Electronic Supporting Information

Dual-stimuli Responsive Chromatic Cholesteric Fiber with Programmable Structural-colour

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Other supporting information for this manuscript include the following:

Video S1 The process of fiber response to UV light.

The video shows that a gradual and continuous colour change from blue to red when the fibres are exposed to UV light at 1.2 mw cm^{-2}.

Video S2 The process of fiber response to VOC, methylene chloride.

This video shows the gradual loss of colour until the fibres are completely black when exposed to toluene gas at a concentration of 800 ppm.

1、Molecular structures three chiral molecules

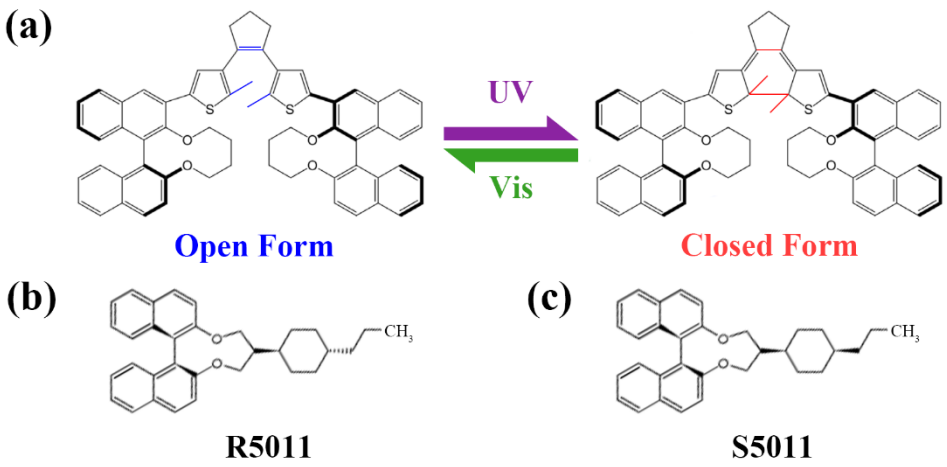

Fig. S1. (a) Molecular structures of the photoresponsive chiral molecular switch (s,s)-BTTC in the ring-open form and the ring-closed form, acting as the chiral motor for the right-handedness and left-handedness helices, respectively. The ring-open structure transforms into the ring-closed isomer and backward upon irradiation with UV (310 nm) and visible (530 nm) light, respectively. Both isomers are fatigue resistant with no thermal relaxation. (b-c) Molecular structures of the right-handed chiral molecular R5011 and S5011, respectively.

2、Stability testing of (s,s)-BTTC

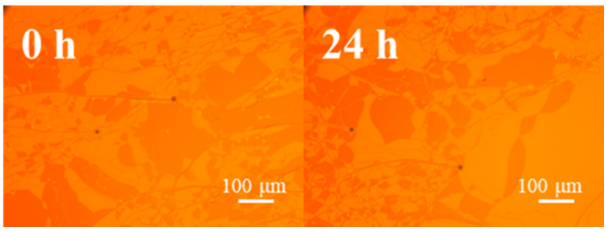

Fig. S2. Texture of the CLC containing (s-s)-BTTC before and after 24 h of shade placement in the PSSvis state. The white text in the upper left corner shows the placement time.

3、Tests of fatigue resistance of (s,s)-BTTCs

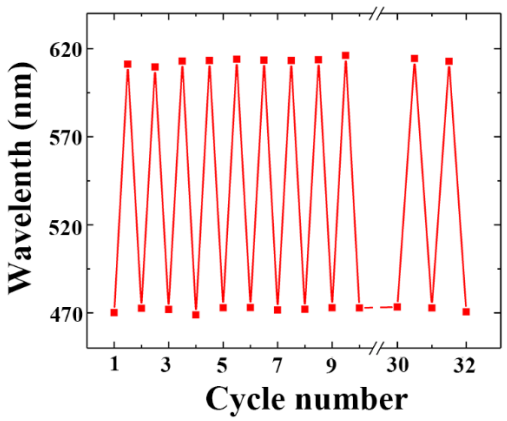

Fig. S3. Reversible change in CLC reflection wavelengths under cyclic irradiation of UV and visible light.

