Perfluorinated polymer with unexpectedly efficient deep blue electroluminescence for full-colour OLED display and light therapy applications

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GPC analysis of PFO-TFP

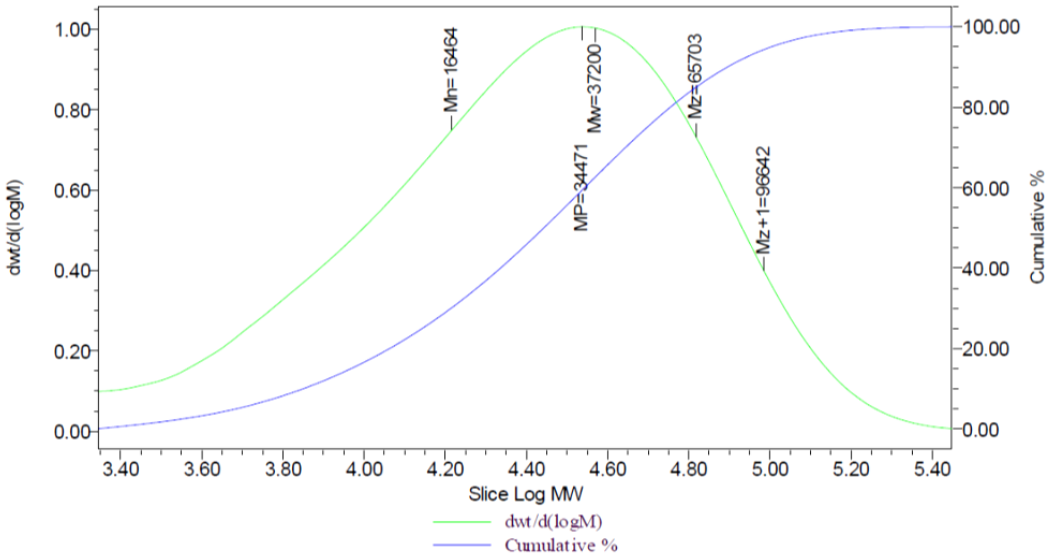


Figure S1. GPC of Poly[(9,9-di-n-octylfluoren-2,7-diyl)-alt-terafluoro-p-phenylene] (PFO-TFP)

Table S1 . GPC results

	Ret. Time	Mp	Mn	Mw	Mz	Mw/Mn	Mz/Mw
PFO-TFP	16469	34471	16464	37200	65703	2.26	1.77

NMR characterization of PFO-TFP

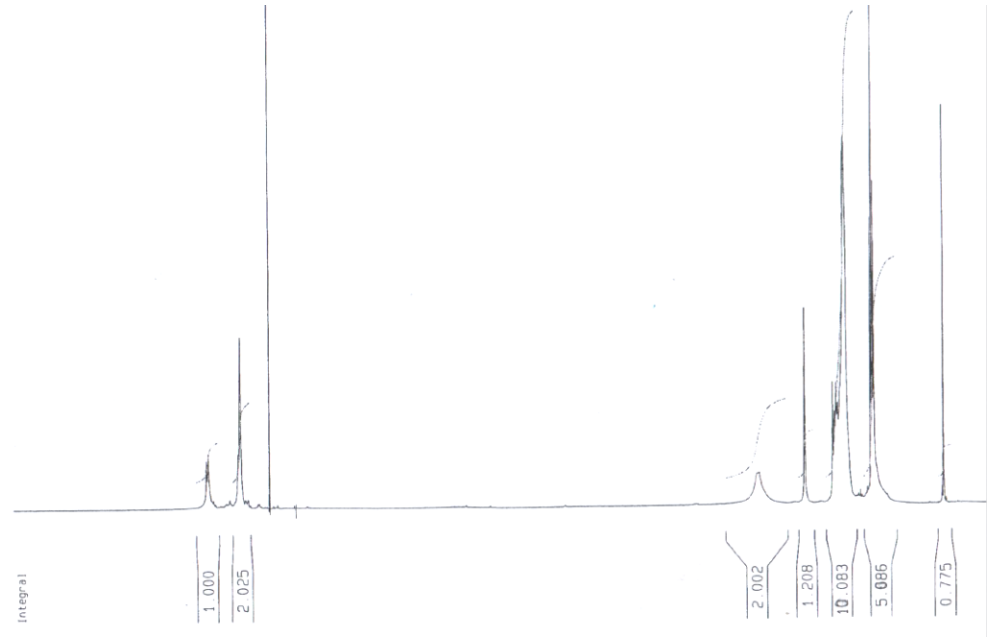


Figure S2. ^{1}H NMR of Poly[(9,9-di-n-octylfluoren-2,7-diyl)-alt-terafluoro-p-phenylene] (PFO-TFP)

