

Electronic Supplementary Information (ESI)

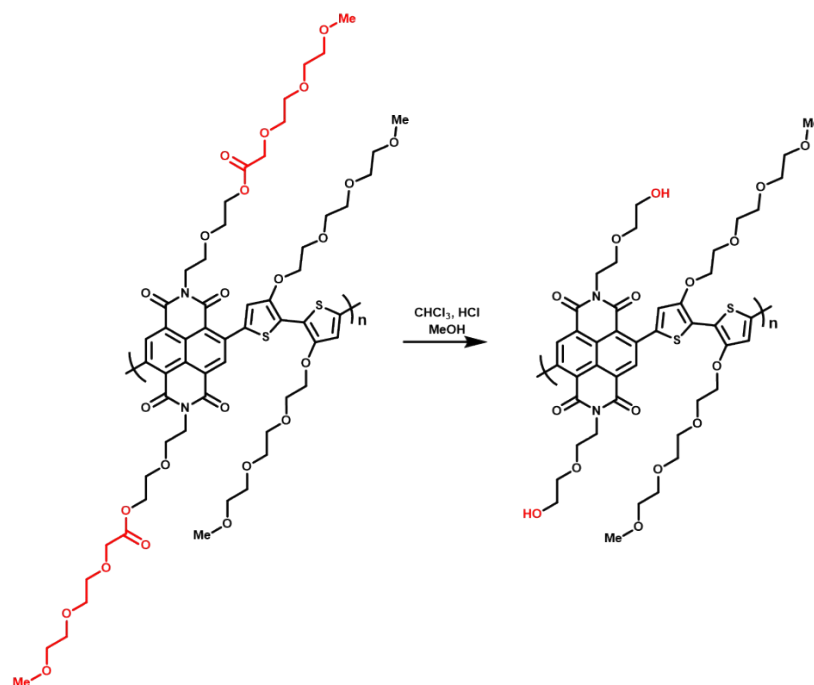
Lipid Bilayer Formation on Organic Electronic Materials

Yi Zhang,^a Shofarul Wustoni,^a Achilleas Savva,^a Alexander Giovannitti,^b Iain McCulloch^{b,c} and Sahika Inal^a

^a Biological and Environmental Sciences and Engineering Division, King Abdullah University of Science and Technology (KAUST), Building 2, Level 4, Room 4276, Thuwal 23955 - 6900, Kingdom of Saudi Arabia Address here.

^b Department of Chemistry and Centre for Plastic Electronics, Imperial College London, London SW7 2AZ, UK

^c Physical Science and Engineering Division, KAUST, Thuwal 23955-6900, Kingdom of Saudi Arabia



Scheme S1. The chemical structure and the functionalization procedure of p(OH-gNDI-gT2)

The semiconducting polymer p(gNDI-gT2)¹ was dissolved in 4.0 mL of chloroform (48.5 mg, 38.8 μ mol), followed by the addition of 2.0 mL of methanol and 50 μ L of concentrated HCl into the solution. The reaction mixture was heated to reflux for 4 h and then cooled to room temperature during which the polymer precipitated. 50 mL of methanol was added and the polymer was filtered and washed with water, methanol, acetone and chloroform. Finally, the polymer was dried under high vacuum. 34.9 mg (37.6 μ mol) of the polymer p(OH-gNDI-gT2) was obtained with a yield of 97 %.

