Supporting Information

Solution Processed Red Organic Light-Emitting-Diodes using an N-Annulated Perylene Diimide Fluorophore

Sergey V. Dayneko, [a] *Mohammad Rahmati,* [b] *Majid Pahlevani,* [c,]* *Gregory C. Welch*[a,]*

[a]Department of Chemistry, University of Calgary, 731Campus Place NW, Calgary, Alberta, Canada T2N 1N4

[b]Genoptic LED Inc, 6000 72nd Ave SE, Calgary, AB, Canada, T2C 5B1

[c]Department of Electrical and Computer Engineering, Queen's University, 19 Union St., Kingston, ON, Canada, K7L 3N6

*E-mail: majid.pahlevani@queensu.ca and gregory.welch@ucalgary.ca

TABLE OF CONTENTS

1. Materials and Methods

Materials: All chemicals/solvents were purchased from Millipore-Sigma and used without further purification. tPDI2N-EH was made as previously reported (Small Methods, 2018, 2, 180081). PFO and F8BT was purchased from Ossila.

UV-Visible Spectroscopy (UV-Vis): All optical absorption measurements were recorded using Agilent Technologies Cary 60 UV-Vis spectrometer at room temperature. Films were spin-cast onto Corning glass micro slides. Prior to use, glass slides were cleaned with soap and water, acetone and isopropanol, and followed by UV/ozone treatment using a Novascan UV/ozone cleaning system.

Photoluminescence Quantum Yield (PLQY): PLQY was measured by using the integrating sphere with Flame spectrometer (Ocean Optics). The QEX7 Solar Cell Spectral Response/QE/IPCE Measurement System (PV Measurement, Model QEX7) was used for selecting the excitation wavelength of the sample.

Atomic Force Microscopy (AFM): AFM measurements were performed by using a TT2- AFM (AFM Workshop) in tapping mode and WSxM software with a resonance frequency of 300 kHz, a force constant of 40 N/m and a reflective back side aluminum coating (Tap300Al-G, BudgetSensors). Samples for AFM measurements were the same ones that were used to collect the respective device parameters.

OLED Device Fabrication and Testing (spin-coated): OLED devices were fabricated on ITO-coated glass substrates (sheet resistance of 10 Ohm Sq-1). The ITO substrates were cleaned by sequentially ultra-sonicating in detergent/de-ionized water, acetone and isopropanol before use.

ITO substrates were pretreated under UV-ozone for 30 minutes. PEDOT:PSS was spin-coated onto the ITO-coated glass substrates at 3,000 rpm for 60s and annealed in air at 120°C.

F8:F8BT:

For deposition of the F8:F8BT active layer, the blend solution of F8:F8BT (ratio 19:1 at total concentration of 15 mg mL-1) dissolved in toluene was spin-cast at 2,000 rpm on top of the PEDOT:PSS layer in air.

F8:tPDI2N-EH:

For deposition of the F8:tPDI2N-EH active layer, the blend solution of F8:tPDI2N-EH (different ratio at total concentration of 15 mg mL-1) dissolved in toluene was spin-cast on top of the PEDOT:PSS layer in air.

Finally, the LiF (1 nm)/Ag (200 nm) electrode was deposited using a thermal evaporation system through a shadow mask under a base pressure of $\sim 2 \times 10{-}6$ torr. The device area was 9 mm^2 as defined by the overlapping area of the ITO films and top electrodes.

Current density-voltage (J-V) characteristics were measured using a Keithley 2612B source-meter combined with calibrated Si-photodiode and spectrometer.

2. Characteristics of OLEDs

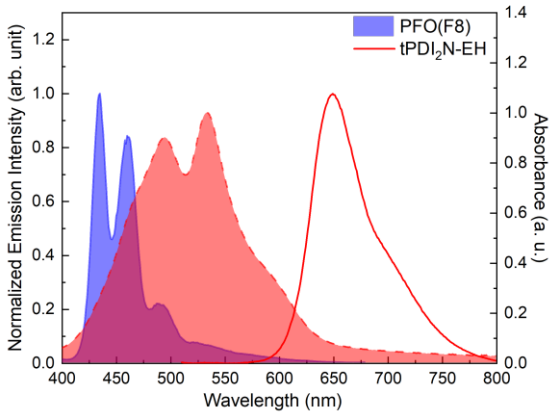

Figure S1. Normalized photoluminescence spectra of PFO (solid blue) and the optical absorption (solid red) and photoluminescence (solid white) spectra of tPDI2N-EH. Plot shows the overlapping of photoluminescence spectra of PFO and optical absorption of tPDI2N-EH films.

