Electronic Supplementary Information (ESI)

# Lipid Bilayer Formation on Organic Electronic Materials

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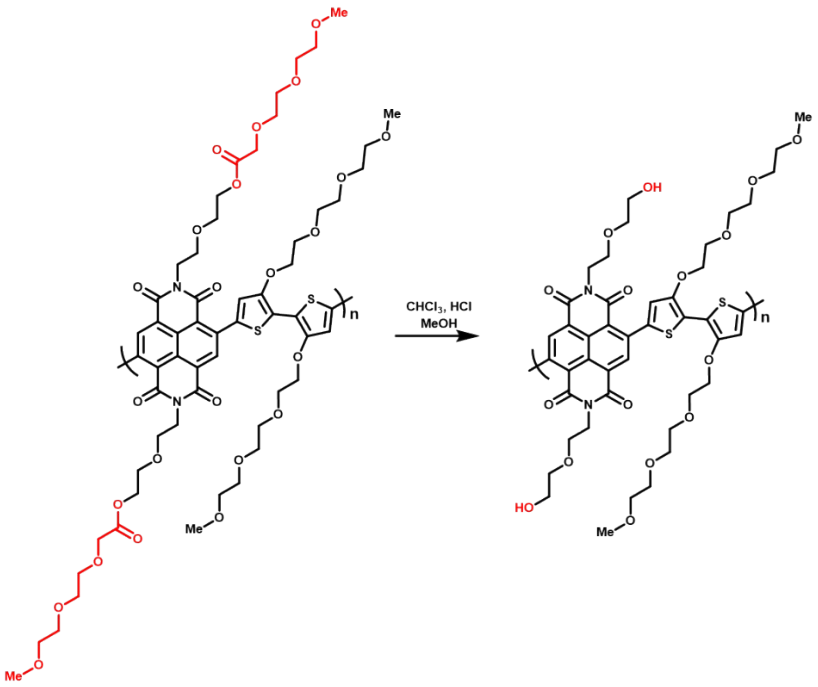


**Scheme S1.** The chemical structure and the functionalization procedure of p(OH-gNDI-gT2)

The semiconducting polymer p(gNDI-gT2)[1] (48.5 mg, 38.8 µmol) was dissolved in 4.0 mL of chloroform, followed by the addition of 2.0 mL of methanol and 50 µL 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 µmol) of the polymer p(OH-gNDI-gT2) was obtained with a yield of 97 %.