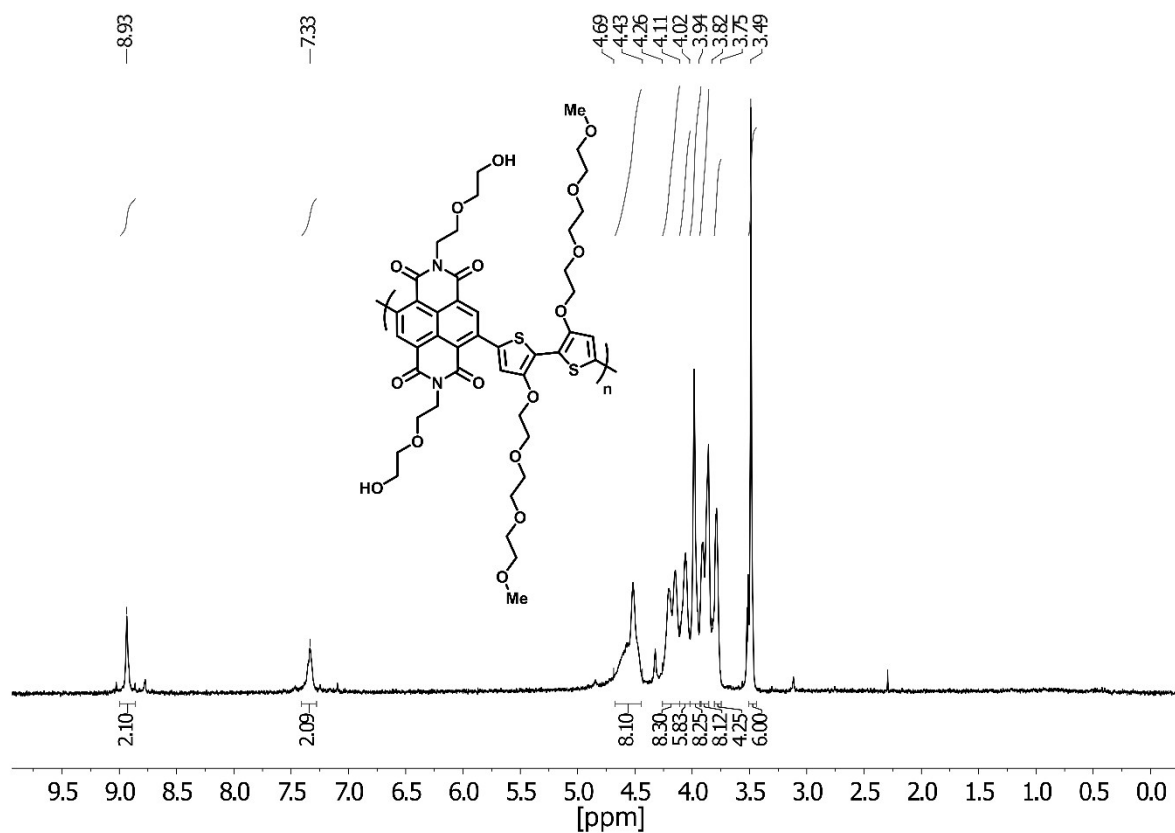


Figure S1. ¹H NMR spectrum of p(OH-gNDI-gT2) measured in TFA-*d*₁.

(TFA-*d*₁, 400 MHz) δ : 8.93 (s, 2 H), 7.33 (s, 2H), 4.69 – 4.43 (m, 8H), 4.26 – 4.11 (m, 8H), (s, 4H), 4.02 – 3.94 (m, 8H), 3.94 – 3.82 (m, 8H), 3.82 – 3.75 (m, 4H), 3.49 (s, 6H) ppm.

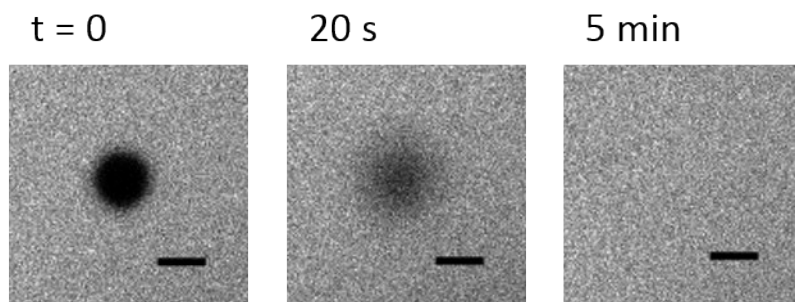


Figure S2. Characterization of lipid bilayer formation from DPhPC/DPhPE (7:3) vesicles on glass using FRAP. FRAP images are shown at $t=0$, 20 s and 5 min (from left to right). Scale bar = 20 μm . We find D to be $1.5 \pm 0.1 \mu\text{m}^2/\text{s}$, and MF to be 97%.

Table S1. QCM-D signals measured during the course of the vesicle fusion experiments on PEDOT:PSS films. The values correspond to the time points when the signals stabilize in PBS. Mass and thickness values were calculated using Sauerbrey equation, using only one overtone (here, 7th

overtone) as described in equation
$$\Delta m = \frac{-17.7}{n} \Delta f_{n,2}$$

EG content (%)	Δf (vesicle) (Hz)	Δf (PBS after 1 st osmotic shock) (Hz)	Δf (final) (Hz)	ΔD (vesicle) ($\times 10^{-6}$)	ΔD (PBS after 1 st osmotic shock) ($\times 10^{-6}$)	ΔD (final) ($\times 10^{-6}$)	Mass (final) (ng/cm^2)	Thickness (final) (nm)
0	-221	-155	-136	116	92	95	2400	24
5	-279	-189	-176	66	37	40	3120	31
10	-267	-200	-186	99	66	62	3301	33
20	-214	-170	-177	59	32	24	3135	31