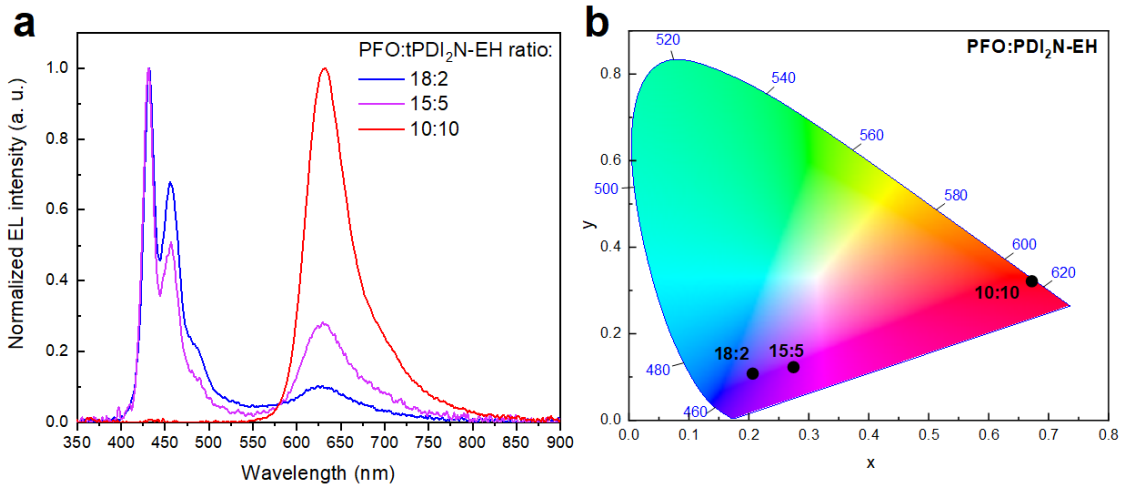

Figure S2. (a) Normalized electroluminescence (EL) and (b) color coordinates spectra of PFO:tPDI$_2$N-EH-based OLEDs with different ratio of PFO and tPDI$_2$N-EH.

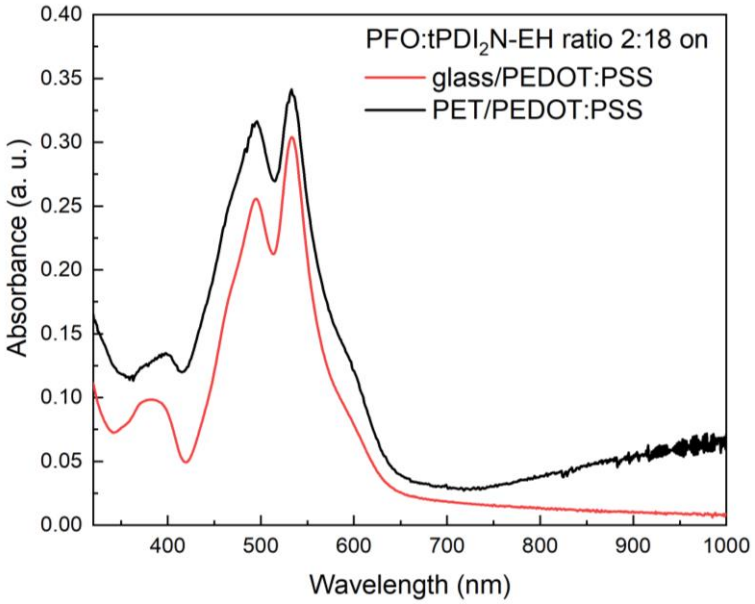

Figure S3. Optical absorption spectra of OLEDs based on PFO:tPDI$_2$N-EH with ratio of 2:18, spin-cast on glass/ITO/PEDOT:PSS and slot-die coated on PET/ITO/PEDOT:PSS.