4、Measurement of HTP values by the Grandjean-Cano method

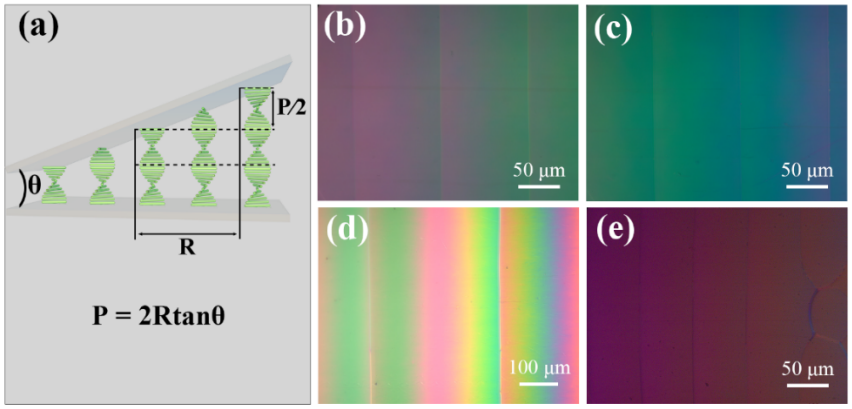

Fig. S4. (a) Mechanism diagram of the HTP value calculation by adopting the Grandjean-Cano method. (b-c) Cano lines observed under POM of 0.2wt% R5011 and S5011 in TEB300, respectively. (d-e) Cano lines observed under POM of 2wt% (s,s)-BTTC in TEB300 at PSSvis state and PSS_{UV} state, respectively.

5、Texture and reflectance spectra of different chiral molecular S5011 concentrations

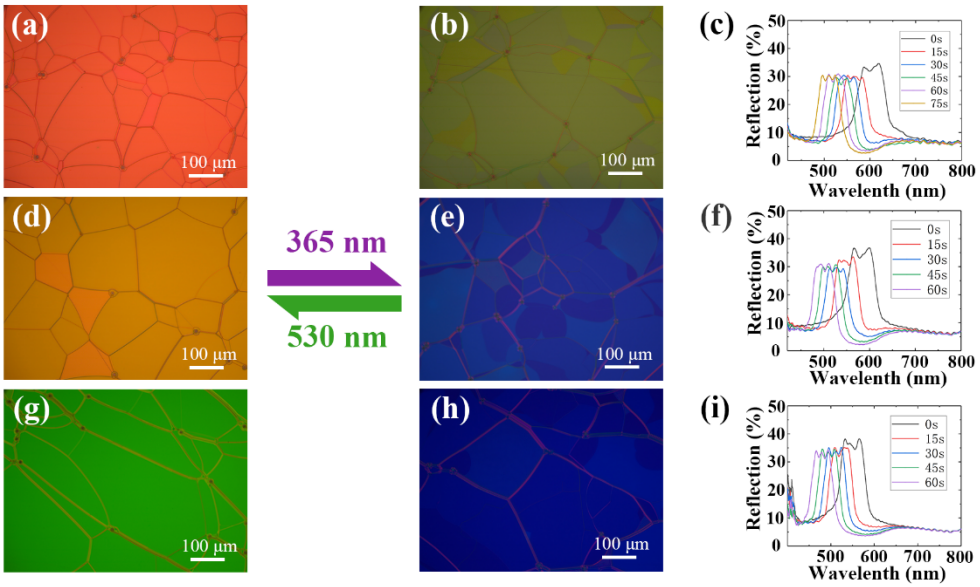

Fig. S5. Texture and reflectance spectra of CLCs with the same photoresponsive chiral molecular switch concentration and different chiral molecular S5011 concentrations under the same UV power irradiation. (a-c) 2.15 wt% S5011, 3.00 wt% (s,s)-BTTC in TEB300. (d-f) 2.25 wt% S5011, 3.00 wt% (s,s)-BTTC in TEB300. (g-i) 2.35 wt% S5011, 3.00 wt% (s,s)-BTTC in TEB300.

6、Polarization microscope estimation of CLC layer thickness

The diameter of the fibre to be about 248μm and the diameter of the nylon to be about 209μm, therefore the thickness of the CLC in this fibre is about 19.5μm. The thickness of the CLC in the fibre is approximately 20 μm.

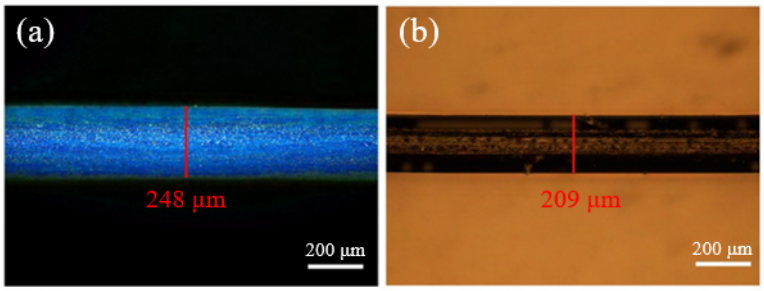

Fig. S6. (a) The texture of the fibres with orthogonal polarizers. (b) The photo of the nylon without orthogonal polarizers.

