Supplemental Information

Organic electrochemical transistor-based biosensors using doped polyaniline

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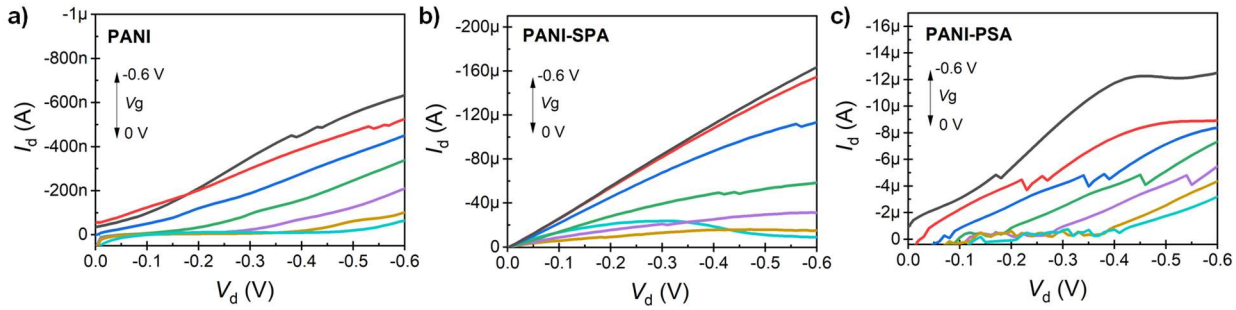

Fig. S1 Output characteristics of OECTs based on a) **PANI**, b) **PANI-SPA**, and c) **PANI-PSA**.

