Supplementary Information

A deep-blue crystalline organic light-emitting diode based on solid-solution thin-film emitting layer

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1. Fabrication and AFM image of crystalline OSS layer

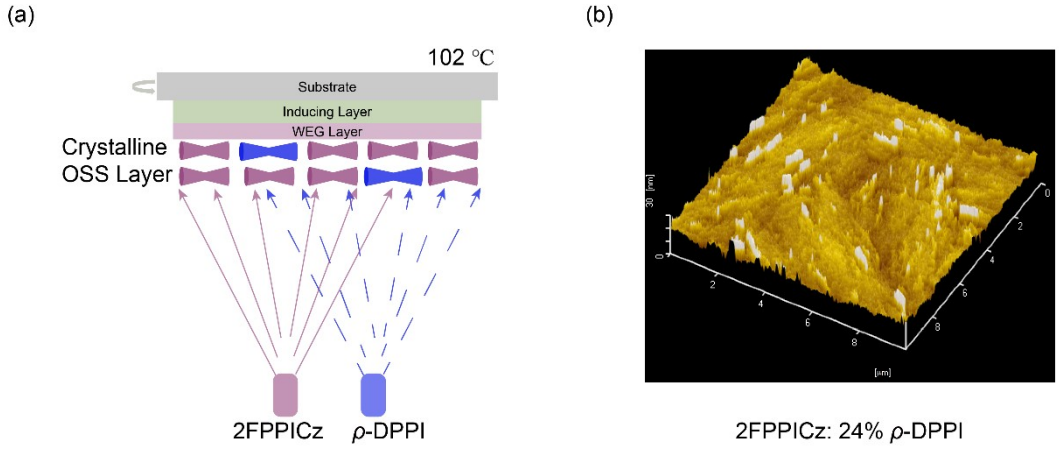


Fig. S1 (a) Fabrication of crystalline OSS layer. (b) AFM image of 2FPPICz: 24% *ρ*-DPPI crystalline thin films.

2. 2Theta of out-of-plane XRD patterns

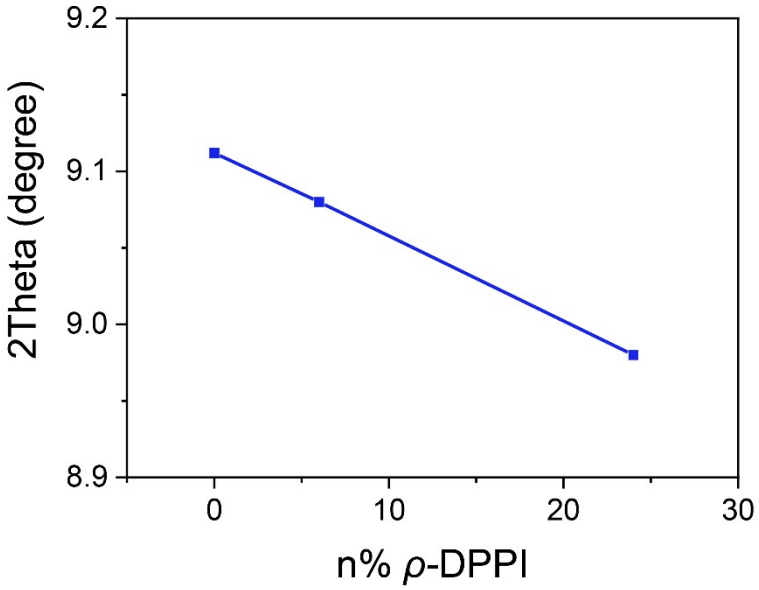


Fig. S2 2Theta of out-of-plane X-ray diffraction patterns corresponding to different concentrations of crystalline OSS thin films.

