Electronic Supporting Information for

Environmentally stable light emitting field effect transistors based on 2-(4-pentylstyryl)tetracene

by

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Photoluminescence quantum yield (PLQY) measurements.

PLQY of PST in 1,2-dichlorobenzene solution was measured relatively to fluorescein, for which the absorption and emission wavelengths are close to that of PST. Solid state PLQY was estimated by comparing the intensity of the photoluminescence of PST films with that of tris(8-hydroxyquinoline) (Alq_3) reference films (λ^{PL}_{max} = 522 nm, PLQY = 0.32±0.02 [1]) of a similar thickness (in the range of 150-250 nm), normalized by the ratio of their absorbances at the excitation wavelength (350 nm). The PLQY of PST was found to be 0.24±0.01 times that of Alq_3.

See: http://www.isainc.com/usadivisions/Fluorescence/applications /quantumyieldstrad.pdf for a convenient guide to solution PLQY measurements.

1 D. Z. Garbuzov, V. Bulovic, P. E. Burrows, S. R. Forrest, *Chem. Phys. Lett.* 1996, **249**, 433.

Electrical and optoelectronic measurements.

The films were deposited on circular Au source/drain (bottom-contact) electrodes patterned on 190 nm-thick SiO_2 thermally grown on heavily *n*-doped (Sb) Si ($\rho \approx$ 0.01–0.02 Ohm cm). SiO_2 substrates had a root mean square (rms) roughness of 0.2 nm The heavily doped *n*-Si substrate was used as common gate electrode. The thickness of the electrodes was about 25 nm. Au patterning was achieved by lift off using a 5 nm thick Cr adhesion layer. Prior to deposition, substrates were cleaned by sonication in acetone and isopropyl alcohol followed by exposure to O_2 plasma. Interdigitated devices had channel lengths of 6, 10 and 40 μm and corresponding widths of 42000, 41000 and 18000 μm and single channel devices had channel lengths of 6, 10, 20 and 40 μm and width of 1880 μm.

High FET mobility and high I_{on}/I_{off} ratio in PST-LEFETs

Figure SI-1a shows the output characteristics of a PST-FET having W/L=1880/6, that led to a μ_{FET}= 0.17 cm^2/Vs with V_T= –5 V. The gate voltage increases in steps of –10 V from 0 V to –60 V. Figure SI-1b shows the transfer characteristics at the saturation (V_{ds}= -60 V) for the same device. The left y axis reports the square root of $|I_{ds}|$ and the right y axis $|I_{ds}|$ in a logarithmic scale, from which I_{on}/I_{off} could be calculated. These curves lead to a μ_{FET} = 0.22 cm^2/Vs, V_T= –10V and I_{on}/I_{off}=5×10^6.