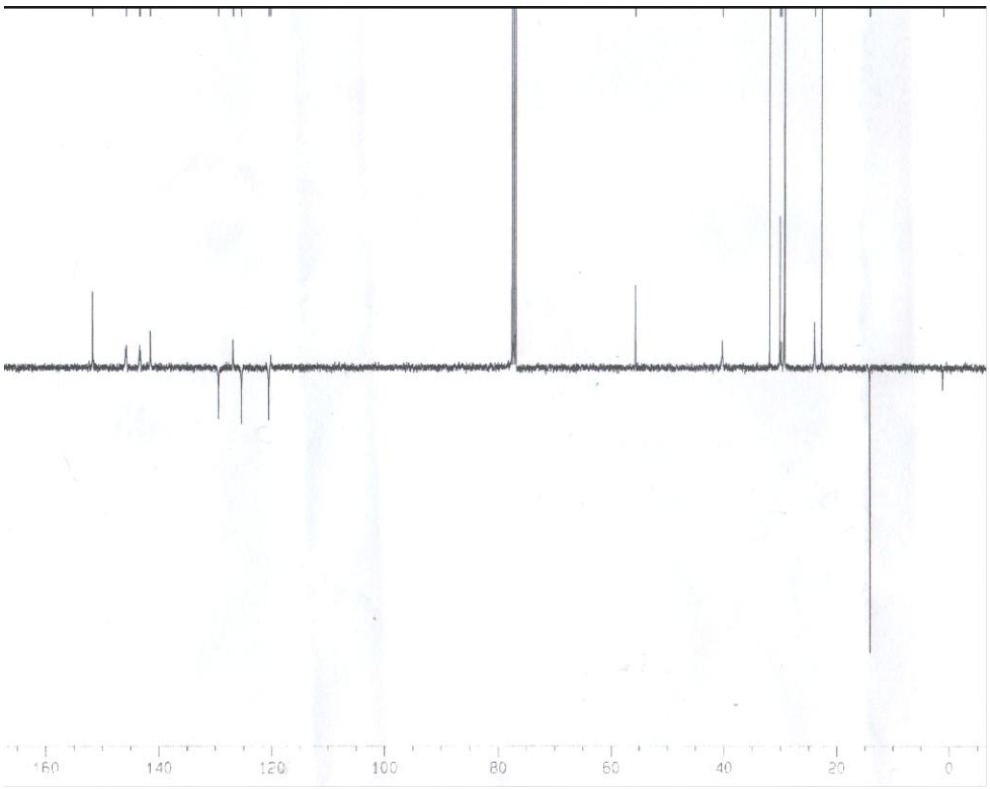


Figure S3. ^{13}C-NMR DEPT spectra of Poly[(9,9-di-n-octylfluoren-2,7-diyl)-alt-terafluoro-p-phenylene] (PFO-TFP)

MALDI-TOF mass spectrometry of PFO-TFP

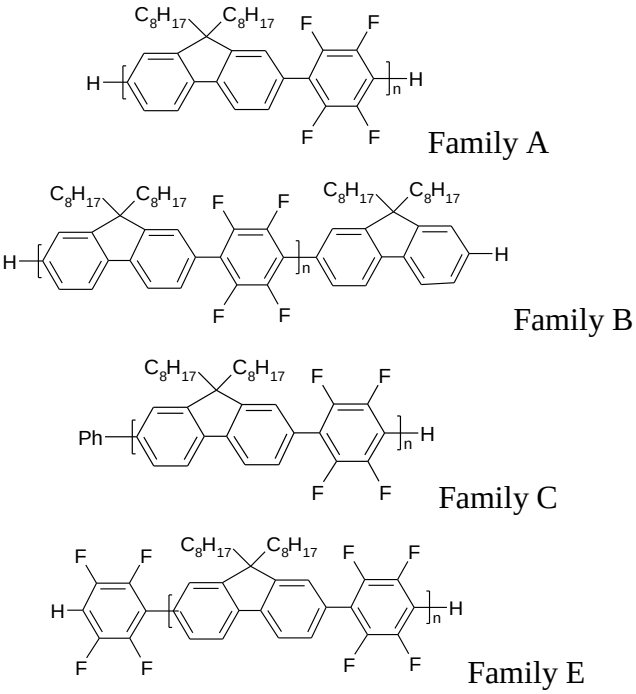


Figure S4. schematic representation of the main structure composing the polymer.