3. ADPL measurement

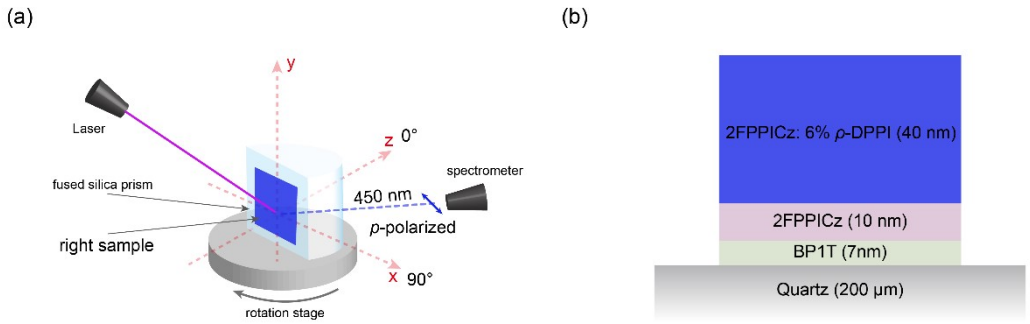


Fig. S3 Schematic illustration of ADPL (a) and corresponding sample structure (b).

4. TDMV of *ρ*-DPPI molecule

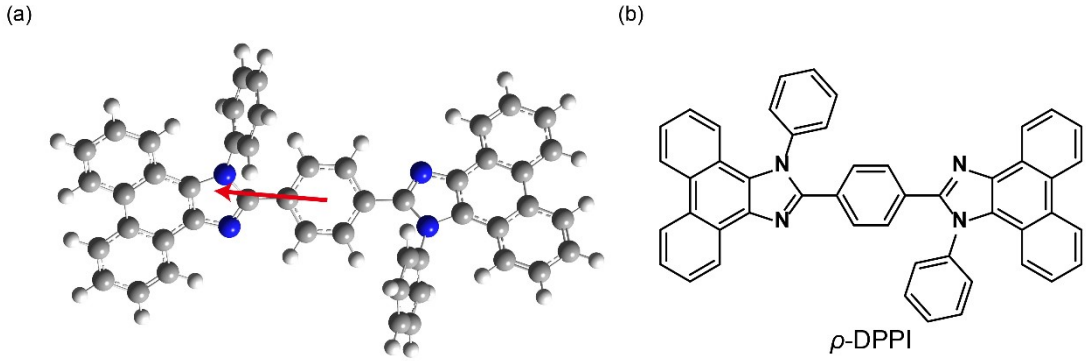


Fig. S4 TDMV of *ρ*-DPPI molecule (a) and molecular structure of *ρ*-DPPI (b).

5. Photophysical characterization

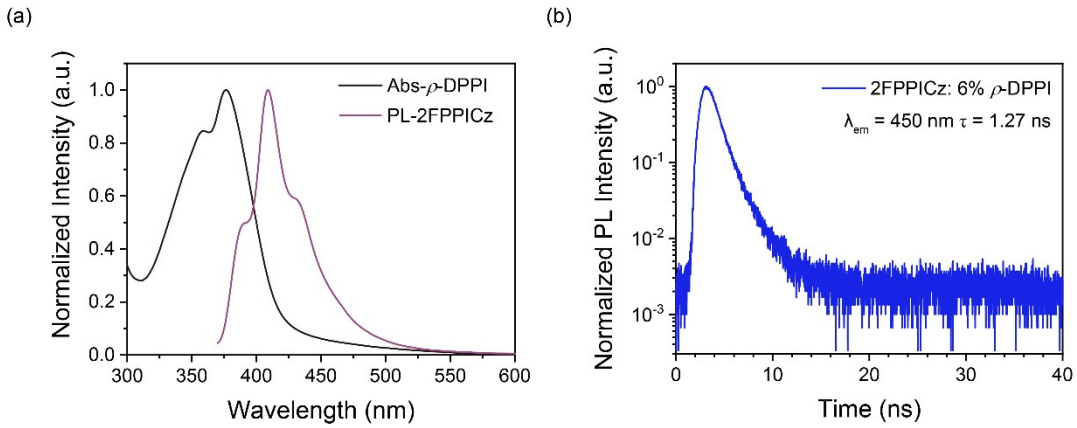


Fig. S5 (a) PL spectrum of 2FPPICz crystalline thin film and absorption spectrum of ρ-DPPI crystalline thin film. (b) Transient PL decay curve of 2FPPICz: 6% ρ-DPPI crystalline OSS thin film.

