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Supporting Information for Publication

A Novel Intermediate Connector with Improved Charge Generation and Separation for Large-Area Tandem White Organic Lighting Devices

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Figure.S1. Voltage vs. current density (a) and current density vs. luminance (b) characteristics of the hole-only device with MoO_3 in the different positions of IC.we designed four devices as: ITO/NPB(75 nm)/Alq_3(60 nm)/IC/NPB(50 nm)/Al(150 nm), where "IC" stands for Bphen: Li(55nm, 1.2%)/Al(0.5 nm)/F_4-TCNQ(10 nm)/HAT-CN(10 nm) (Device B-1); Bphen: Li (55nm, 1.2%)/Al(0.5 nm)/MoO_3(10 nm)/F_4-TCNQ(10 nm)/HAT-CN(10 nm) (Device B-2); Bphen: Li(55nm, 1.2%)/Al(0.5 nm)/F_4-TCNQ/MoO_3(10 nm)/HAT-CN(10 nm) (Device B-3); Bphen: Li(55nm, 1.2%)/Al(0.5 nm)/F_4-TCNQ(10 nm)/HAT-CN(10 nm)/MoO_3(10 nm) (Device B-4), respectively.the B-4 device exhibits the highest current density than that of other devices at the same driving voltage. However, the current density-luminance (*J-L*) shows that the luminance of the B-4 device is the lowest light emission, while the other devices show the similar emission intensity. In the present work, the HOMO and LUMO levels of MoO_3 are 9.7 eV and 6.7 eV. This indicates that hole injection and transport through the Bphen: Li/Al/F_4-TCNQ/HAT-CN/$MoO_3$are greatly enhanced, however, electron are suppressed. Therefore, the B-4 device has the highest current density at the same driving voltage, while the luminance of the B-4 is significantly reduced. Nevertheless, other IC devices show the similar luminance, it means that the devices of other location of MoO_3 don't change the charge separation, only affect the carrier transport.

Figure.*S*2. EL performances of green fluorescent tandem OLEDs with different intermediate connector. We fabricated green fluorescent tandem OLEDs with a structure of ITO/HAT-CN/NPB/Alq_3/intermediate connector (IC)/NPB/Alq_3/ Liq/Al, where IC stands for Bphen: Li/F_4-TCNQ/HAT-CN (C-1) and Bphen: Li/Al/F_4-TCNQ/HAT-CN (C-2). Figure R1 shows the EL performances of green fluorescent tandem OLEDs with different intermediate connector. It can been seen that the current density of device C-2 is higher than that of device C-1 at the same voltage, which indicates that the thin film Al in the interface between *n*-type doped Bphen: Li and F_4-TCNQ/HAT-CN can effectively reduce the driving voltage. Meanwhile, the Al thin film in the intermediate connectors can further improve the carrier injection, without generating additional barrier. The current and power efficiency of device C-2 is much higher than that of device C-1.

Figure.*S*3.Top: Proposed energy-level diagram of a white stacked OLED with two electrophosphorescent elements, bottom: the chemical structures of the materials used in this structure.

Figure.*S*4. EL performances of tandem white OLEDs with different intermediate connector. We fabricated white tandem OLEDs with a structure of ITO/HAT-CN/TAPC/SSTF: FIrpic/SSTF: PO-01/TmPyPB/IC/TAPC/SSTF: FIrpic/ SSTF: PO-01/TmPyPB/Liq/Al, where IC stands for Bphen: Li/Al/ F_4-TCNQ/HAT-CN and Bphen: Li/Al/HAT-CN. As seen from the *J-V* characteristics in Figure S4a, the current density in the tandem WOLED with Bphen: Li/Al/F_4-TCNQ/HAT-CN is lower than that in the device without F4-TCNQ at the same voltage. The luminance and efficiency are shown in Figure S4b and S4c. F_4-TCNQ based device showed higher luminance and efficiency than that of device without F_4-TCNQ.