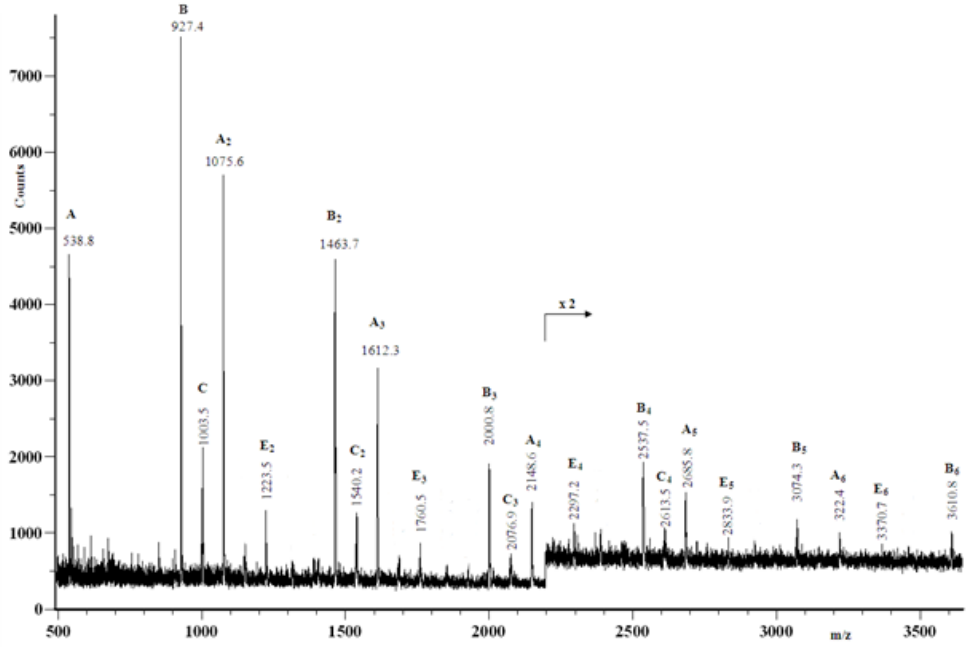


Figure S5. Positive ions MALDI-TOF mass spectrum of PFO-TFP, recorded in linear mode

Thermal analysis of PFO-TFP

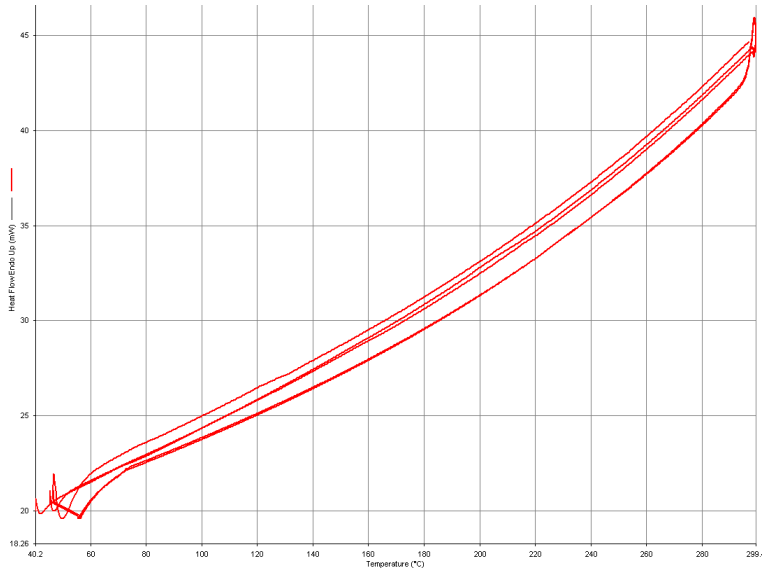


Figure S6. DSC thermogram 20°C/min for the polymer showing that there are no thermal events in the range 60-290°C.

The chemical structures of the reference compounds PFO and PFO-P are reported in figure S1, together with PFO-MPEG.