7、The texture of the fibres during stretching

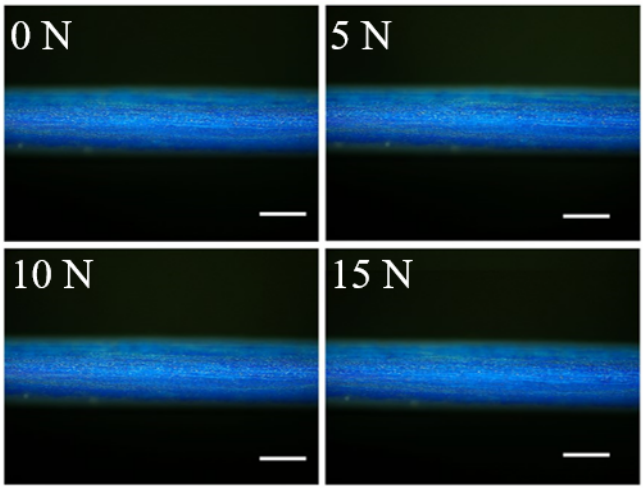

Fig. S7. The texture of the fibres during stretching, with a scale of 200 μm. The white lettering in the upper left corner shows the applied tension force.

8、Reflectance spectra of CLC irradiated with different UV power

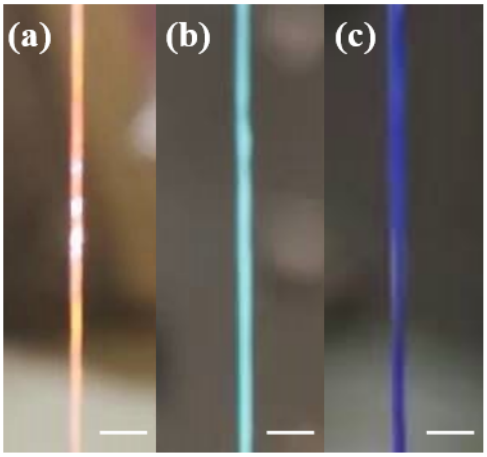

Fig. S8. The physical pictures of the fibres with different initial colours, with a scale of 1 mm. (a) The proportions of red CLC were 2.3 wt% S5011, 3.1 wt% (s,s)-BTTC and 94.6 wt% TEB300. (b) The proportions of cyan CLC were 2.2 wt% R5011, 3.1 wt% (s,s)-BTTC and 94.7 wt% TEB300. (c) The proportions of blue CLC were 2.4 wt% S5011, 3.1 wt% (s,s)-BTTC and 94.5 wt% TEB300.