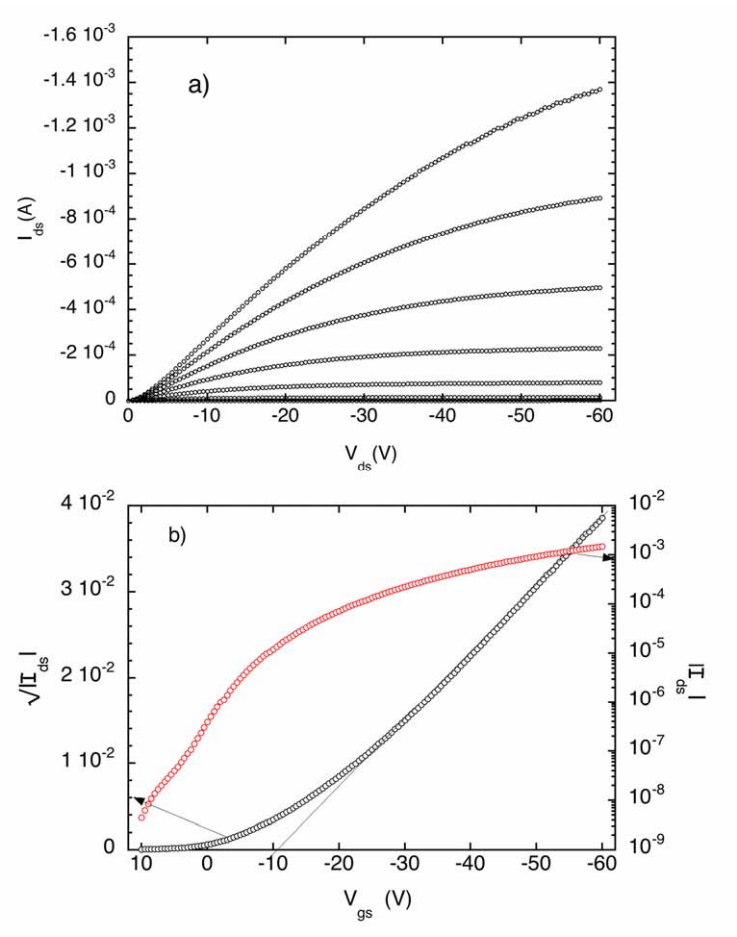

Figure SI-1

Decay of electroluminescence with time

Under a constant bias of $V_{ds} = V_g = -60$ V, the *EL* intensity and I_{ds} of PST-LEFETs decay exponentially with time (Figure SI-2). Interestingly, the initial values of *EL* and I_{ds} could be restored by leaving unbiased the device for a few minutes (see Figure SI-2). The inset reports the first portions of the curves.

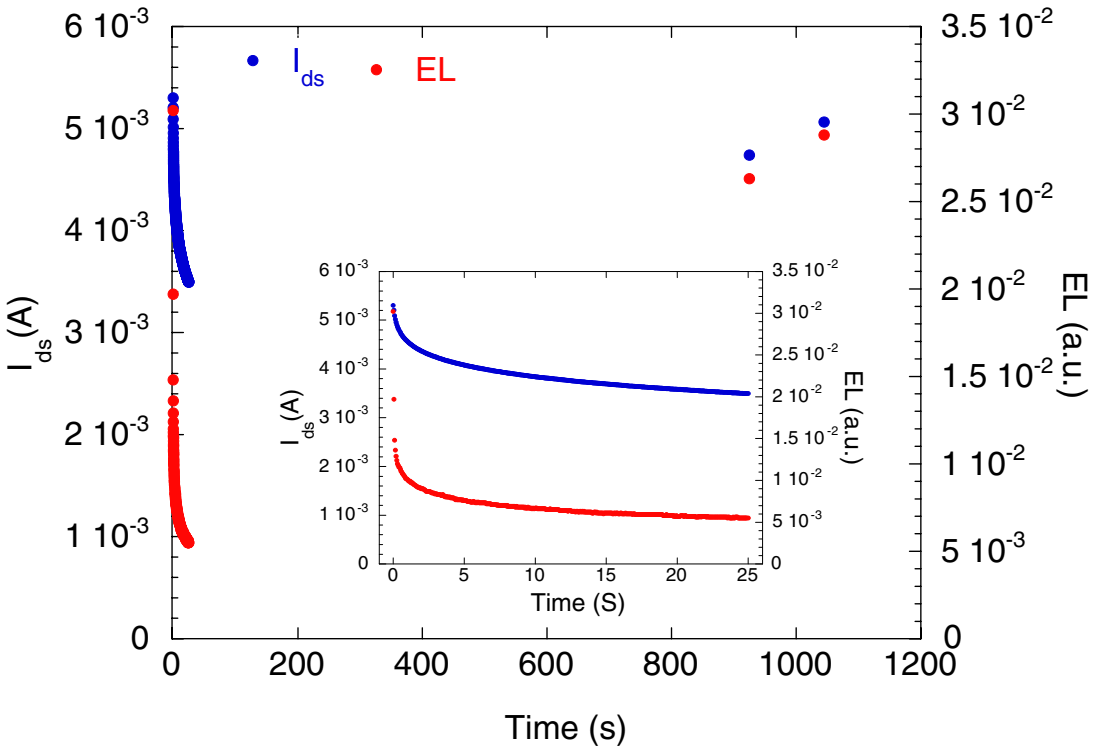

Figure SI-2

Transfer electrical characteristics of a PST LEFET in ambient air

Figure SI-3 shows transfer characteristics at the saturation (V_{ds}= –80V) of a PST FET operated in ambient air (W/L=42000/6). The left y axis reports the square root of $|I_{ds}|$ and the right y axis $|I_{ds}|$ in a logarithmic scale, from which I_{on}/I_{off} could be calculated. These curves lead to V_T = +4V and I_{on}/I_{off}= 10^3.