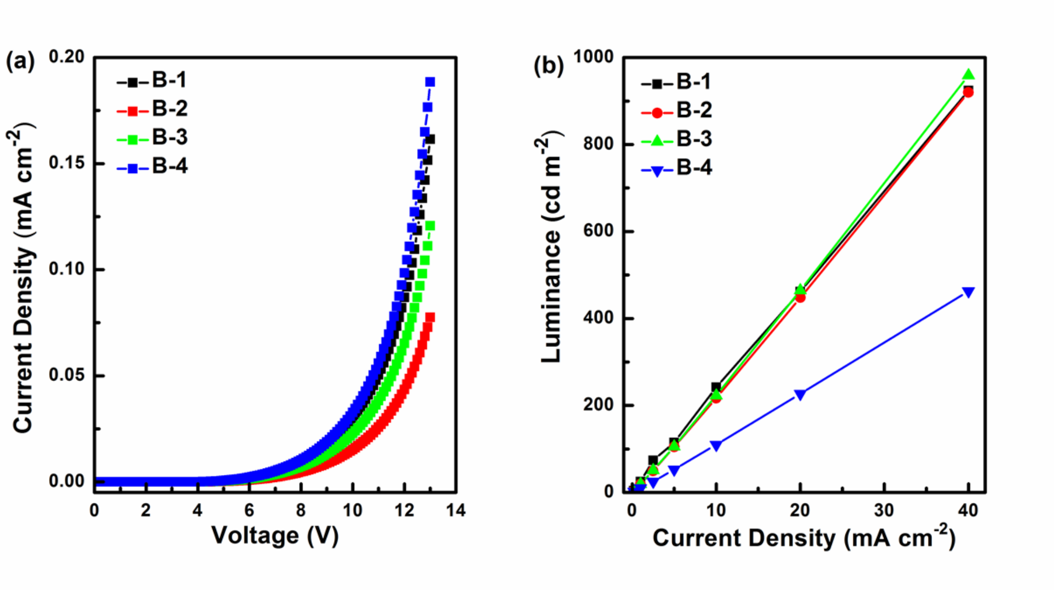

Figure *S*1. Voltage vs. current density (a) and current density vs. luminance (b) characteristics of the hole-only device with MoO_3 in the different positions of IC.

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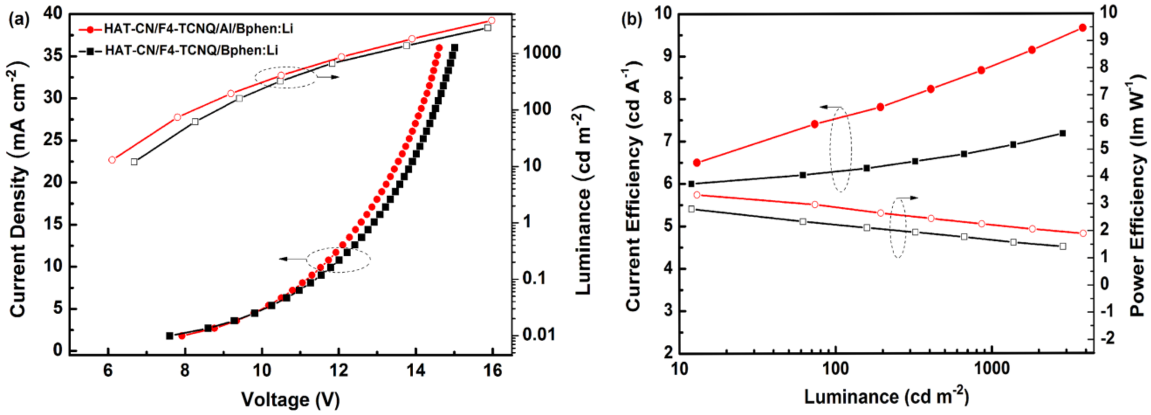
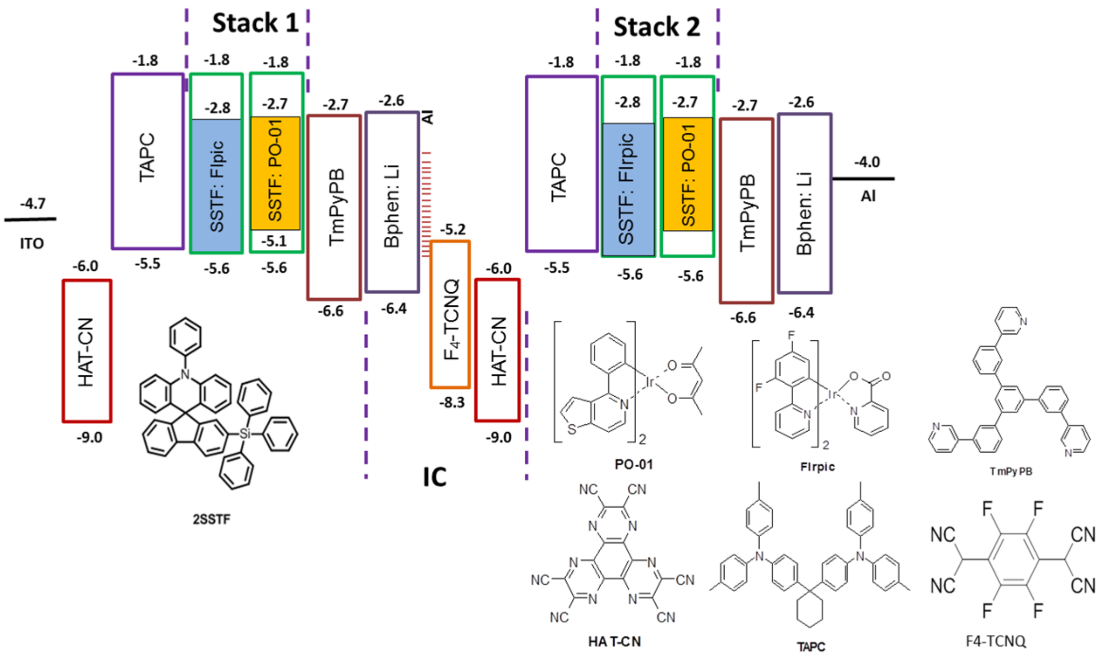


