

Supporting information

A PEDOT based graft copolymer with enhanced electronic stability

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Table S1. Thickness (d) of polymeric films synthesised on ITO and OECT single channel devices.

Substrate	Sample name	Thickness (μm)
ITO	Poly(EDOTS- <i>g</i> -EDOT) ($d_{\text{graft-copolymer}}$)	1.093 ± 0.209
	PEDOTS (d_{PEDOTS})	1.064 ± 0.204
	Grafted PEDOT layer ($d_{\text{grafted-PEDOT-layer}}$)	0.029 ± 0.008
OECT devices	Poly(EDOTS- <i>g</i> -EDOT)	1.082 ± 0.263
	SC-PEDOT:PSS	1.794 ± 0.171
	EP-PEDOT:PSS	9.374 ± 0.347

Table S2. Poly(EDOTS-*g*-EDOT), EP-PEDOT:PSS, and SC-PEDOT:PSS XPS fitting parameters for S $2p_{3/2}$.¹⁻³

Components	Poly(EDOTS- <i>g</i> -EDOT)		
	FWHM	Binding energy (eV)	Ratio (%)
Sulfur in thiophene ring	0.9	163.8	37
Oxidized sulfur in thiophene ring	1.2	165.3	16
Sulfur from sulfone group	1.2	168.0	2
Sulfur from sulfonate group	1.2	168.4	45
Components	EP-PEDOT:PSS		
	FWHM	Binding energy (eV)	Ratio (%)
Sulfur in thiophene ring	0.9	162.4	9
Oxidized sulfur in thiophene ring	1.2	164.1	4
Sulfur from sulfone group	-	-	-
Sulfur from sulfonate group	1.2	166.7	87
Components	SC-PEDOT:PSS		
	FWHM	Binding energy (eV)	Ratio (%)
Sulfur in thiophene ring	1.0	164.0	19
Oxidized sulfur in thiophene ring	1.2	165.3	8
Sulfur from sulfone group	-	-	-
Sulfur from sulfonate group	1.2	168.1	73