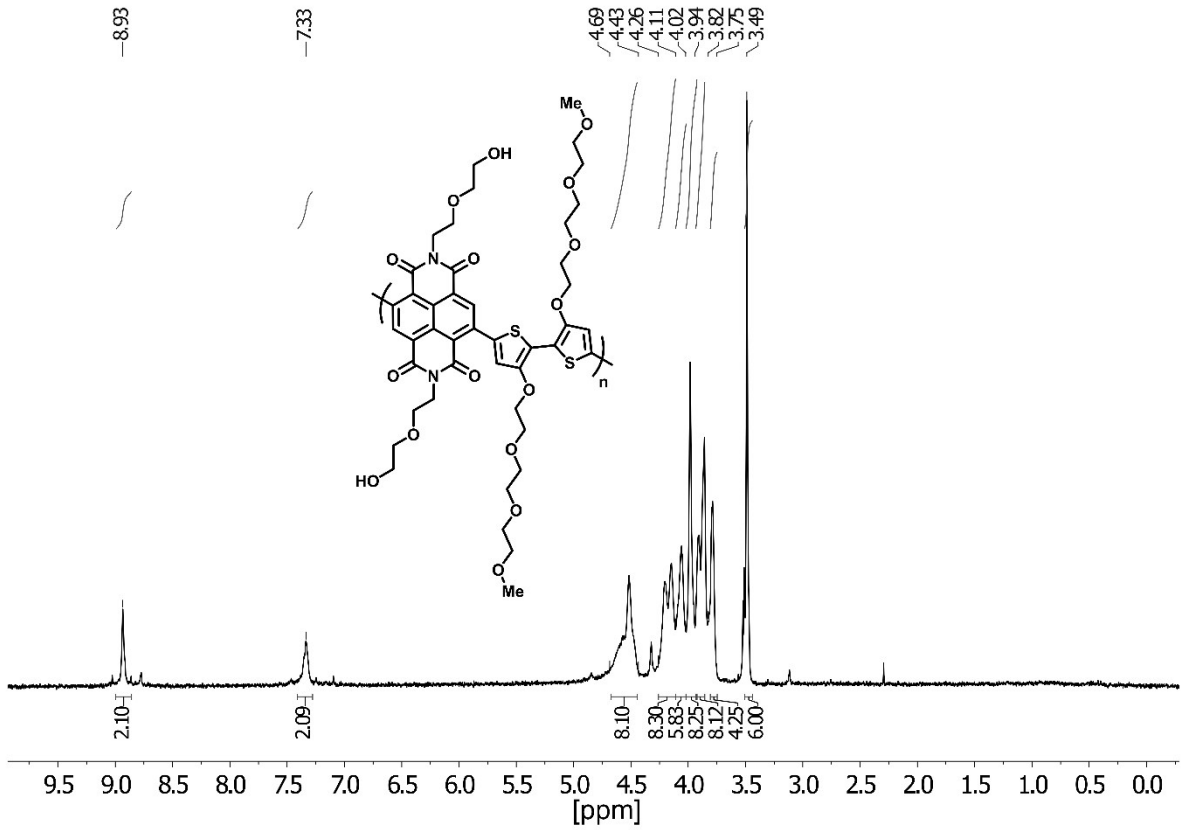


**Figure S1.** $^{1}$H NMR spectrum of p(OH-gNDI-gT2) measured in TFA-$d_1$.

(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.

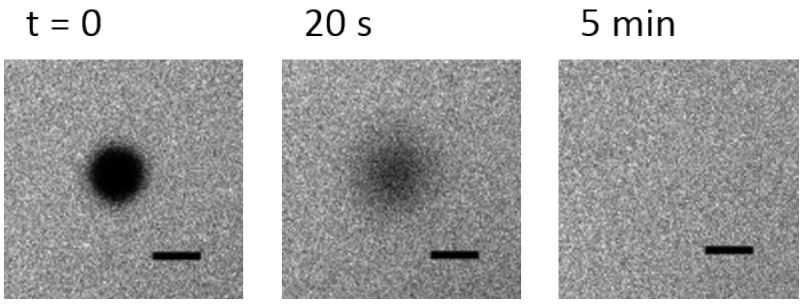


**Figure S2.** Characterization of lipid bilayer formation from DPhPC/DPhPE (7:3) vesicles on glass using FRAP. FRAP images are shown at t=0, 20 s and 5 min (from left to right). Scale bar = 20 μm. We find *D* to be 1.5 ± 0.1 μm$^2$/s, and *MF* to be 97%.

**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 7$^{th}$ overtone as described in equation $\Delta m = -17.7\,\Delta f_{n.2}$

| EG content (%) | Δf (vesicle) (Hz) | Δf (PBS after 1$^{st}$ osmotic shock) (Hz) | Δf (final) (Hz) | ΔD (vesicle) (x10$^{-6}$) | ΔD (PBS after 1$^{st}$ osmotic shock) (x10$^{-6}$) | ΔD (final) (x10$^{-6}$) | 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 |