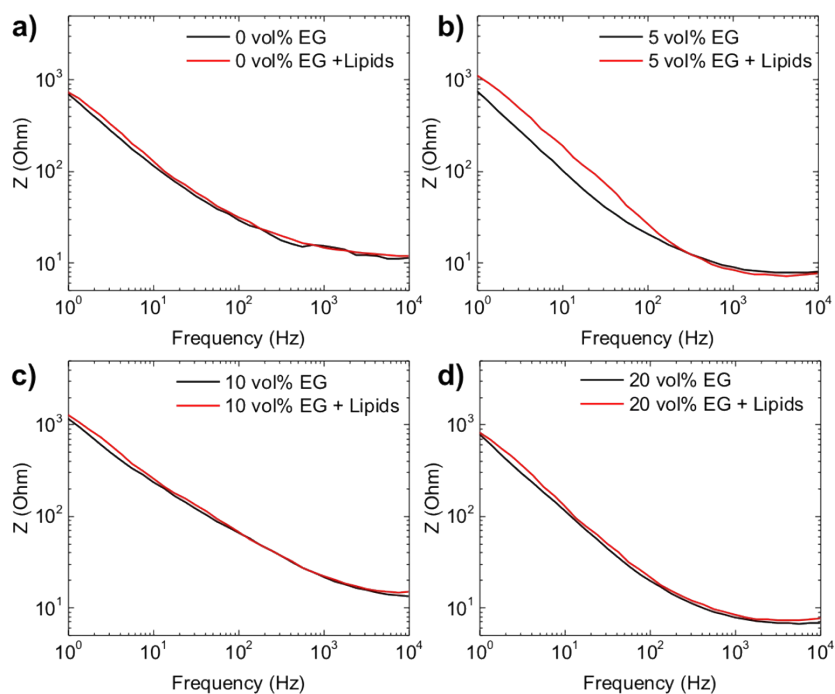


Figure S3. Electrochemical impedance spectra recorded in PBS at $V=-0.05V$ vs. V_{oc} for PEDOT:PSS coated SiO_2 sensors with (red lines) and without lipid bilayer (black lines). From a to d, PEDOT:PSS films were cast from dispersions containing 0, 5, 10 and 20 vol% EG, respectively.

Table S2. Water contact angle of PEDOT:PSS films prepared from dispersions containing various EG concentrations before and after DI water immersion as well as after the last step of fusion treatment.

EG content (%)	As-prepared	After DI water immersion	Plasma treatment
0	$51.9 \pm 4.9^\circ$	$73.1 \pm 1.2^\circ$	0°
5	$21.1 \pm 3.1^\circ$	$50.8 \pm 0.9^\circ$	0°
10	$7.5 \pm 2.4^\circ$	$47.6 \pm 1.0^\circ$	0°
20	$4.8 \pm 1.6^\circ$	$49.7 \pm 1.8^\circ$	0°

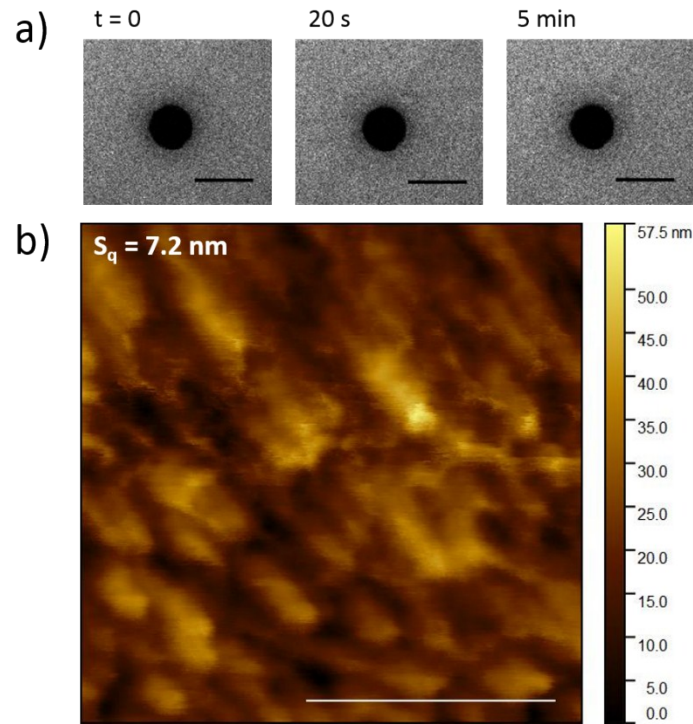


Figure S4. (a) FRAP images showing no fluorescence recovery for lipids deposited on electropolymerized PEDOT:PSS film. Scale bar = 20 μm (b) AFM image of electropolymerized PEDOT:PSS film in PBS at pH 7.4 after water immersion and O_2 plasma activation. Scale bar = 400 nm.

