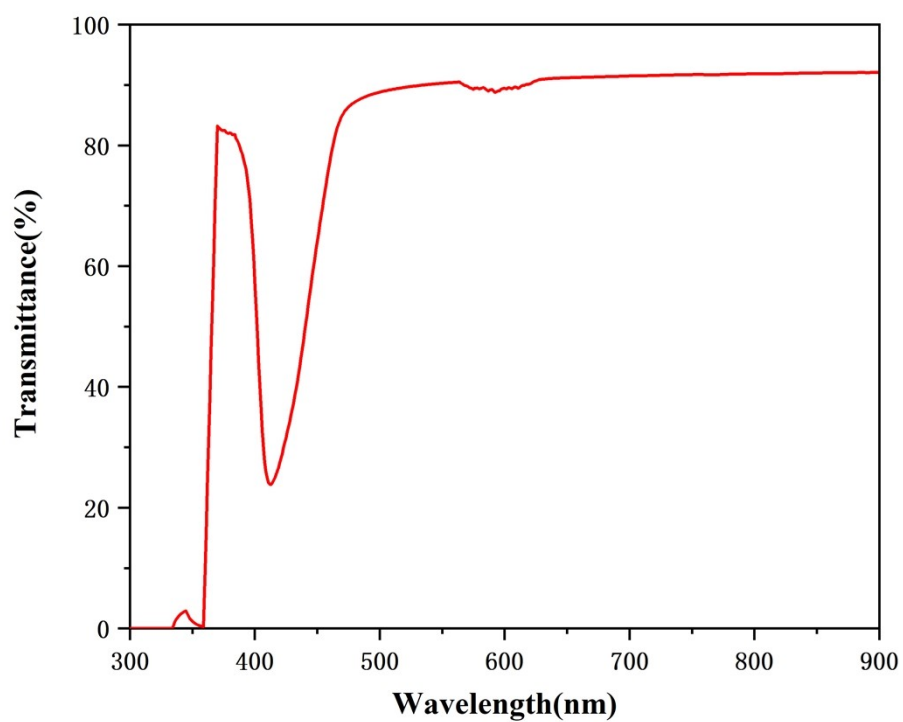**Figure S3**. FT-IR spectrum of the photocurable resin PB-864.

Figure S4. The transmission spectrum of the fluorocarbon polymer.

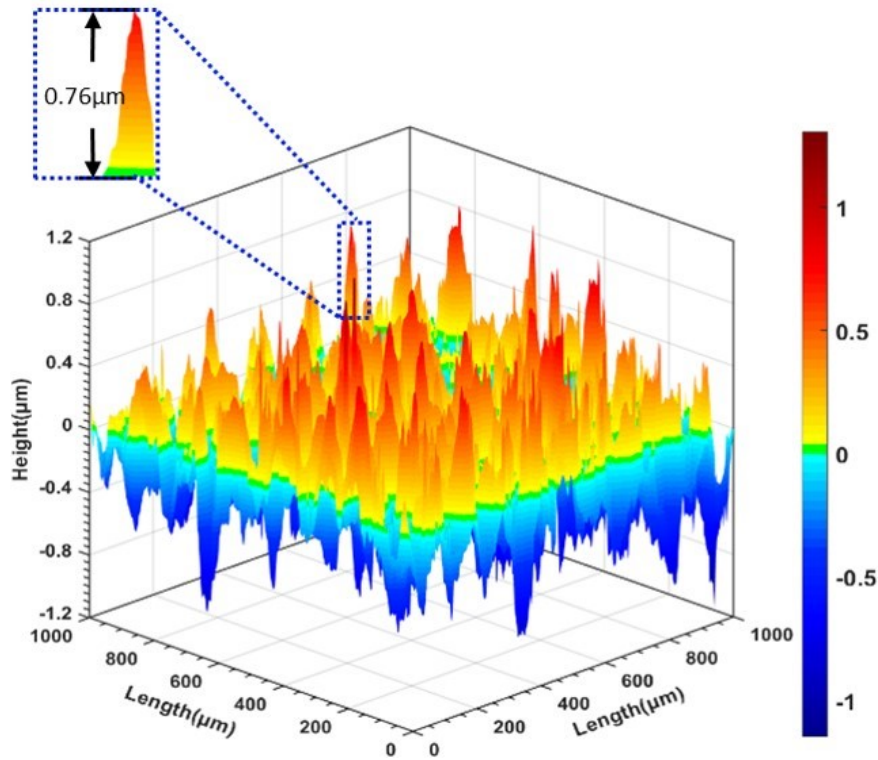**Figure S5**. Simulated and counted the average height and number of peaks on the surface of different PB-864 samples in a 1.0 μm^2 area through MATLAB software.

