Electronic Supplementary Information

Stable Deep-Blue Photoluminescence from Photoirradiated Cyanobiphenyl Liquid Crystals

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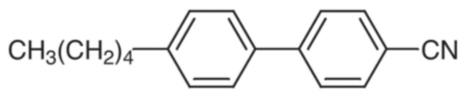
Movie information

Movie S1 Thermal behavior of pristine 5CB (left) and the BE-state sample (right) observed under white-light illumination upon heating from room temperature to 50 °C. Both samples undergo the nematic-to-isotropic phase transition, visible as a change from turbid to optically transparent. The transition temperature of the BE-state sample is slightly higher than that of pristine 5CB.

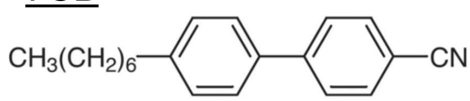
Movie S2 Thermal behavior of pristine 5CB (left) and the BE-state sample (right) observed under continuous 365 nm UV illumination upon heating. The pristine 5CB sample shows no detectable emission throughout, whereas the BE-state sample exhibits clear blue emission that persists beyond the nematic-to-isotropic phase transition into the isotropic phase, confirming that the emissive species is not strictly dependent on long-range nematic ordering.

Supplementary figures

5CB



7CB



8CB

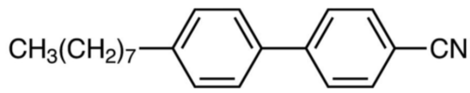


Figure S1 Molecular structures of the cyanobiphenyl liquid crystals used in this study: 4-cyano-4′-pentylbiphenyl (5CB), 4-cyano-4′-heptylbiphenyl (7CB), and 4-cyano-4′-octylbiphenyl (8CB). The alkyl chain length increases from 5CB to 8CB while the biphenyl core and cyano group are conserved.

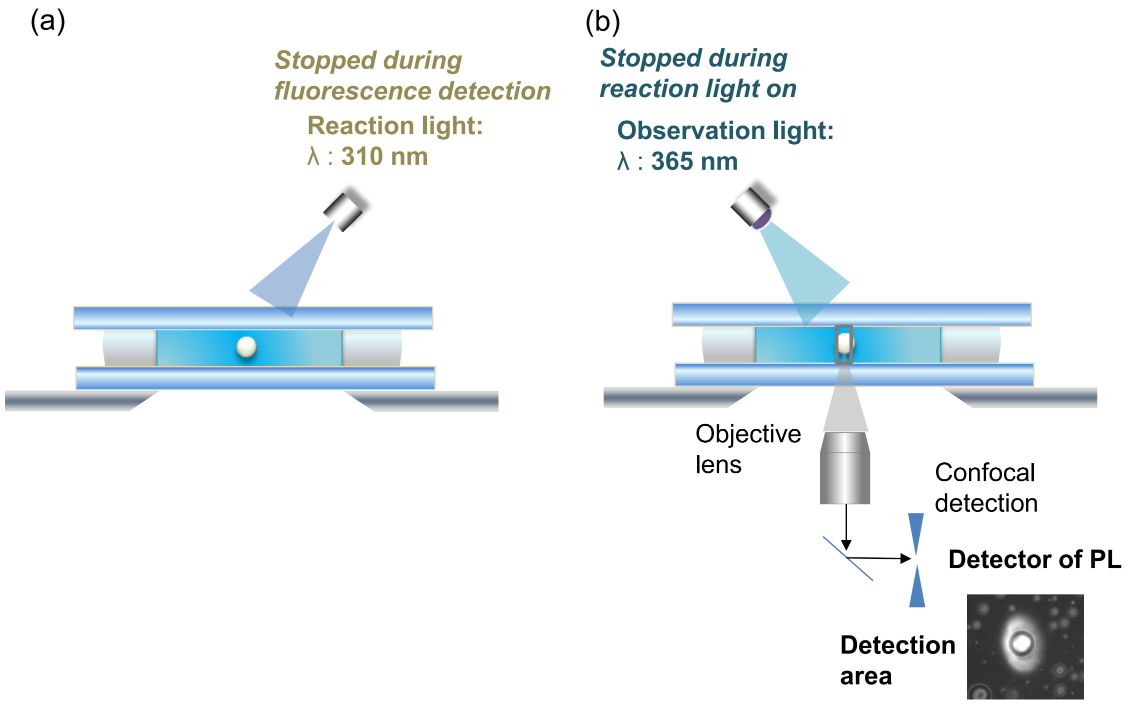


Figure S2 Schematic diagram of the sandwich-type sample cell used for optical measurements. The cell consists of two glass cover slips with a silicone rubber spacer (central open circular region, thickness ~500 μm) defining the sample volume. The LC was introduced into the central cavity and the cell was sealed prior to measurements. (a) Reaction step: illumination at 310 nm only (365 nm probe off) drives formation of the BE state. (b) Observation step: illumination at 365 nm only (310 nm beam off) probes the persistent emission of the BE state.