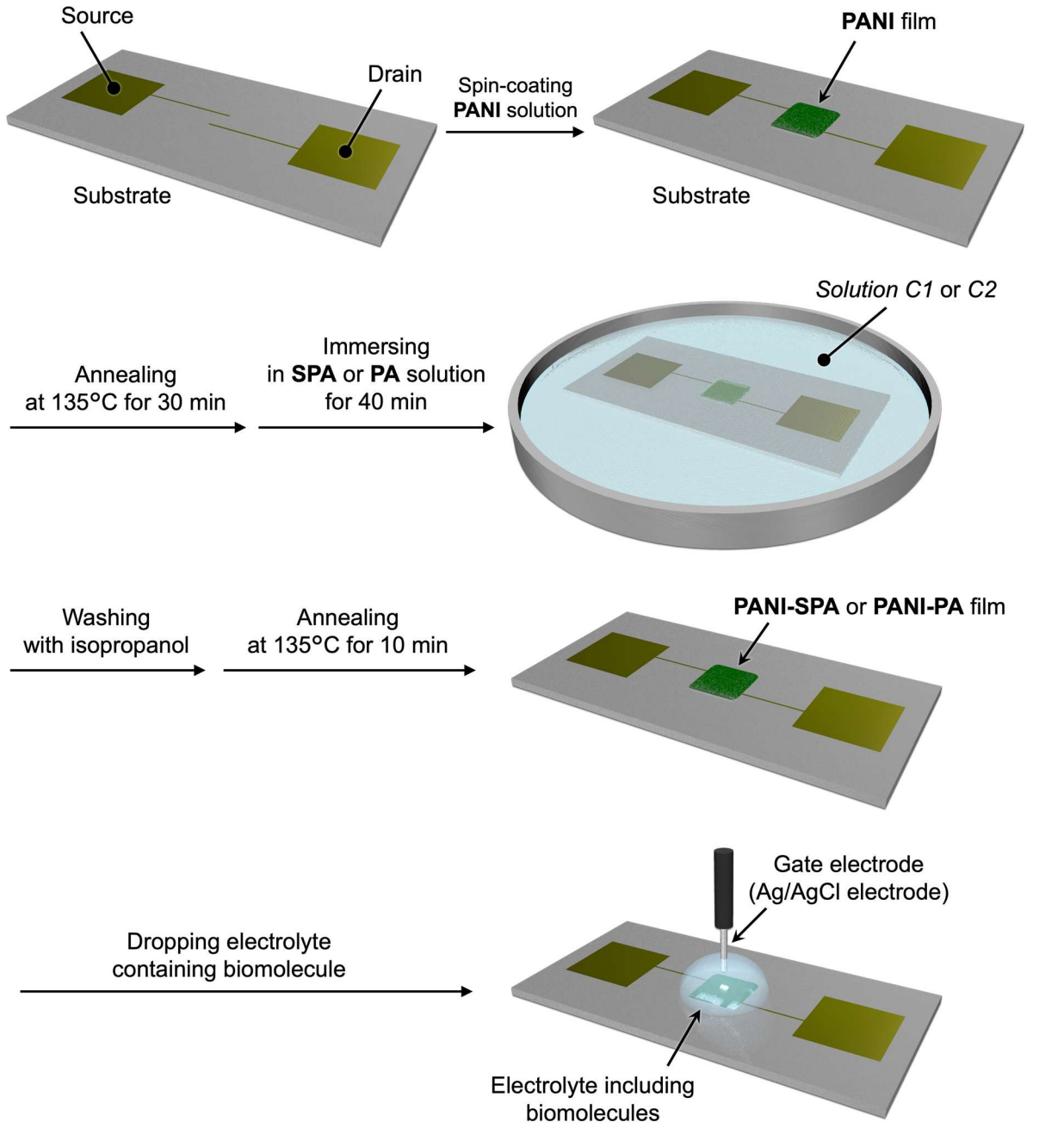

Fig. S2 The detailed fabrication process of **PANI** film and the OECT device in this study.

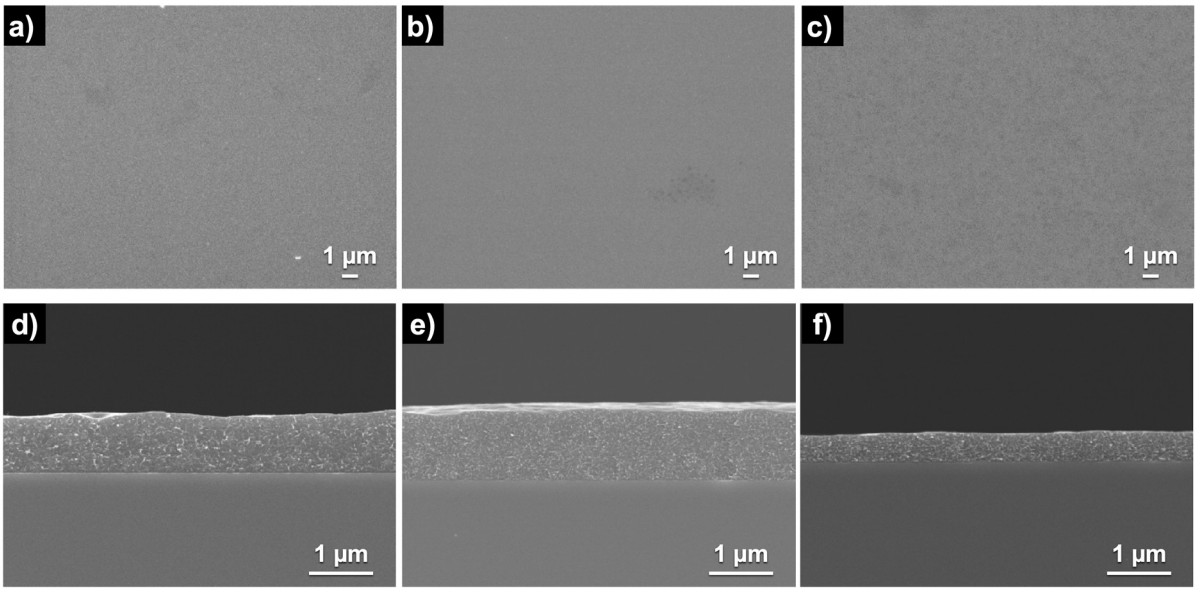

Fig. S3 SEM images of the polymer film surface and cross-section for a,d) **PANI**, b,e) **PANI-SPA**, and c,f) **PANI-PSA**.