9、Reflectance spectra of CLC irradiated with different UV power

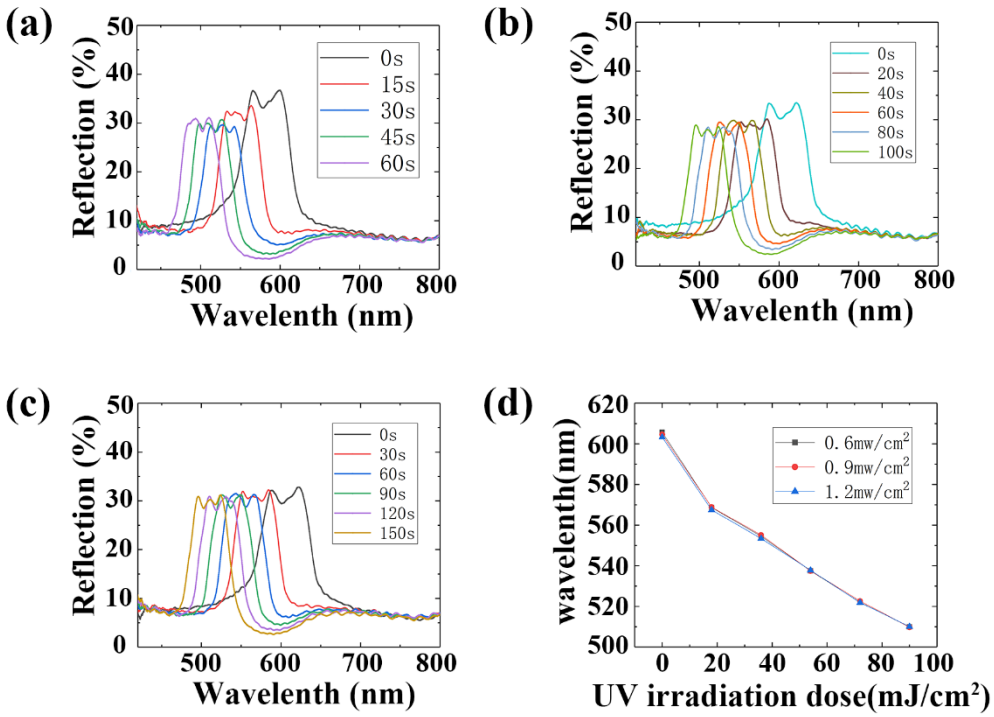

Fig. S9. Reflectance spectra of CLC with the same photoresponsive chiral molecular switch and chiral molecular S5011 concentration irradiated with different UV power. (a) UV power of 0.6mw cm^{-2}. (b) UV power of 0.9mw cm^{-2}. (c) UV power of 1.2mw cm^{-2}. (d) Correspondence between the centre wavelength of the reflective band and the dose of UV irradiation under different UV irradiation power.

10、Response of fibres to toluene gas

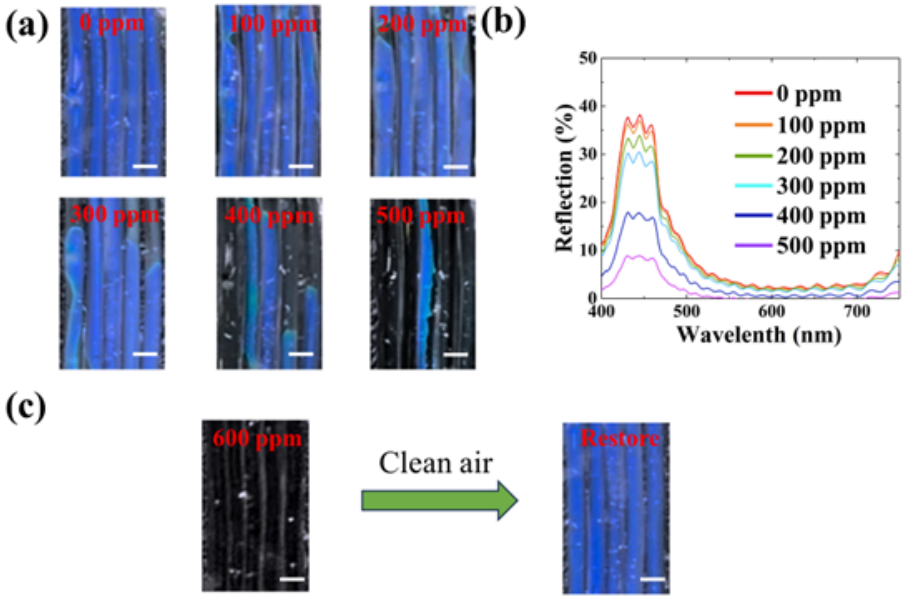

Fig. S10. (a) Colour change of a fibre pieced plane in air with different concentrations of VOC, toluene, with a scale of 500 μm. (b) Reflectance spectra under different concentrations of toluene. (c) The fibres returned to their initial colour from a completely black state in clean air.

11、Response of fibres to acetone gas

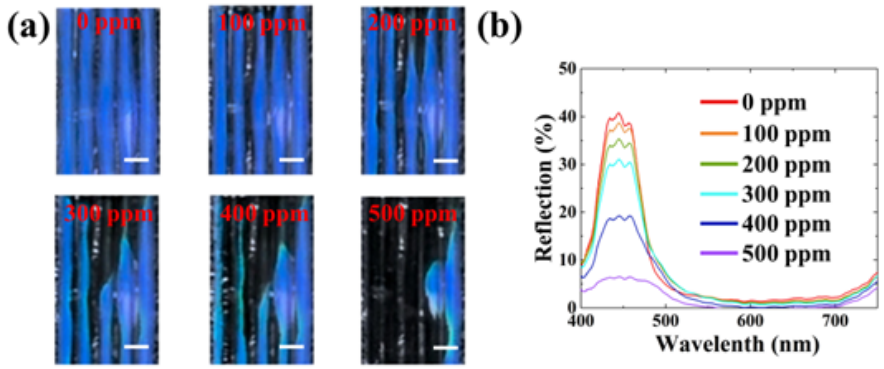

Fig. S11. (a) Colour change of a fibre pieced plane in air with different concentrations of VOC, acetone, with a scale of 500 μm. (b) Reflectance spectra under different concentrations of acetone.