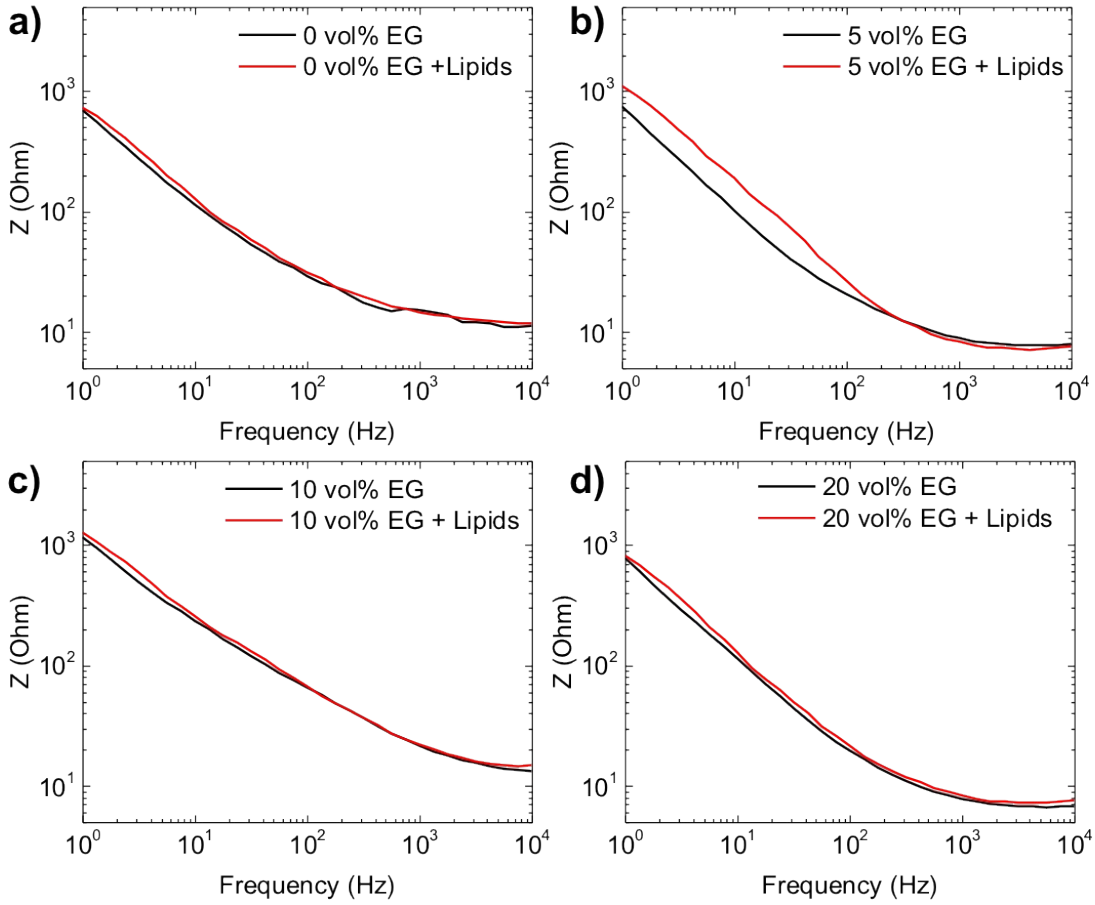


**Figure S3.** Electrochemical impedance spectra recorded in PBS at $V$=-0.05V vs. $V_{oc}$ for PEDOT:PSS coated $SiO_2$ sensors with (red lines) and without lipid layers (black lines). From a to d, PEDOT:PSS films were cast from dispersions containing 0, 5, 10 and 20 vol% EG, respectively.

**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 (vol%) | As-prepared | After DI water immersion | Plasma treatment |
|---|---|---|---|
| 0 | 51.9 ± 4.9 ° | 73.1 ± 1.2 ° | 0° |
| 5 | 21.1 ± 3.1 ° | 50.8 ± 0.9 ° | 0° |
| 10 | 7.5 ± 2.4 ° | 47.6 ± 1.0 ° | 0° |
| 20 | 4.8 ± 1.6 ° | 49.7 ± 1.8 ° | 0° |