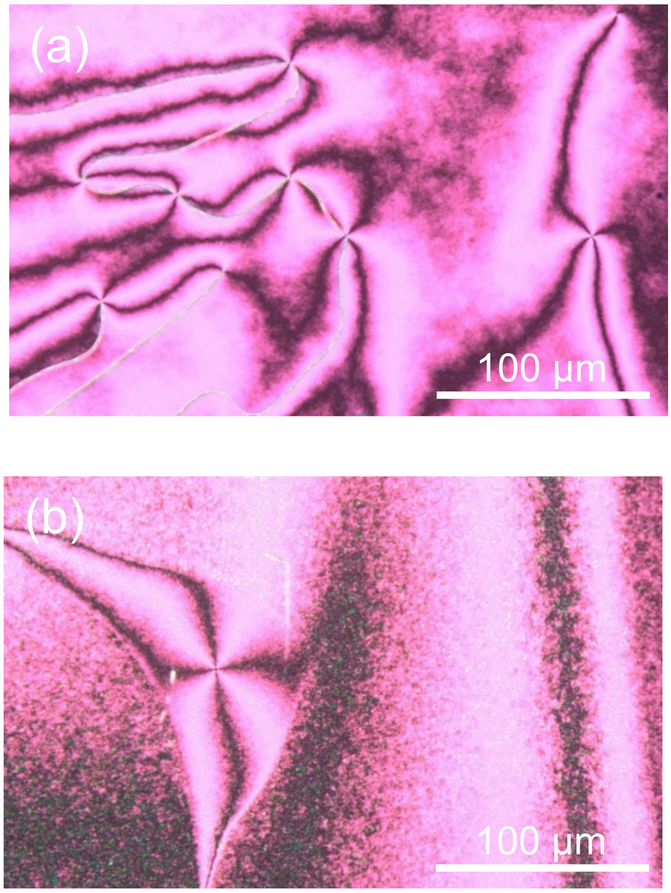
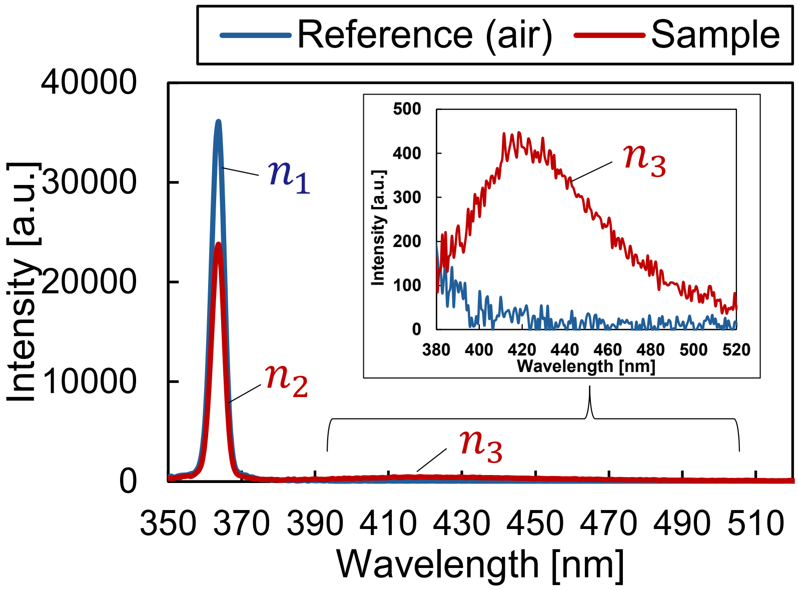


Figure S3 Polarized optical microscopy images of pristine 5CB (left) and the BE sample (right) at room temperature, showing the characteristic Schlieren texture with dark brushes and topological defect points typical of the nematic liquid crystalline phase. Both pristine 5CB and the BE-state sample retain a Schlieren texture characteristic of the nematic phase.



$$PLQY = \frac{n_3}{n_1 - n_2} = 0.52$$

Figure S4 Photoluminescence quantum yield (PLQY) of the BE sample determined by the integrating sphere method under 365 nm excitation. The absolute PLQY was 0.516 immediately after preparation. After storage in a sealed optical cell for three months, the PLQY remained essentially unchanged, and even under ambient air conditions the value was 0.483 after one week, demonstrating the excellent long-term stability of the BE state.