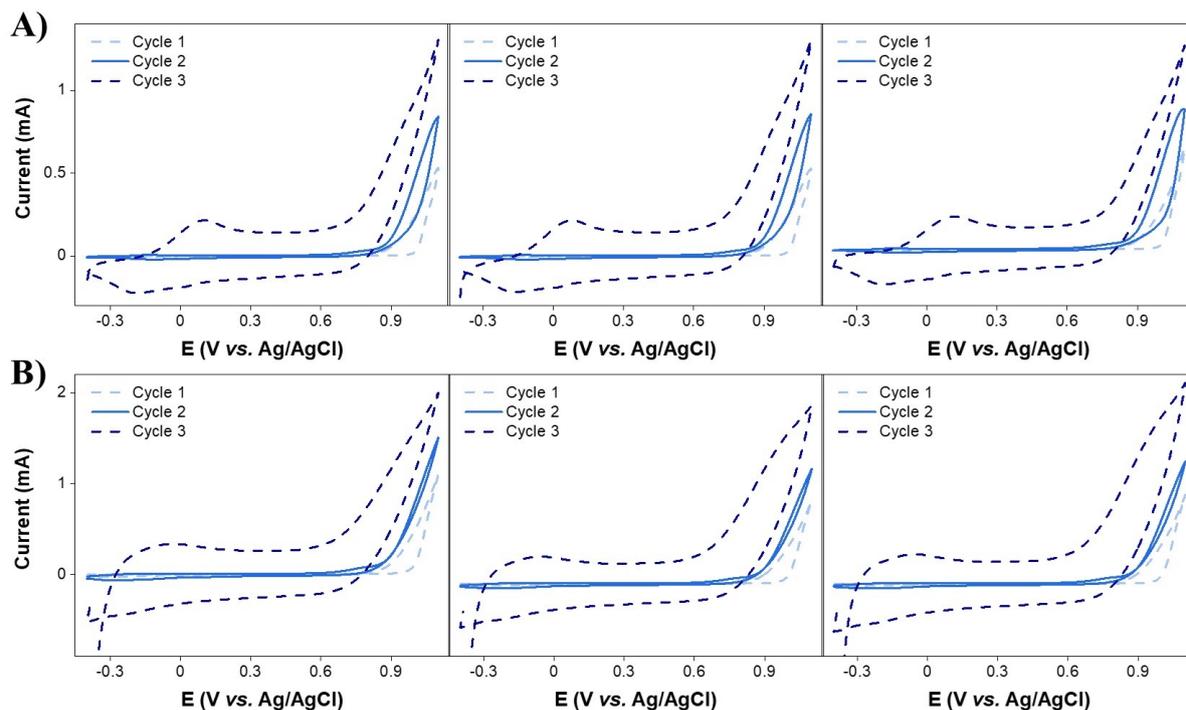


Figure S1: CV curves of electropolymerization of P(EDOTS-g-EDOT): A) repeats of 3 samples synthesised on IDME devices, and B) repeats of 3 samples synthesised on ITO substrates. The voltammograms were recorded by applying 2 cycles from -0.4 V to $+1.1$ V with a scan rate of $10 \text{ mV}\cdot\text{s}^{-1}$ to electrodeposit PEDOTS (labelled as cycle 1 and cycle 2 in the legend), followed by one cycle from -0.4 V to $+1.1$ V with a scan rate of $100 \text{ mV}\cdot\text{s}^{-1}$ to electrodeposit PEDOT (labelled as cycle 3 in the legend).