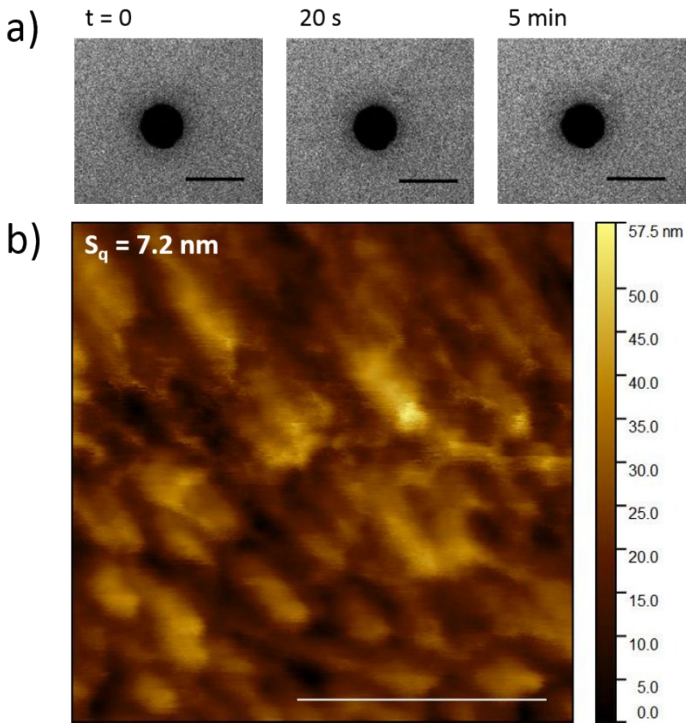


**Figure S4.** (a) FRAP images showing no fluorescence recovery for lipids deposited on electropolymerized PEDOT:PSS film. Scale bar = 20 µm (b) AFM image of electropolymerized PEDOT:PSS film in PBS at pH 7.4 after water immersion and $O_2$ plasma activation. Scale bar = 400 nm.

**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 |

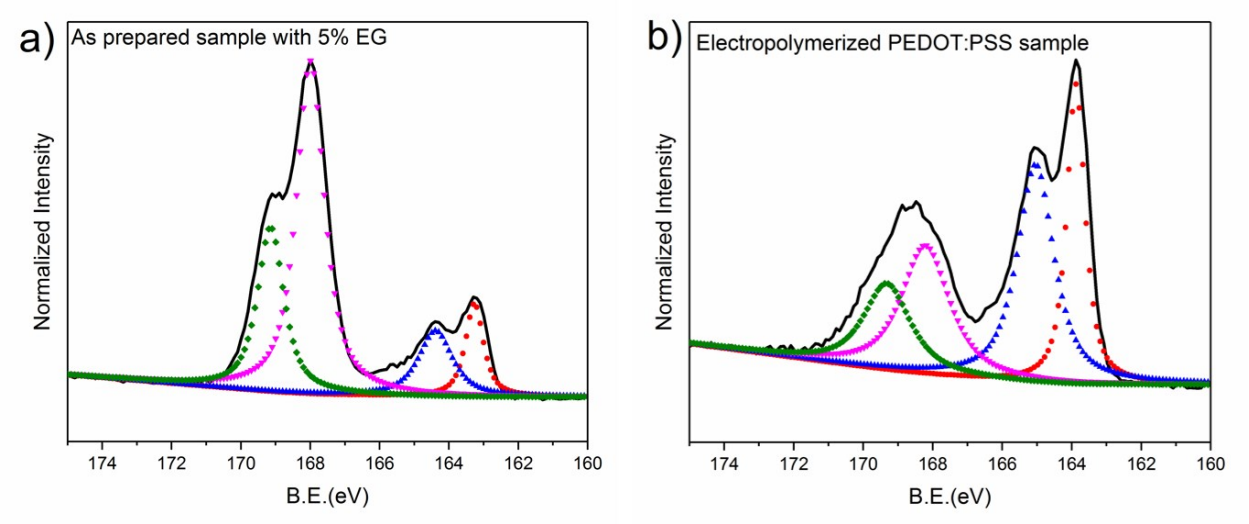


**Figure S5.** XPS S 2p spectra of as-prepared PEDOT:PSS film cast from the dispersion containing 5 vol% EG (a) and electropolymerized PEDOT:PSS film (b)

## 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.