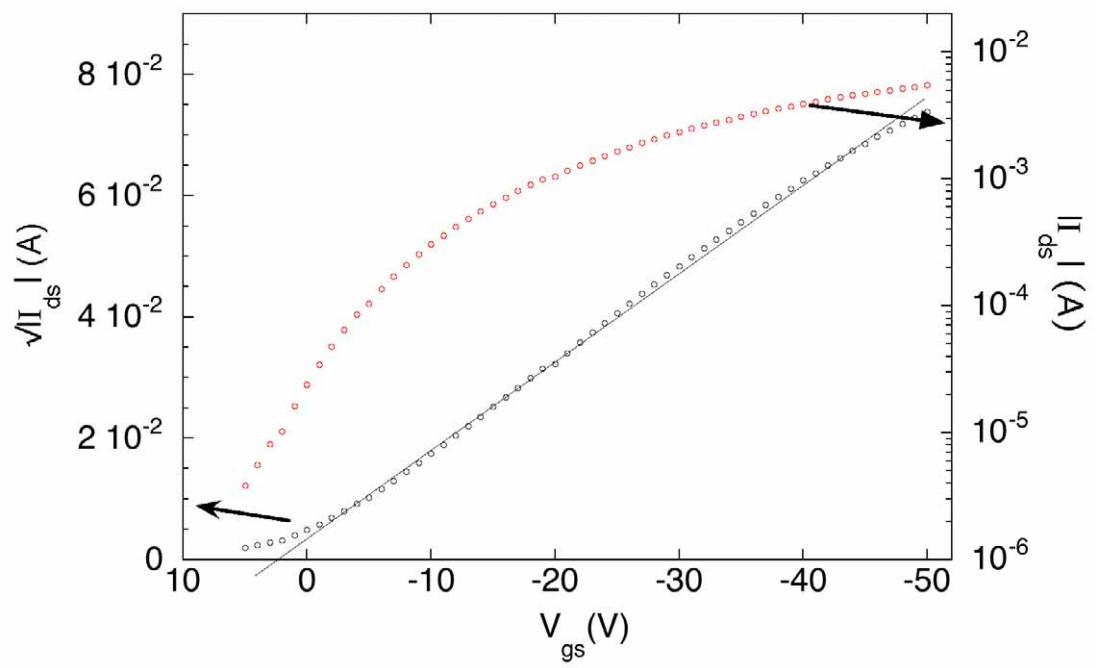

Figure SI-3

Comparison between operation in N_2 and in dry air.

In Figures SI-4a and SI-4b the optoelectronic properties of the same device (W/L= 41800/10) are measured subsequently in N_2 (a) and in dry air (b). The optoelectronic characteristics are similar. The gate voltage increased from 0V to –60 V in steps of –15 V.