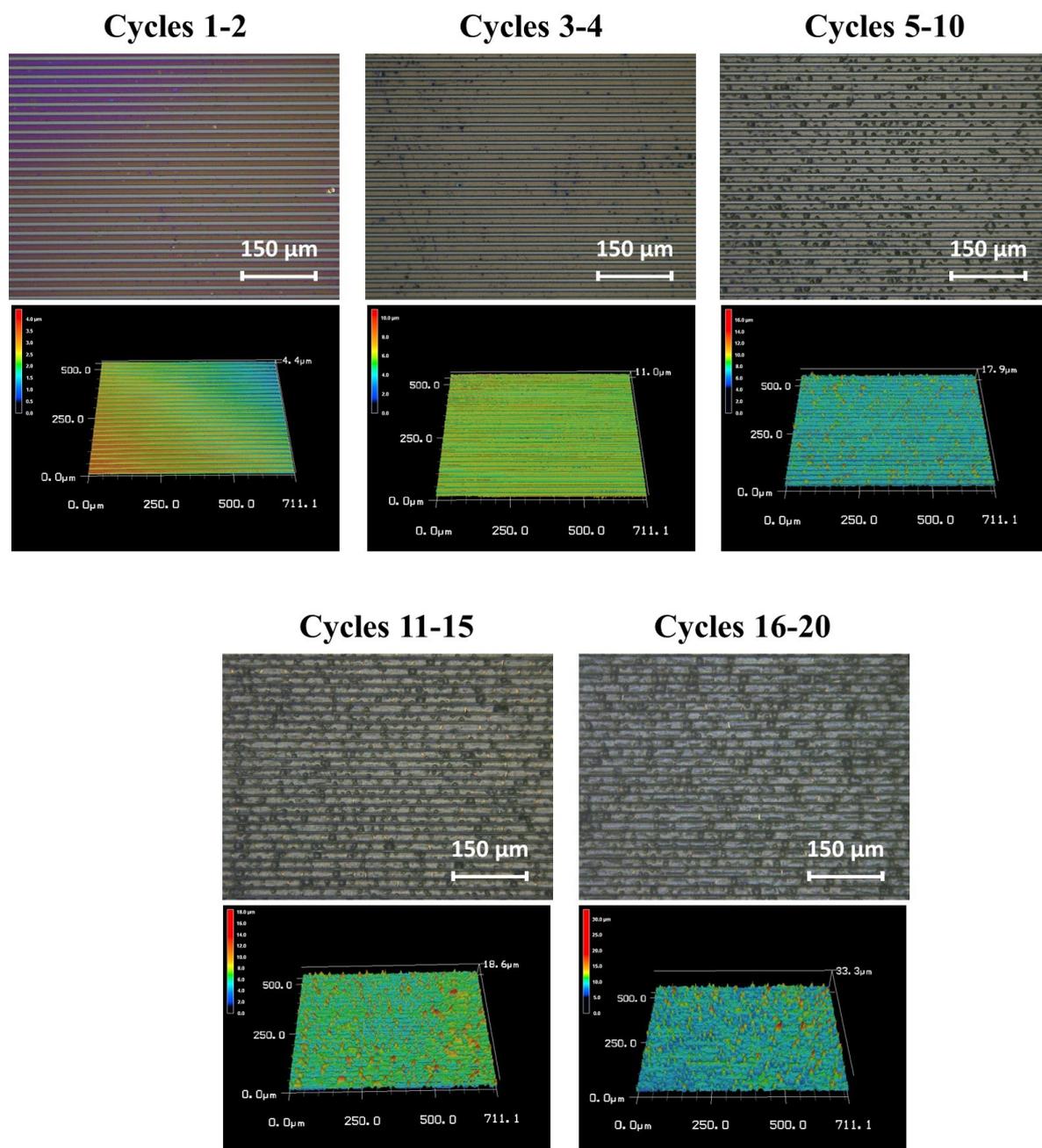


Figure S2. Laser confocal microscopy images taken after cycles 2, 4, 10, 15, and 20 to assess the extent of PEDOT:PSS coverage by electropolymerization on the IDME surface.

