## **Electronic Supplementary Information**

## High efficient crystalline organic light-emitting diodes

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## **Experimental details**



**Fig. S1** (a) Four sets of device structure of the crystalline OLEDs. (b) Turn-on voltage distribution. (c) Maximum current efficiency distribution. (d and e) Current efficiency distribution at 1000 cd m<sup>-2</sup> or at 5000 cd m<sup>-2</sup>. (f) Maximum power efficiency distribution. (g and h) Power efficiency distribution at 1000 cd m<sup>-2</sup> or at 5000 cd m<sup>-2</sup>.

We fixed the thickness of p-6P in the crystalline OLEDs, and adjusted the thickness of Alq<sub>3</sub> to optimize the devices. We prepared four sets of devices for performance comparison as follows.

A: ITO/PEDOT:PSS (30 nm)/p-6P (6 nm)/Alq<sub>3</sub> (X nm)/LiF (1 nm)/Al

B: ITO/PEDOT:PSS (30 nm)/p-6P (12 nm)/Alq<sub>3</sub> (X nm)/LiF (1 nm)/Al

C: ITO/PEDOT:PSS (30 nm)/p-6P (25 nm)/Alq<sub>3</sub> (X nm)/LiF (1 nm)/Al

D: ITO/PEDOT:PSS (30 nm)/p-6P (40 nm)/Alq<sub>3</sub> (X nm)/LiF (1 nm)/Al

Each data point was collected no less than 5 times. As the thickness of p-6P increases, the best performance in each set of devices is declining.



**Fig. S2** (a and b) The measurement and UPS spectra of the deposited films. (c) The electronic structure according to the UPS spectra.



**Fig. S3** (a and b) In the amorphous OLED, CE, PE and EQE as a function of luminance.