Table S1. Surface structure statistics

PB-864 sample number	G04 content in LCN/%	Number of peaks	Average height of peaks/μm
1	1	65	0.1193
2	2	107	0.3366
3	3	236	0.4730
4	4	112	0.3042
5	5	68	0.1678

To characterize the mechanical properties of PB-864, the stress-strain curve tests were performed on PB-864 and PDMS. In this study, PDMS was used as a comparison with PB-864. The stress-strain curves were shown in Fig. S6 and the mechanical properties data were listed in Table S2. The elongation at break of PB-864 is 59.69%,

while the elongation at break of PDMS is 204.71%. The comparison data show that PDMS is more elastic. The breaking strengths of PB-864 and PDMS are 10.77 MPa, and 7.87 MPa, respectively. It was found from the comparison data that PB-864 possessed higher strength. The shape of the stress-strain curve shows that PB-864 is a "hard and brittle" polymer material, while PDMS is a "soft and tough" polymer material. In general, PB-864 has higher strength, ensuring its durability as a friction layer for TENG.
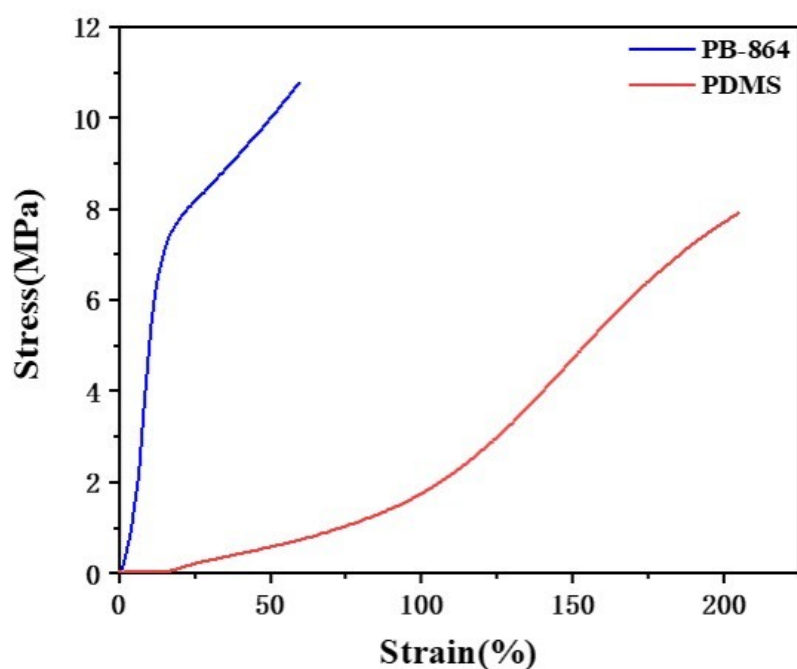

Figure S6. Stress-strain curves of PB-864 and PDMS.