Table S3. The peak parameters of S 2p components. High binding energy region is attributed to PSS whereas the low binding energy region originates from PEDOT. For PEDOT, both peaks are attributed to the sulfur atoms in the thiophene ring. For PSS, S 2p_{1/2} and S 2p_{3/2} are related to the neutral and ionic sulfur of PSS, respectively. The peak area of PSS relative to PEDOT decreases gradually as EG content increases, suggesting that more PEDOT-rich components exist in the uppermost surface. The film with 5 vol% EG has the highest area of PSS 2p_{3/2} peak, showing that it has the most negatively charged surface.

EG content (vol%)	Peak assigned to	FWHM (eV)	B.E. (eV)	Area (%)
0	PEDOT 2p _{3/2}	0.624	163.747	10.4
5			163.752	11.8
10			163.76	14.4
20			163.851	14.4
0	PEDOT 2p _{1/2}	1.163	164.879	13.9
5			164.894	16.6
10			164.902	20.8
20			165.01	20.4
0	PSS 2p _{3/2}	1.013	168.093	19.5
5			168.135	24.3
10			168.044	22.1
20			168.137	20.8
0	PSS 2p _{1/2}	1.645	169.18	56.2
5			169.184	47.2
10			169.072	42.6
20			169.133	44.4

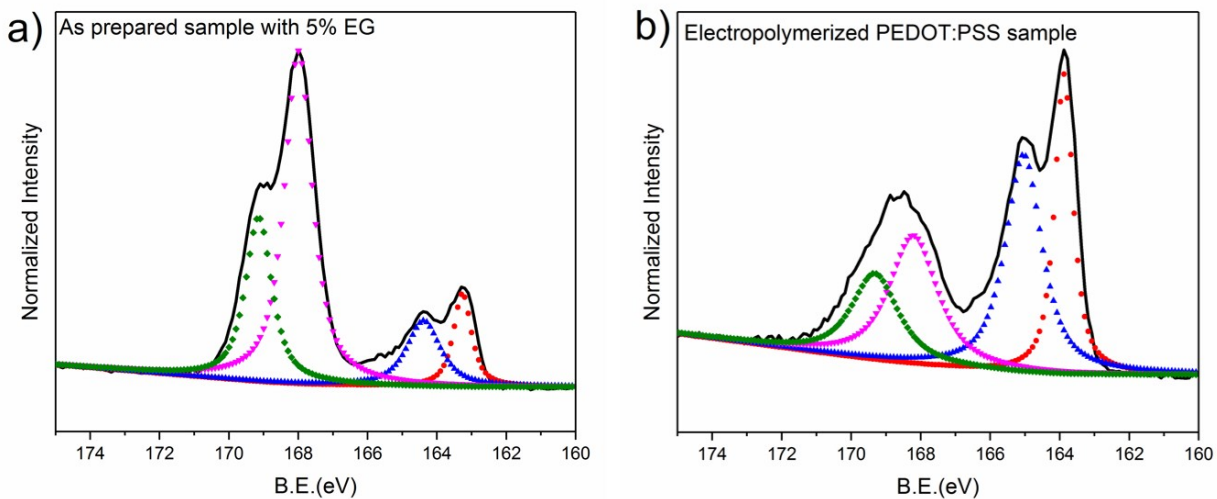


Figure S5. XPS S 2p spectra of as-prepared PEDOT:PSS film cast from the dispersion containing 5 vol% EG (a) and electropolymerized PEDOT:PSS film (b)

References

1. A. Giovannitti, C. B. Nielsen, D.-T. Sbircea, S. Inal, M. Donahue, M. R. Niazi, D. A. Hanifi, A. Amassian, G. G. Malliaras, J. Rivnay and I. McCulloch, *Nature Communications*, 2016, **7**, 13066.
2. N.-J. Cho, C. W. Frank, B. Kasemo and F. Hook, *Nat. Protocols*, 2010, **5**, 1096-1106.