6. Optimized OSS C-OLED device

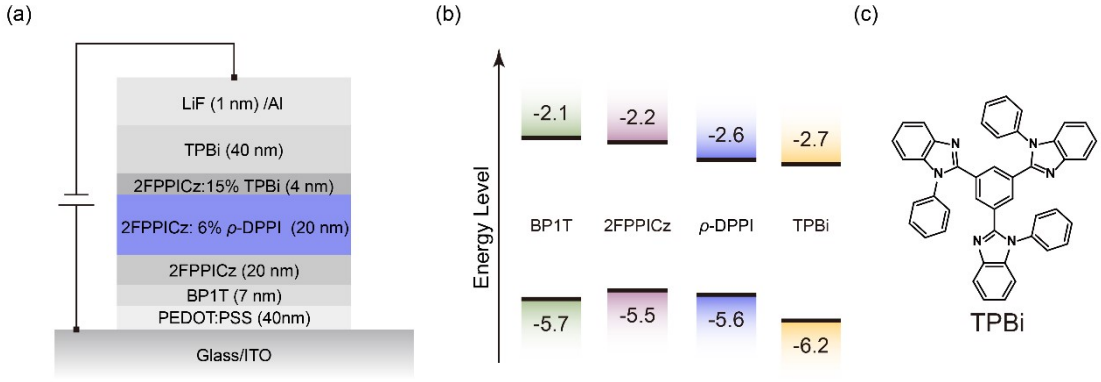
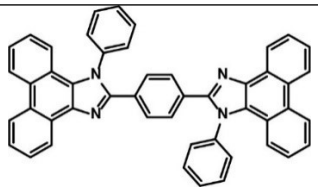
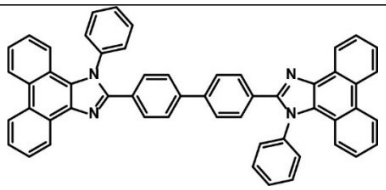


Fig. S6 (a) Architecture of optimized OSS C-OLED. (b) Energy level of BP1T, 2FPPICz, *ρ*-DPPI and TPBi. (c) Molecular structure of TPBi.

Table S1 Comparisons between 2FPPICz: *ρ*-DPPI and 2FPPICz: BPPI OSS C-OLEDs.

Comparisons	2FPPICz: *ρ*-DPPI (*this work*)	2FPPICz: BPPI* (*Ref. 24*)
Guest molecules	*ρ*-DPPI	BPPI
Guest molecular structure		
Solid-solution solubility	24%	10%
Characteristic peak of Out-of-plane XRD	Vary with guest concentrations.	Do not vary with guest concentrations.
Substitutional form	One guest molecule substitutes one host molecule.	One guest molecule substitutes more than one host molecules.
Anisotropy factor Θ	90%	92.5%
PLQY	72%	86%
CIE	(0.15, 0.07)	(0.15, 0.07)
Maximum EQE	5.3%	6.5%
Maximum CE, PE	4.4 cd A^{-1}, 4.4 lm W^{-1}	5.8 cd A^{-1}, 5.9 lm W^{-1}
Driving voltage	4.6 V @ 1000 cd m^{-2}	4.0 V @ 1000 cd m^{-2}
Series-resistance joule-heat loss ratio	12.6% @ 1000 cd m^{-2}	11.1% @ 1000 cd m^{-2}

*Data of 2FPPICz: BPPI C-OLED are extracted from the article of *Nat. Photon*. 17, 264–272 (2023).