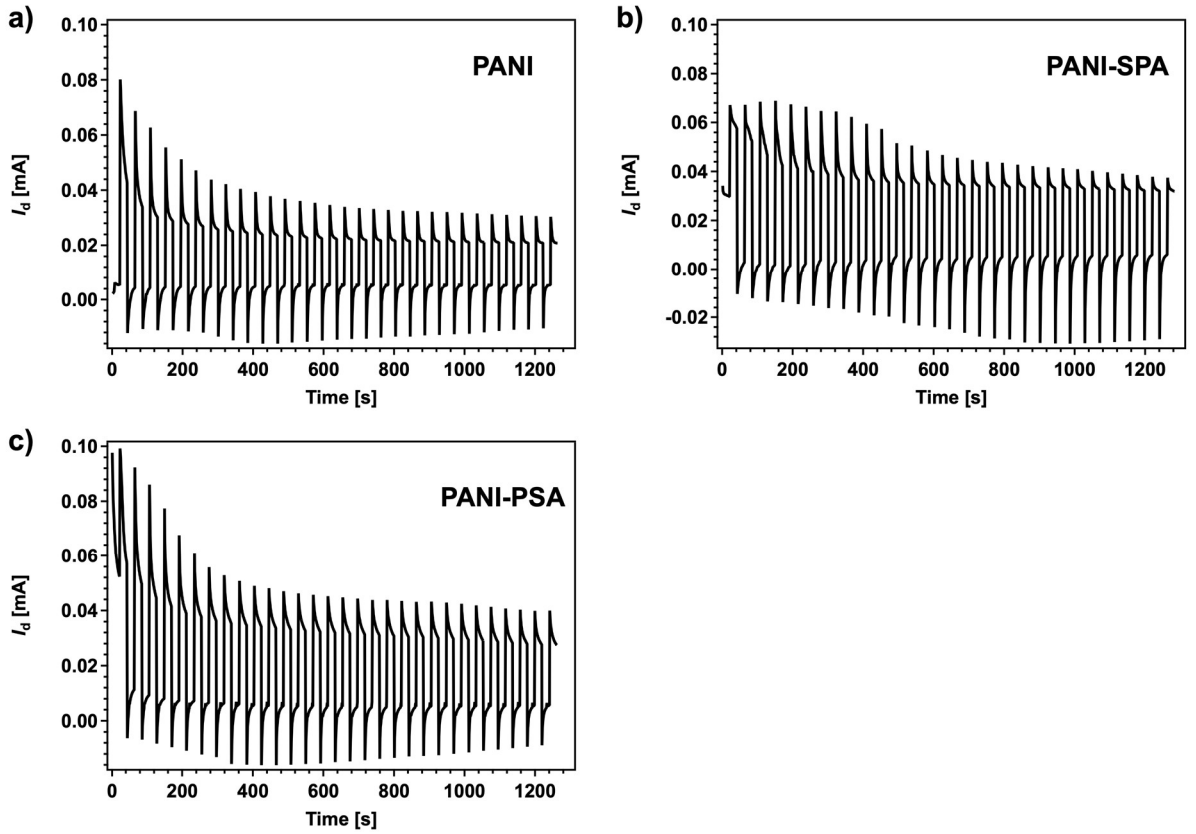

Fig. S4 Real-time drain current switching profiles under repeated on/off gate voltage cycles (0.5 V / 0 V) for a) **PANI**, b) **PANI-SPA**, and c) **PANI-PSA**. Measurements were performed under ambient conditions with a fixed drain voltage of −0.6 V. Each gate voltage cycle lasted 40 s (20 s on / 20 s off) and was repeated for a total duration of 1200 s.