Table S2. Mechanical properties of PB-864 and PDMS

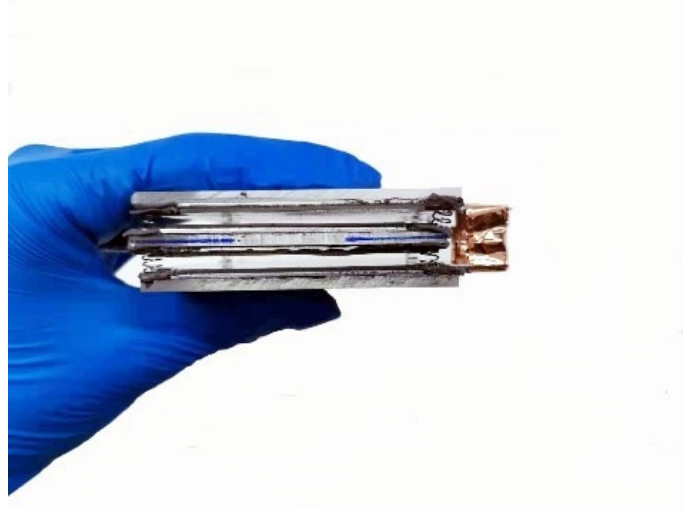|	Elongation at break/%	Tensile strength at break/MPa	Tensile stress at a given elongation Se (100) /MPa
PB-864	59.69	10.77	10.77
PDMS	204.71	7.87	1.71

Figure S7. Picture of DFC –TENG.

Fig. S8 shows the accumulated charge with time, here a capacitor can be charged by the output electricity generated by the DFC-TENG with a rectifying circuit. It shows that the accumulated charge can reach 207 μC within the measure time and it allows 33 min to store 15 V according to our testing.
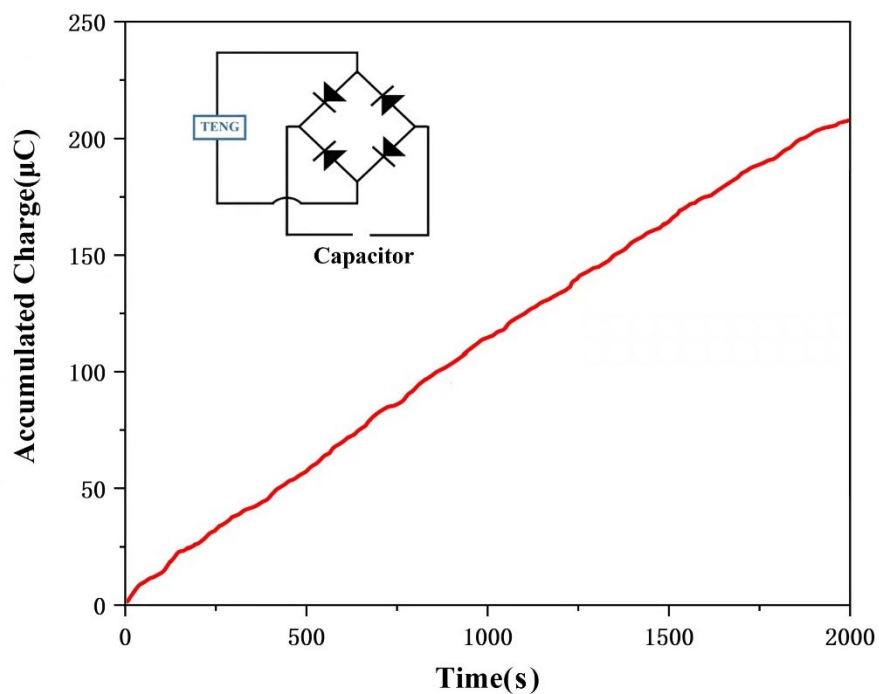

Figure S8. The accumulated charge as a function of time

As shown in Fig. S9, 88 LEDs were driven by DFC-TENG simultaneously through a full-wave rectifier circuit. 88 LEDs were instantly lit by instantaneous pressing, which proves the good electrical output performance of DFC-TENG.

Figure S9. Real images of DFC-TENG lighted 88 white LEDs.