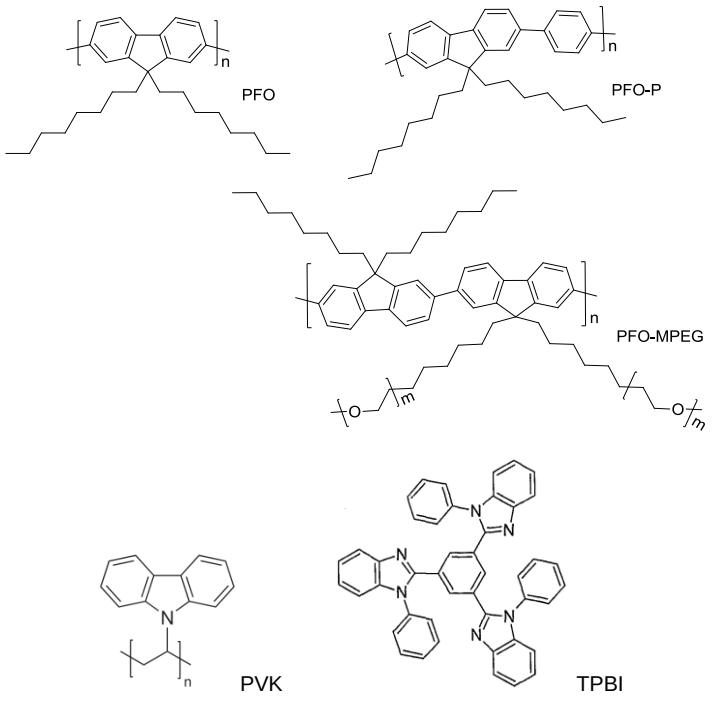


Figure S7. Chemical structure of compounds: PFO, PFO-P, PFO-MPEG, PVK and TPBI.

Electrochemistry

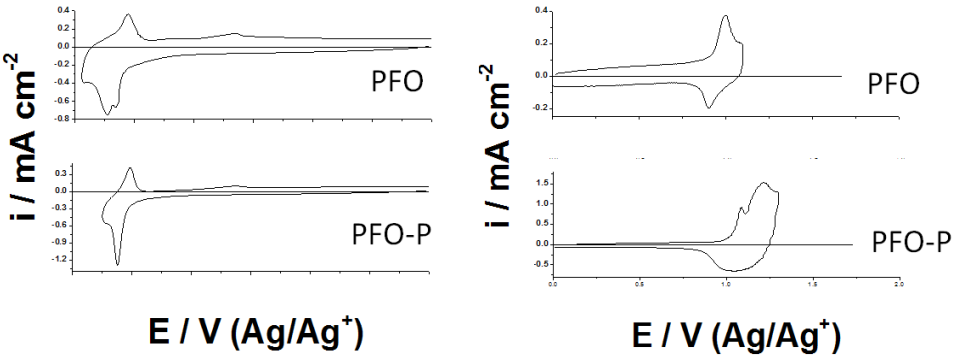


Figure S8. Cyclic-voltammograms of PFO and PFO-P.

Table S2. Data for PFO-TFP, PFO-P and standard PFO.

compound	HOMO (eV)	LUMO (eV)	ΔE^{elec} (eV)
PFO-TFP	-6.2	-2.4	3.8
PFO-P	-5.8	-2.2	3.6
PFO	-5.6	-2.2	3.4

Optical characterization

Table S3. PFO-TFP optical properties compared to PFO-P and commercial PFO.

compound.	film		
	λ_{MAX}^{Abs} (nm)	λ_{MAX}^{PL} (nm)	PL-QY
PFO-TFP	343	405	0.68±0.07
PFO-P	366	418, 443	0.61±0.06
PFO	380[a]	421, 441	0.53±0.05