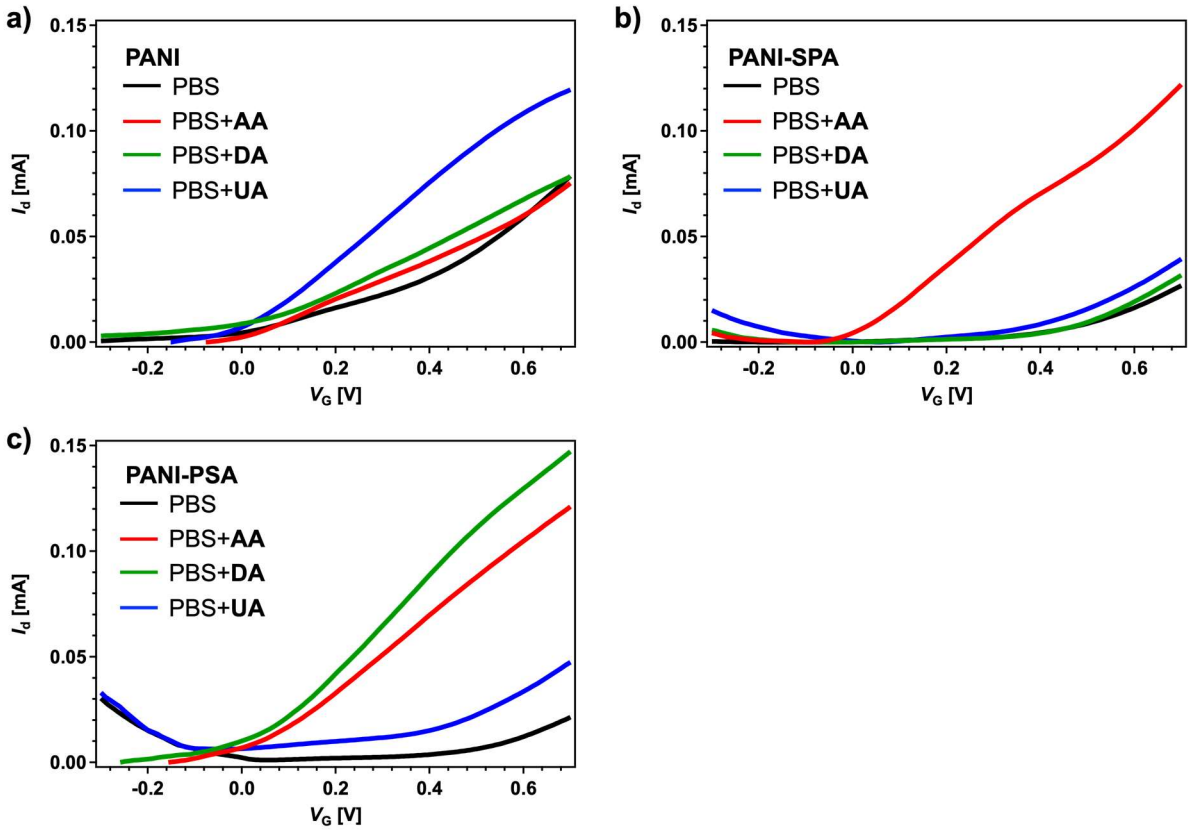

Fig. S5 Transfer curves of a) **PANI**, b) **PANI-SPA**, and c) **PANI-PSA** measured with/without biomolecules in 0.1 M phosphate-buffered saline (PBS, pH 7.0). The drain voltage was set to −0.6 V, and the gate voltage was swept from −0.3 V to 0.7 V.

Table S1 Maximum transconductance ($g_{m,max}$) and threshold voltage obtained from the transfer curves (Figure 5) in OECTs at a biomolecule concentration of 1 mM[a]

Channel materials	**Electrolytes**	$g_{m,max}$ **(mS)**	**Gate voltage at** $g_{m,max}$ **(V)**	**Threshold voltage (V)**
PANI	PBS	-	-	0.10
	PBS + **AA**	0.10	0.12	0.09
	PBS + **UA**	0.19	0.32	0.02
	PBS + **DA**	0.11	0.25	0.10
PANI-SPA	PBS	-	-	0.48
	PBS + **AA**	0.19	0.13	−0.12
	PBS + **UA**	0.15	0.71	0.31
	PBS + **DA**	0.13	0.66	0.49
PANI-PSA	PBS	-	-	0.57
	PBS + **AA**	0.19	0.35	0.03
	PBS + **UA**	0.15	0.65	0.20
	PBS + **DA**	0.24	0.34	−0.01

[a] Since the values in the table are averaged, there may be slight differences compared with those shown in Figure 5.