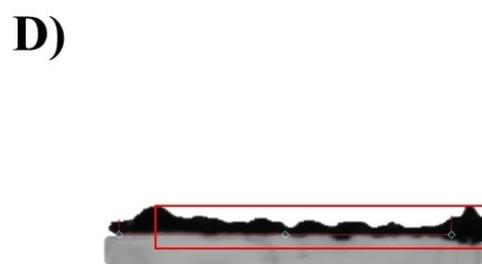
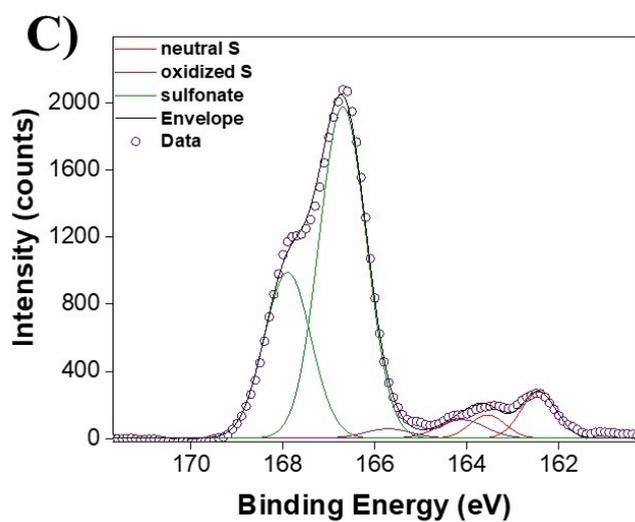
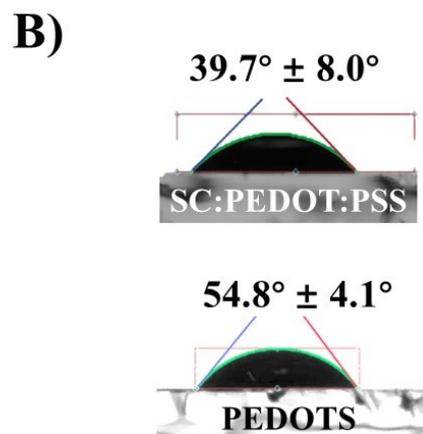
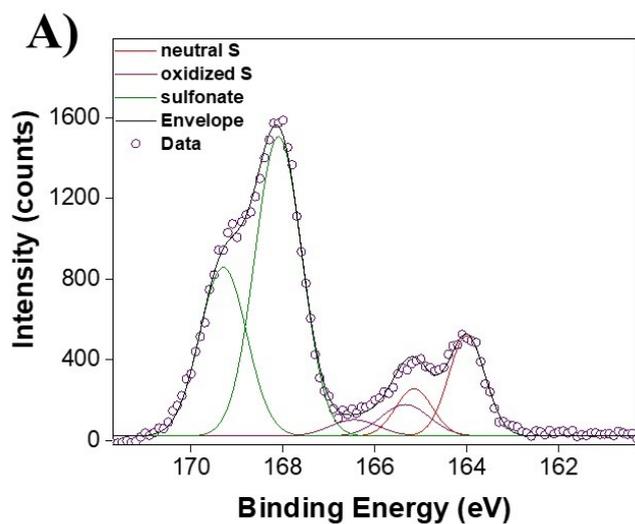