[a] PFO glassy phase

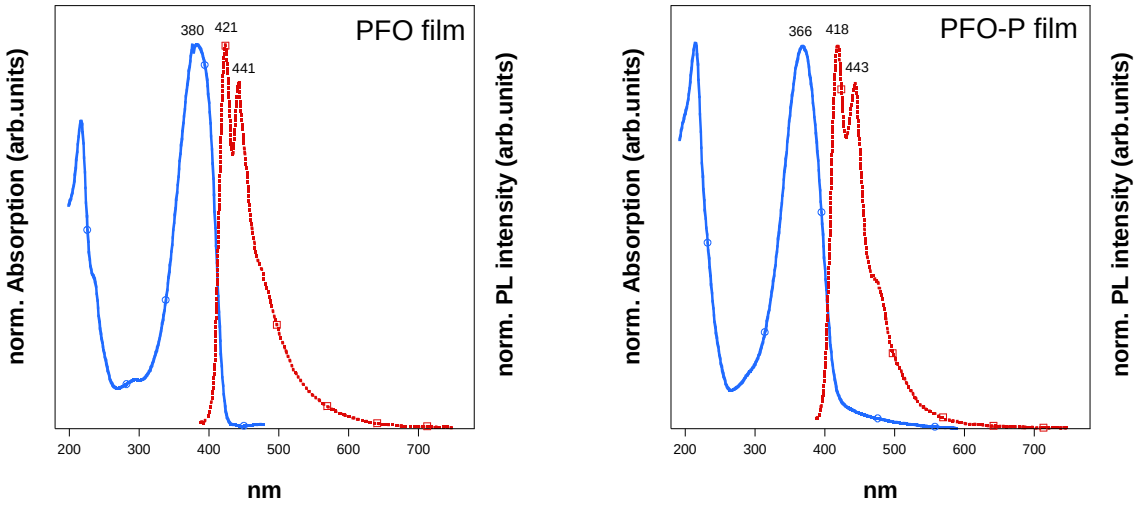


Figure S9. Abs-PL of PFO (left) and PFO-P film (right).

Electroluminescence

Electroluminescence spectra of PFO, PFO-P, PVK and PFO-MPEG in basic device architecture are reported in Figure S3.

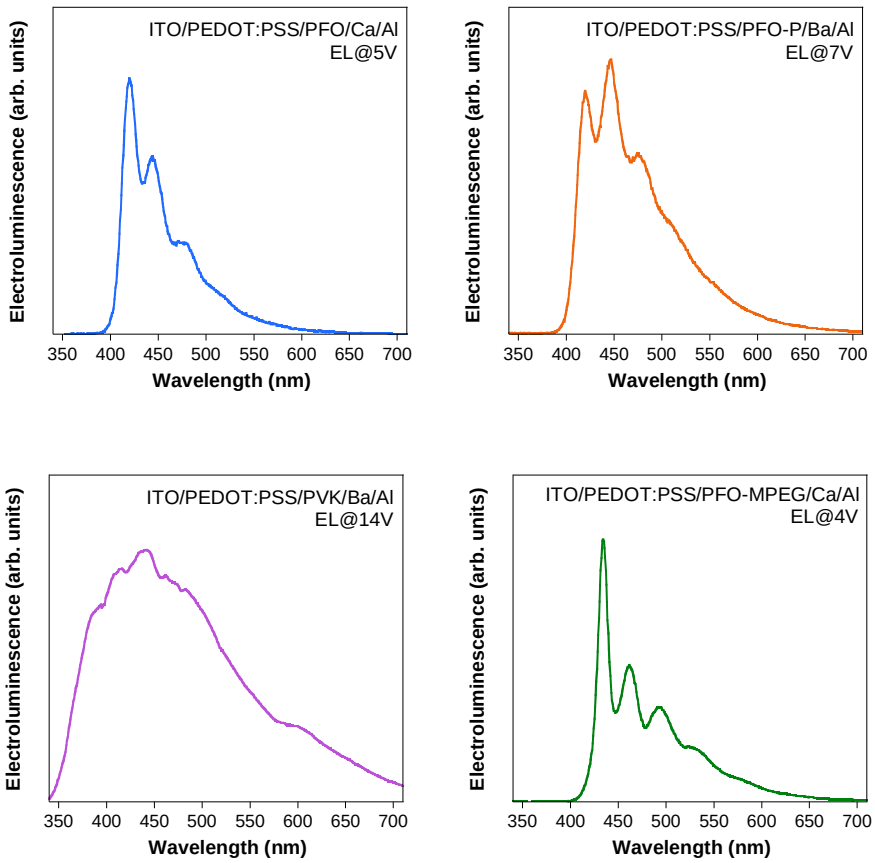


Figure S10. EL spectra of PFO, PFO-P, PVK, PFO-MPEG based basic architecture devices.

Selected device-current/photodiode-current/applied voltage curves of the following devices are reported in Figure S4: ITO/PEDOT:PSS/PFO-TFP/Ba/Al, ITO/PEDOT:PSS/PVK/PFO-TFP/Ba/Al, ITO/PEDOT:PSS/PVK/PFO-TFP/PFO-MPEG/Ba/Al, ITO/PEDOT:PSS/PFO/Ba/Al, ITO/PEDOT:PSS/PVK/Ba/Al, ITO/PEDOT:PSS/PFO-MPEG/Ba/Al and ITO/PEDOT:PSS/PFO-TFP:TPD/Ba/Al.