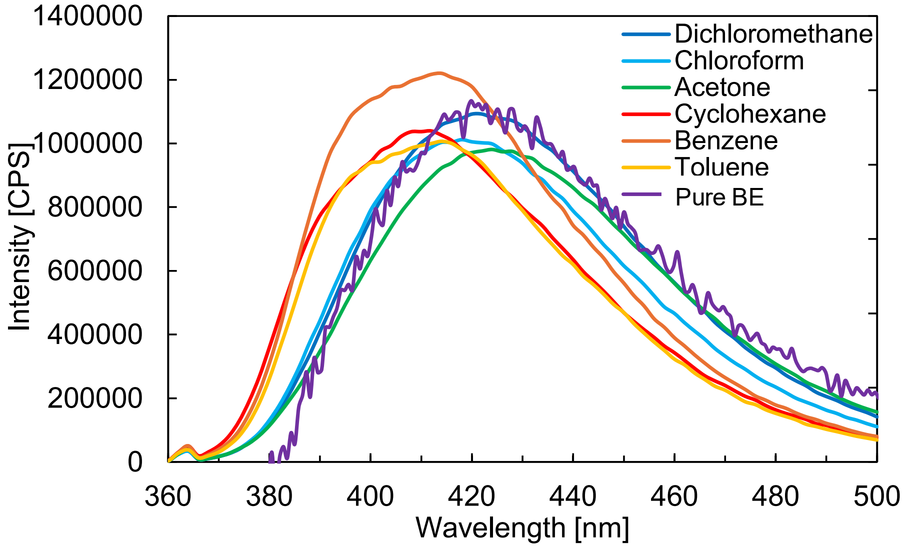


Figure S5 Solvent-dependent emission spectra of the BE-state sample dissolved in solvents of varying polarity. In polar solvents, the emission peak position and spectral shape closely match those of the pure BE liquid crystal.

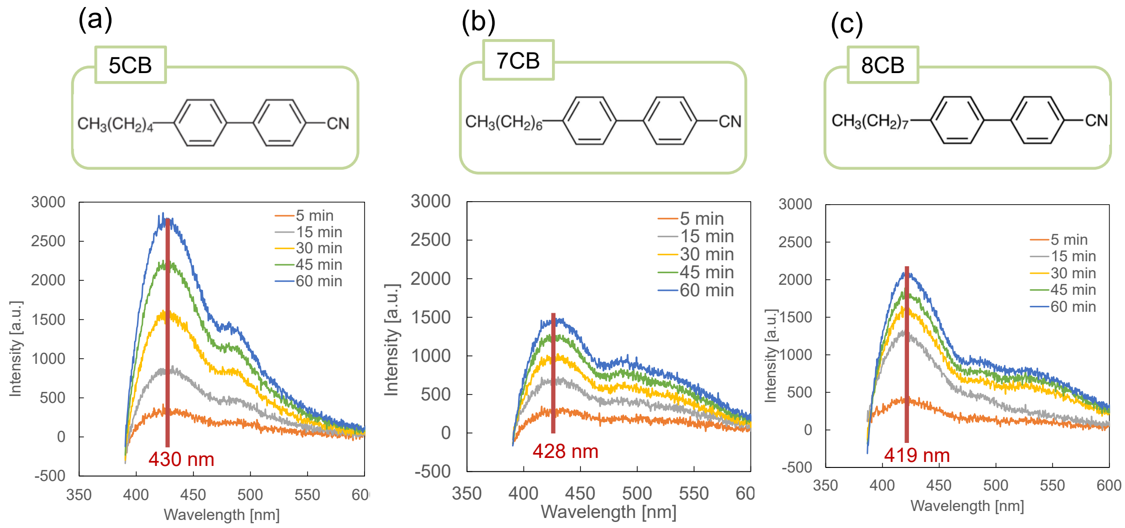


Figure S6 Time-dependent emission spectra of (a) 5CB, (b) 7CB and (c) 8CB under continuous 310 nm irradiation, recorded under 365 nm excitation. The wavelengths for the emission maxima are indicated with the red lines.

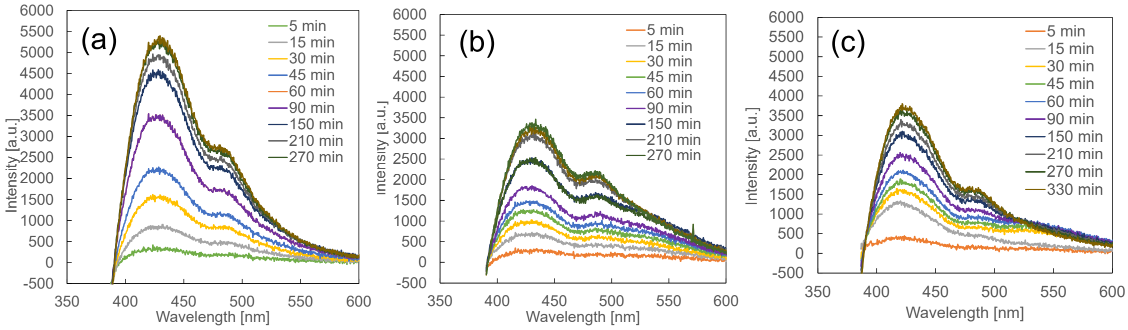


Figure S7 Long-term time-dependent emission spectra of (a) 5CB, (b) 7CB and (c) 8CB under continuous 310 nm irradiation, recorded under 365 nm excitation.