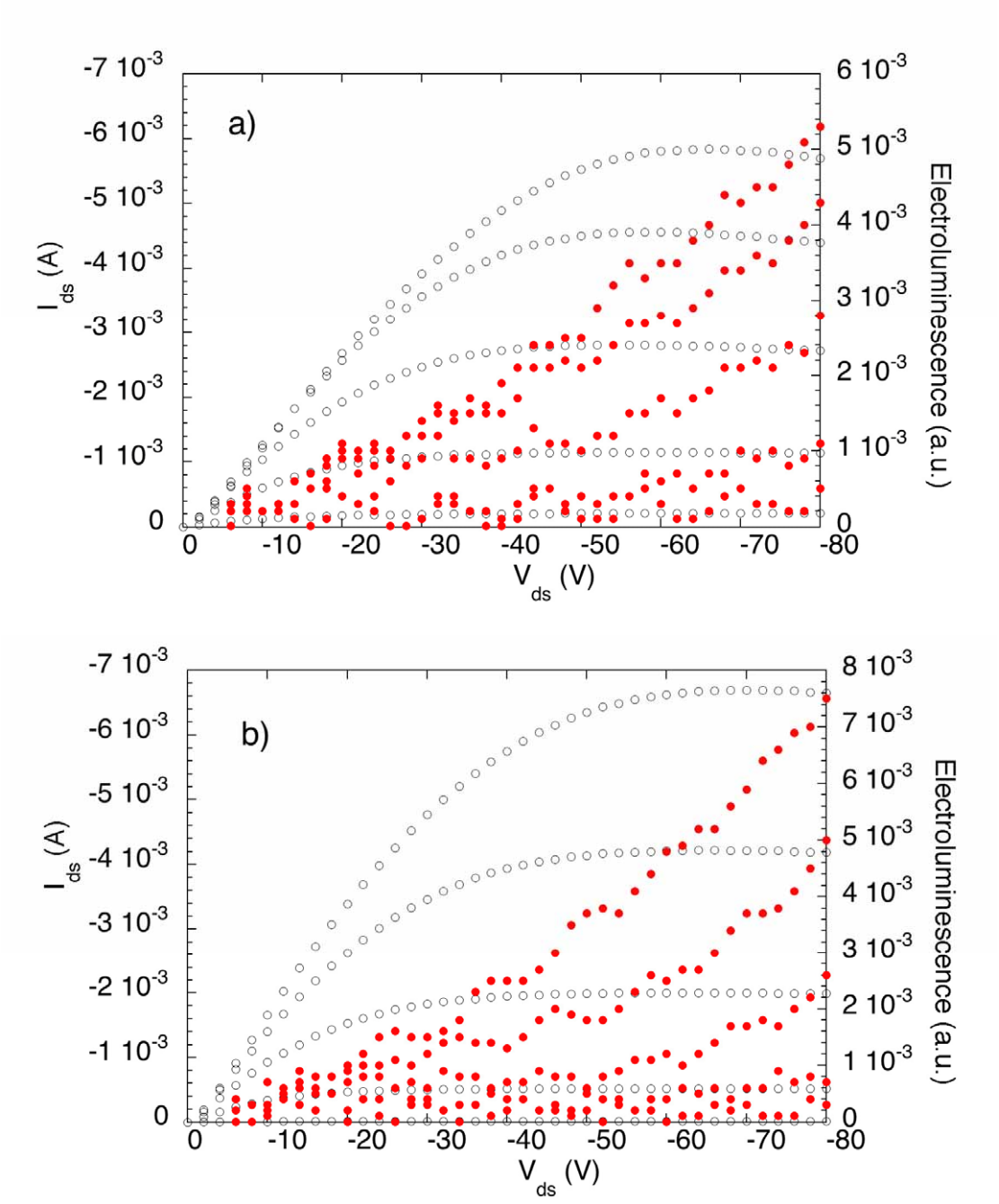

Figure SI-4

Sample aging

PST-LEFETs were stored in ambient air without significant deterioration of the device performance. Figure SI-5a reports output characteristics of a LEFET with W/L=18800/40, freshly prepared (black dashed curves) and 8 months-old, stored in ambient air (red curves). The hole FET mobility remains constant (0.1 cm^2/Vs) since the increase in saturation current upon storage is accompanied by a shift of the threshold voltage towards positive values (from –4 to +6 V from the fresh to the aged sample, as from Figure SI-5b). In Figure SI-5a, the gate voltage increased from 0 V to –60 V in steps of –10 V.

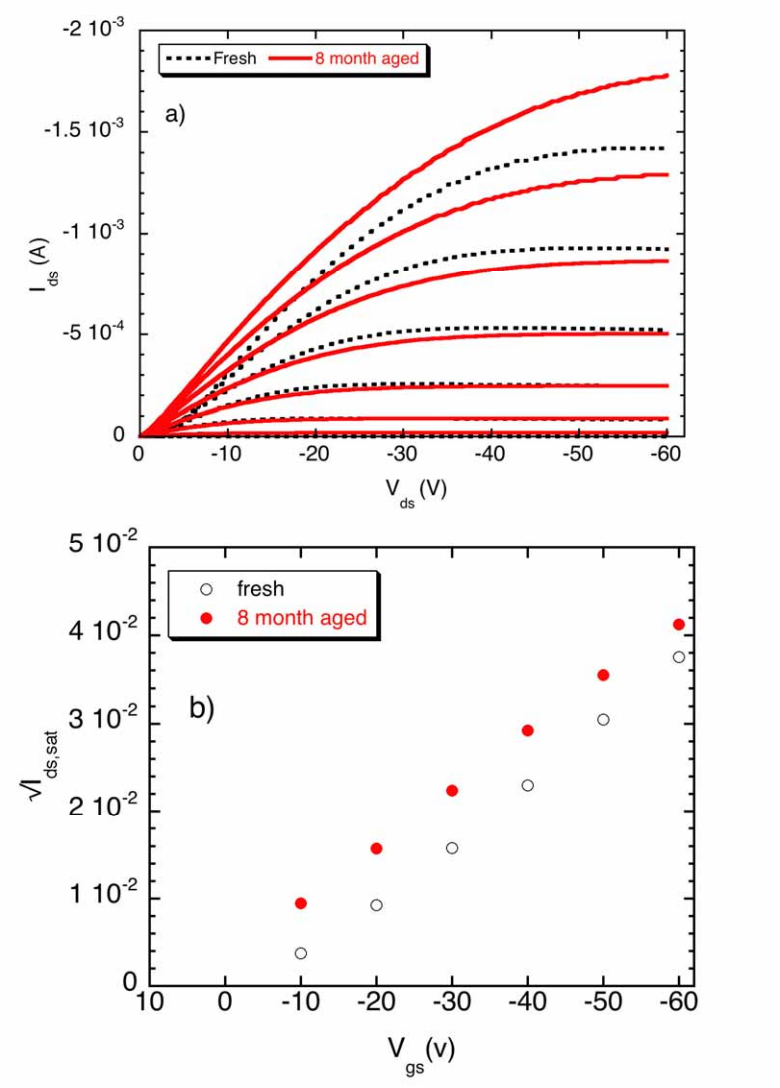

Figure SI-5