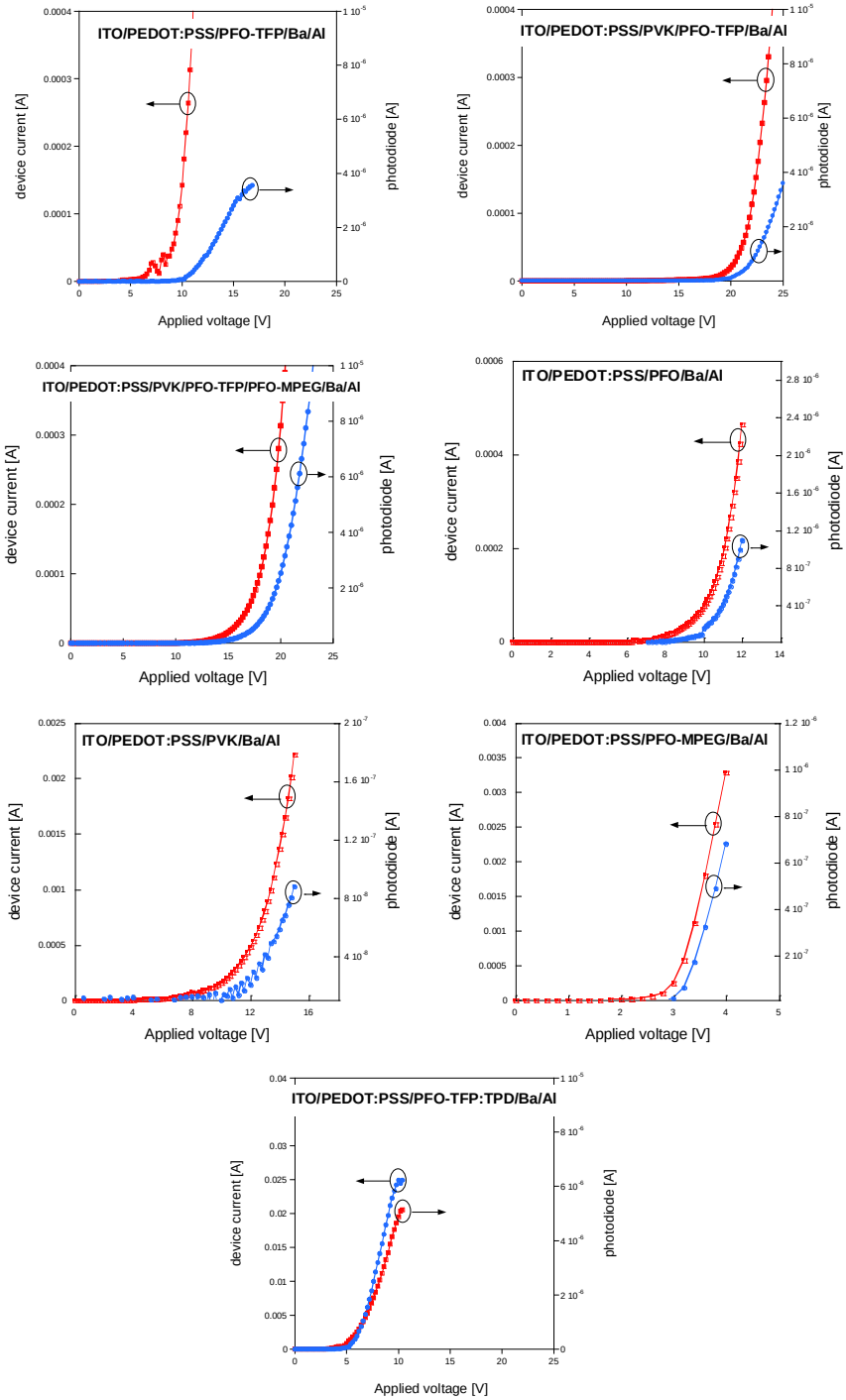


Figure S11. Selected device-current/photodiode-current/applied voltage curves.

Table S4. PVK and PFO-MPEG-based OLED devices performance.

Device architecture	EQE_{MAX} (%)	LE (cd/A)	λ_{MAX}^{EL} (nm)	CIE (1931)
ITO/PEDOT:PSS/PVK/Ba/Al	0.02	0.01	440	0.23, 0.25
ITO/PEDOT:PSS/PFO-MPEG/Ba/Al	0.31	0.12	434, 461, 493	0.19, 0.19

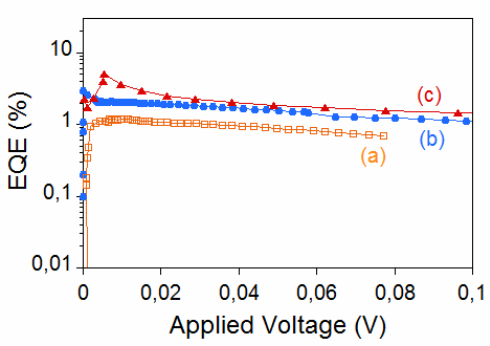


Figure S12. EQE vs current density curves of (a) ITO/PEDOT:PSS/PVK/PFO-TFP/Ba/Al, (b) ITO/PEDOT:PSS/PVK/PFO-TFP/PFO-MPEG/Ba/Al and (c) ITO/PEDOT:PSS/PVK/PFO-TFP/TPBI(vac.dep.)/Ba/Al devices