Figure *S*2. EL performances of green fluorescent tandem OLEDs with different intermediate connector.



FigureS3. Top: Proposed energy-level diagram of a white tandem OLED with two electrophosphorescent elements, bottom: the chemical structures of the materials used in this structure.

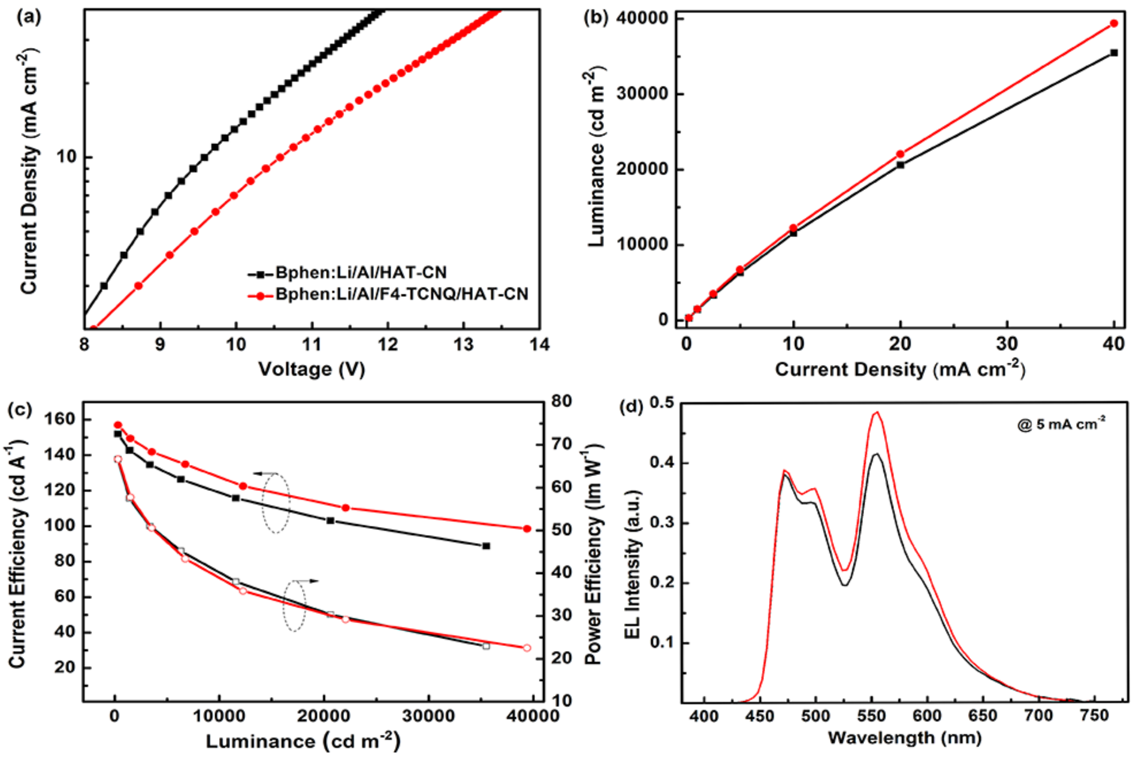


Figure *S*4. EL performances of tandem white OLEDs with different intermediate connector.