Figure S3. XPS analysis of S 2p spectra of A) SC-PEDOT:PSS and C) EP-PEDOT:PSS. Contact angle measurements of B) SC-PEDOT:PSS and PEDOTS that had no grafted PEDOT on its surface, and D) EP-PEDOT:PSS films.

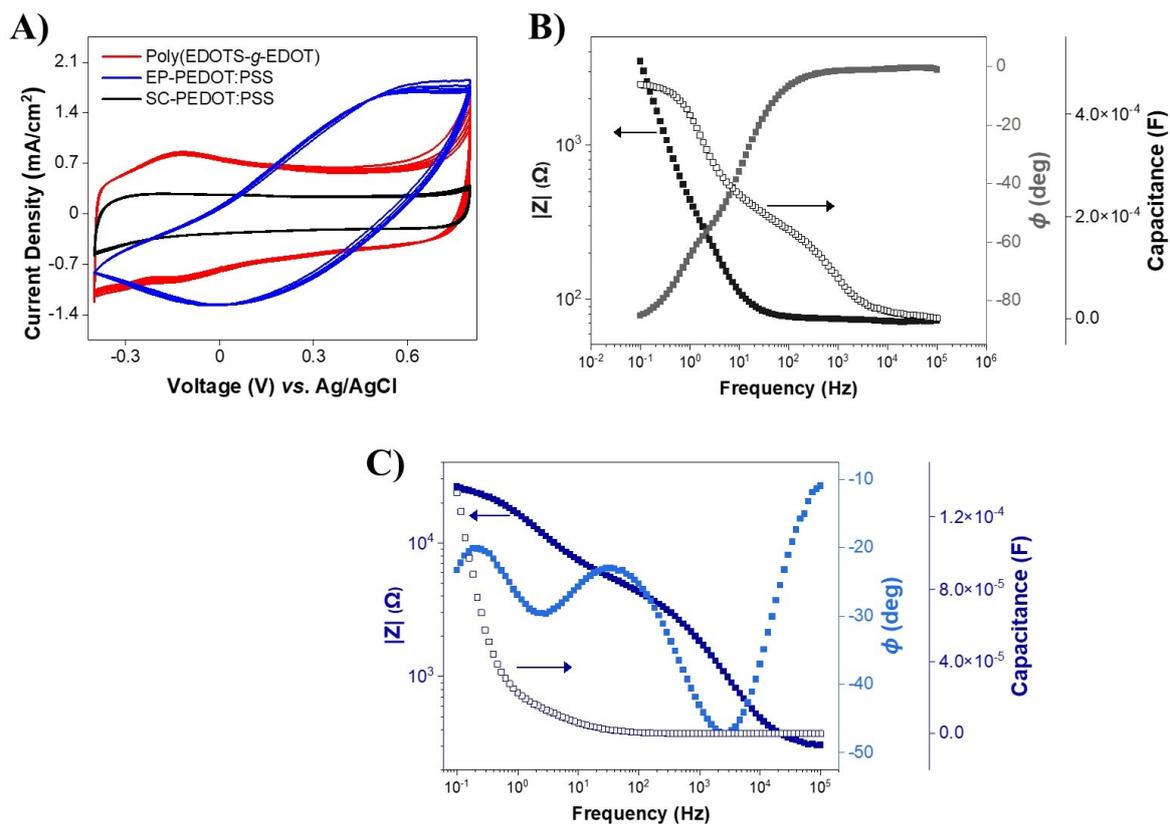


Figure S4. A) Cyclic voltammetry of poly(EDOTS-*g*-EDOT) (red line), EP-PEDOT:PSS (blue line) and SC-PEDOT:PSS (black line) electropolymerized and measured at a scan rate of 50 mV.s⁻¹ in aqueous electrolyte vs. Ag/AgCl for 6 cycles. Bode, phase angle and capacitance plots of B) SC-PEDOT:PSS and C) EP-PEDOT:PSS under an applied voltage of +0.4 V in aqueous electrolyte vs. Ag/AgCl with a frequency range from 100 mHz to 100 kHz.

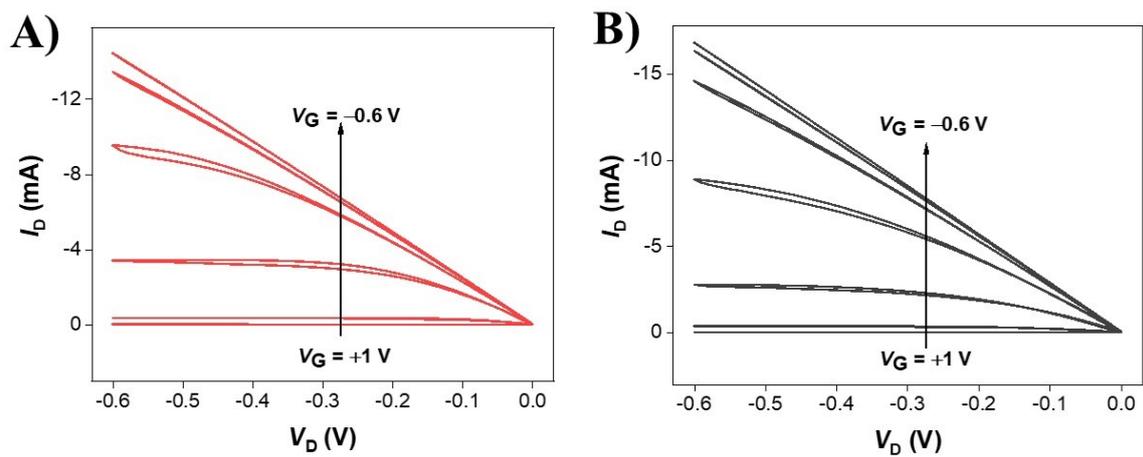


Figure S5. Output curves of A) poly(EDOTS-g-EDOT) (red line), and B) SC-PEDOT:PSS (black line) under gate voltage V_G shift from +1.0 V to -0.6 V with a voltage step of 0.2 V. The gate electrode is an Ag/AgCl reference electrode, and the electrolyte is 0.1 M NaCl aqueous solution.