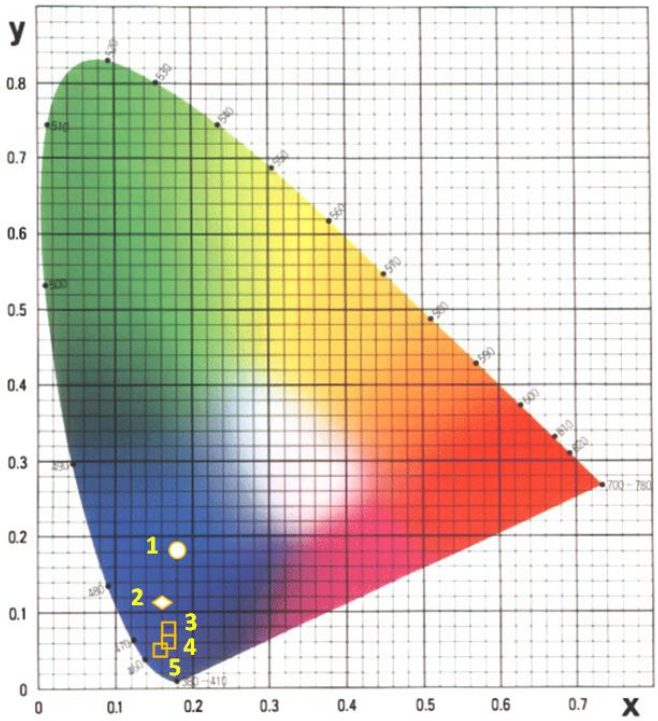


Figure S13. 1931 CIE chromaticity coordinates for EL spectra of following devices; (1) ITO/PEDOT:PSS/PFO-P/Ba/Al; (2) ITO/PEDOT:PSS/PFO/Ba/Al; (3) ITO/PEDOT:PSS/PFO-TFP/Ba/Al; (4) ITO/PEDOT:PSS/PVK/PFO-TFP/Ba/Al; (5) ITO/PEDOT:PSS/PVK/PFO-TFP/PFO-MPEG/Ba/Al.

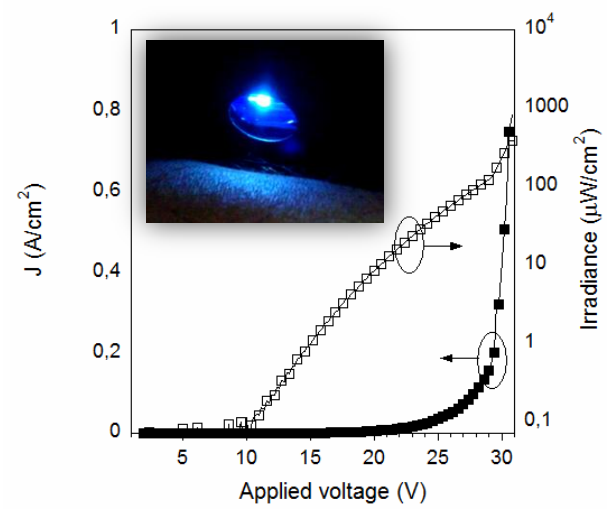
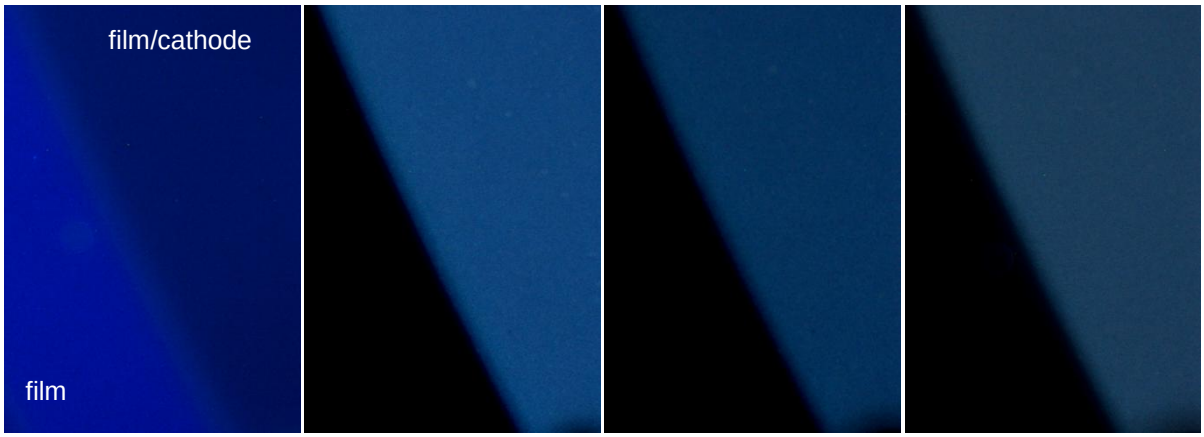


