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Supplementary Information

Dynamically manipulated lasing enabled by a reconfigured fingerprint texture of cholesteric self-organized superstructure

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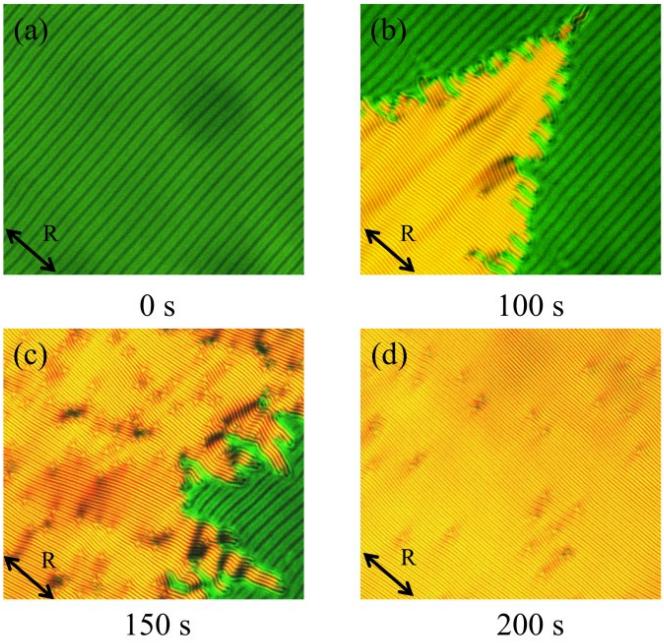

Fig. S1 Texture transformation of fingerprint straight stripes from a perpendicular orientation to parallel with respect to alignment direction. "R" dictates the rubbing direction. The switching process generated by splitting the center and forming a strip, then expanding its territory via gradually replacing the Helfrich deformation induced stripes (green stripes). Such transformation is ascribed to the rearrangement of CLC from the metastable Helfrich deformed helix to the stable lying helix.

Figure S2(a) schematically depicts the mechanism of the oscillation of photons confined in a waveguide of LC cell filled with CLC. It is known that the propagation angle, θ, (labelled in Figure S2(a)) of a confined mode must not exceed the critical angle determined by total reflection on the interface of CLC and polyimide (PI). The mode is associated with light at a discrete angle of propagation which is determined by the condition that phases at the same phase front by different optical paths should be equal, or their difference should be an integral multiple of 2π[1], as expressed by Eq. (S1),

$$\frac{\pi d}{\lambda}\sqrt{n_{CLC}^2 - n_{eff}^2} = \frac{m\pi}{2} + \tan^{-1}\left(\sqrt{\frac{n_{eff}^2 - n_{PI}^2}{n_{CLC}^2 - n_{eff}^2}}\right) \quad \text{(S1)}$$

in which, n_{CLC}, n_{PI} and n_{eff} represent the average refractive index of CLC, the refractive index of PI layer, and the effective refractive index of the medium in waveguide structure; m is the order of a certain guided mode with a wavelength of λ; and d is the thickness of the medium.

Figure S2(b) illustrates the feedback mechanism of a DFB system. Light is backscattered at the interface resulted from the refractive index modulation, *i.e.*, the interface between the adjacent bright and dark stripes of the CLC fingerprint texture, forming the standing waves in DFB resonator. The interference of these backscattered waves causing a strong amplification in the gain medium, emitting the laser with the wavelength expressed as Eq. (S2),

$$2n_{eff}\Lambda = M\lambda \quad \text{(S2)}$$

in which, M represents the DFB order; n_{eff} is the average refractive index of the medium; Λ is the period of stripe texture; λ is laser wavelength, corresponding to the DFB order M.

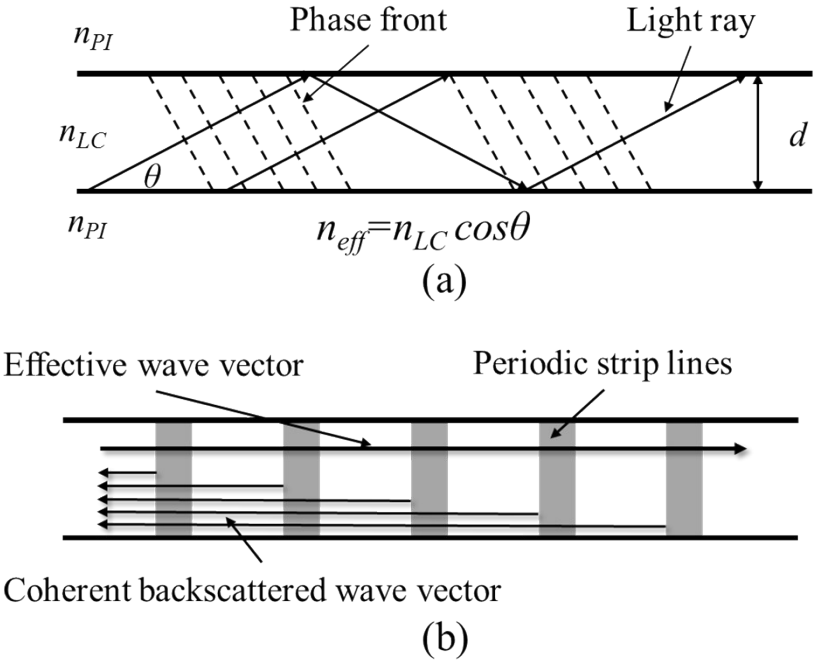

Fig. S2 Illustration for the mode selection mechanism of the high-order DFB based on a waveguide structure. (a) the waveguide configuration; (b) the high-order DFB configuration.

1. K. Okamoto, *Fundamentals of Optical Waveguides*, Elsevier, 2006, pp. 13-27.