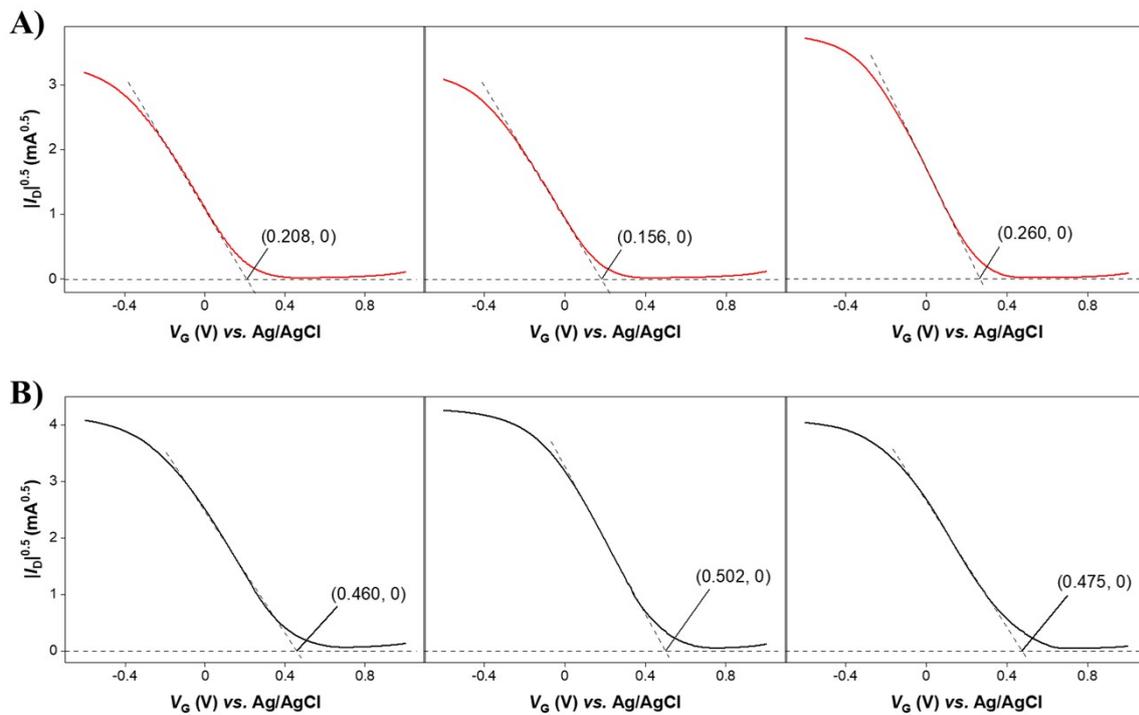


Figure S6. Threshold voltage extraction of A) poly(EDOT-g-EDOT) and B) SC-PEDOT:PSS. Three repeat devices are shown for each polymeric film.

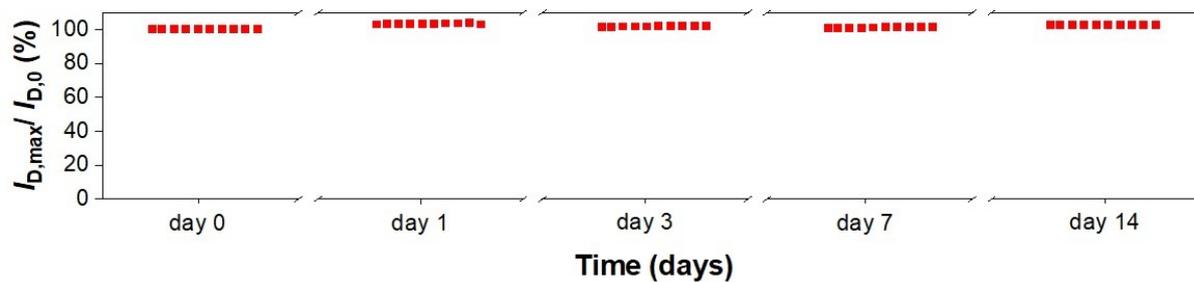


Figure S7: ‘Intermittent’ ON/OFF stability of poly(EDOTS-*g*-EDOT) OECT devices left soaking in the electrolyte and measured at day 0, 1, 3, 7 and 14. $I_{D,max}$ is the maximum drain current at -0.4 V determined for every 5th ON/OFF cycle. $I_{D,0}$ is the maximum drain current determined for the 1st ON/OFF cycle measured at day 0.

References:

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