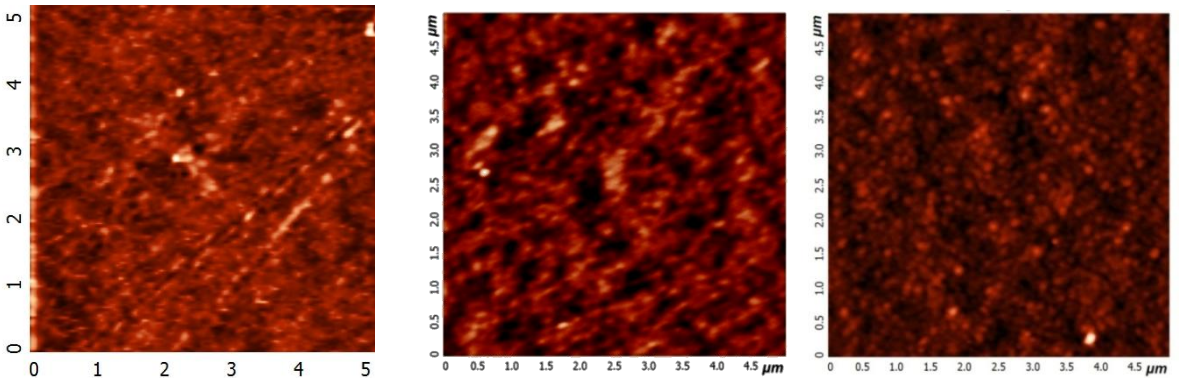
Figure S14. Current density/maximum irradiance/voltage curves for PPFO-TFP based PLED. Inset, picture of the device prototype for skin treatment.



PL EL (30mins) EL (40mins) EL (60mins)

Figure S15. 200x400 μm^2-sized PL-EL microscopy images of ITO/PEDOT:PSS/PVK/PFO-TFP/Ba/Al device shows an homogeneous emitting surface, without appearance of dark spots typically caused by degradation after 60mins of operation.

Morphological characterization



PFO-TFP PEDOT:PSS/PFO-TFP PEDOT:PSS/PVK/PFO-TFP

Figure S16. AFM height (topography) images of PFO-TFP, PEDOT:PSS/PFO-TFP, PEDOT:PSS/PVK/PFO-TFP film.

Table S5. Root Mean Square roughness of spin-coated films.

film	Root Mean Square, Sq (nm)
PFO-TFP	1.3
PEDOT:PSS/PFO-TFP	0,9
PEDOT:PSS/PVK[a]/PFO-TFP	1,2

[a] PVK annealed 150 °C, 30 mins

Photostability

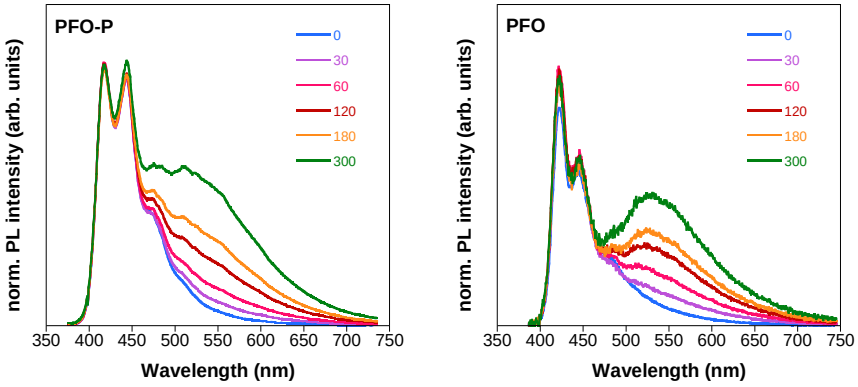


Figure S17. PFO-P photochemical stability (left) compared to commercial PFO (right). Exposure time in seconds