12、Response of fibres to ethanol gas

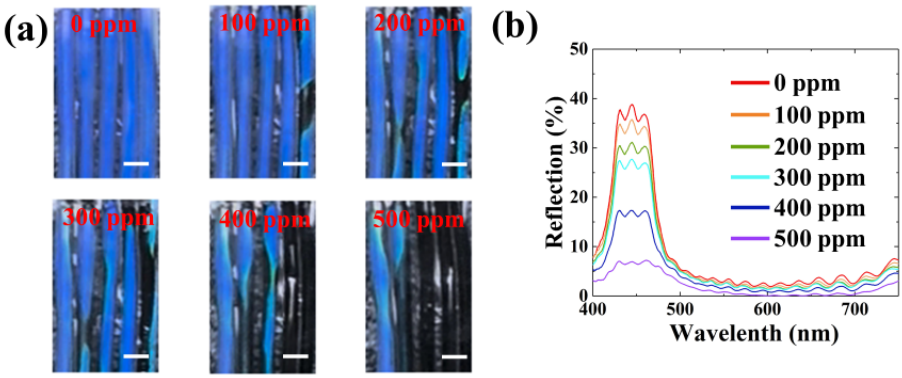

Fig. S12. (a) Colour change of a fibre pieced plane in air with different concentrations of VOC, ethanol, with a scale of 500 μm. (b) Reflectance spectra under different concentrations of ethanol.

13、The relationship between the decrease in reflectivity and the gas concentration of normal fibres (without photo-responsive chiral molecular)

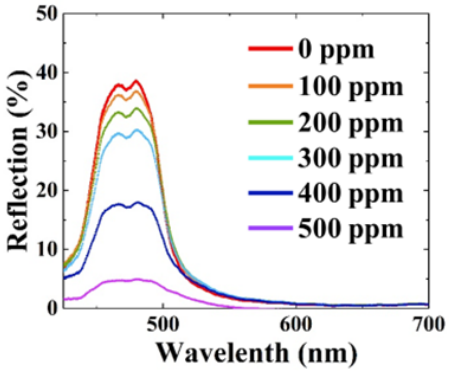

Fig. S13. Reflectance spectra of normal fibres under different concentrations of methylene chloride. Here, the proportions of this CLC were 2.7 wt% R5011 and 97.3 wt% TEB300.

14、Dual orthogonal response properties of fibres.

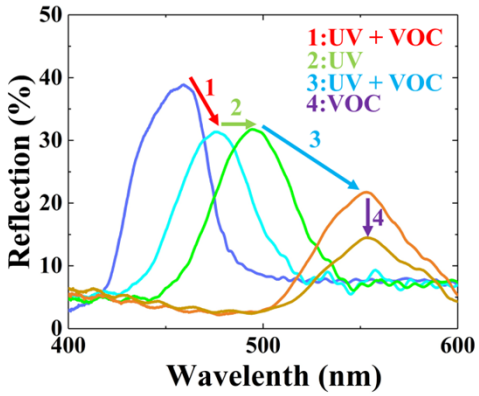

Fig. S14. The spectral changes of fibres under the combined effect of UV light and VOCs.

Step 1: Introduce 300 ppm of dichloromethane gas into the chamber, followed by irradiation with a 365 nm LED light source at an intensity of 0.6 mW cm^{-2} for 60 seconds. The results, indicated by the red arrow in the figure, show a decrease in the reflectance of the fiber by approximately 10% and a redshift of the reflection wavelength by nearly 30 nm.

Step 2: Without adding dichloromethane, subject the fiber to continuous UV irradiation for 60 seconds. As the concentration of VOCs in the chamber remains unchanged, the reflectance of the fiber does not decrease. However, there is a further redshift of approximately 20 nm, as indicated by the green arrow in the figure.

Step 3: Introduce an additional 50 ppm of dichloromethane gas and irradiate the fiber with a 365 nm LED light source at an intensity of 5 mW cm^{-2} for 15 seconds. The results, indicated by the blue arrow in the figure, demonstrate a decrease in the reflectance of the fiber by approximately 10% and a redshift of the reflection wavelength by approximately 60 nm.

In Step 4: By increasing the dichloromethane gas concentration by only 50 ppm, the reflectance of the fiber decreases, but the reflection wavelength remains unchanged, as shown by the purple arrow in the figure.