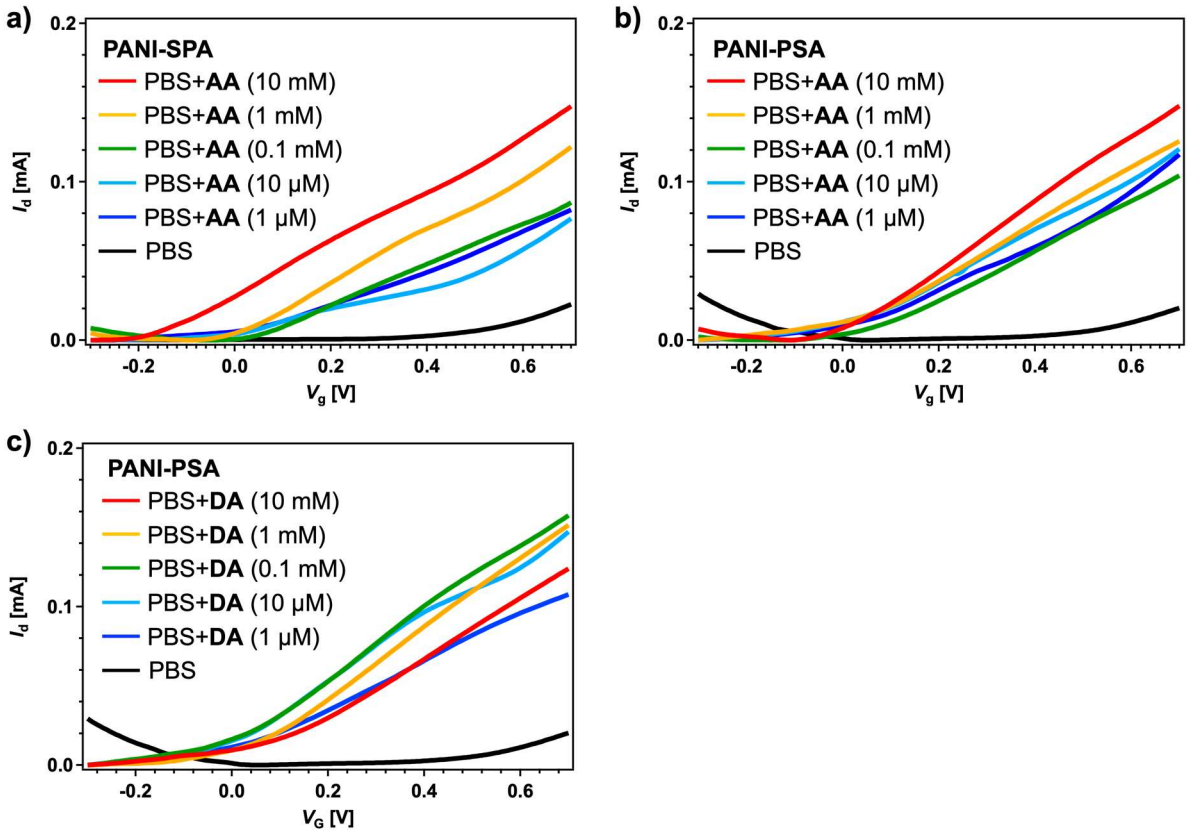

Fig. S6 Transfer curves of a) **PANI-SPA** with varying **AA** concentrations, and b,c) **PANI-PSA** with varying b) **AA** and c) **DA** concentrations. The **AA** or **DA** concentrations were 0 M, 1 µM, 10 µM, 0.1 mM, 1 mM, and 10 mM in 0.1 M PBS. Measurements were performed with a drain voltage of −0.6 V and a gate voltage sweep from −0.3 V to 0.7 V, demonstrating concentration-dependent modulation of channel conductivity.

Table S2 Maximum transconductance ($g_{m,max}$) and threshold voltage extracted from the transfer curves (Figure 6) in OECTs[a]

Channel materials	**Electrolytes**	$g_{m,max}$ **(mS)**	**Gate voltage at** $g_{m,max}$ **(V)**	**Threshold voltage (V)**
PANI-SPA	PBS	-	-	0.48
	PBS + **AA** (1 μM)	0.11	0.14	−0.01
	PBS + **AA** (10 μM)	0.10	0.08	0.03
	PBS + **AA** (100 μM)	0.15	0.15	−0.04
	PBS + **AA** (1 mM)	0.19	0.13	−0.12
	PBS + **AA** (10 mM)	0.19	0.08	−0.26
PANI-PSA	PBS	-	-	0.57
	PBS + **AA** (1 μM)	0.16	0.17	0.02
	PBS + **AA** (10 μM)	0.18	0.19	0.03
	PBS + **AA** (100 μM)	0.17	0.36	0.05
	PBS + **AA** (1 mM)	0.19	0.35	0.03
	PBS + **AA** (10 mM)	0.23	0.27	−0.11
PANI-PSA	PBS	-	-	0.57
	PBS + **DA** (1 μM)	0.17	0.35	−0.03
	PBS + **DA** (10 μM)	0.24	0.26	0.01
	PBS + **DA** (100 μM)	0.25	0.26	0.02
	PBS + **DA** (1 mM)	0.24	0.29	−0.01
	PBS + **DA** (10 mM)	0.20	0.37	0.03

[a] Since the values in the table are averaged, there may be slight differences compared with those shown in Figure 6.

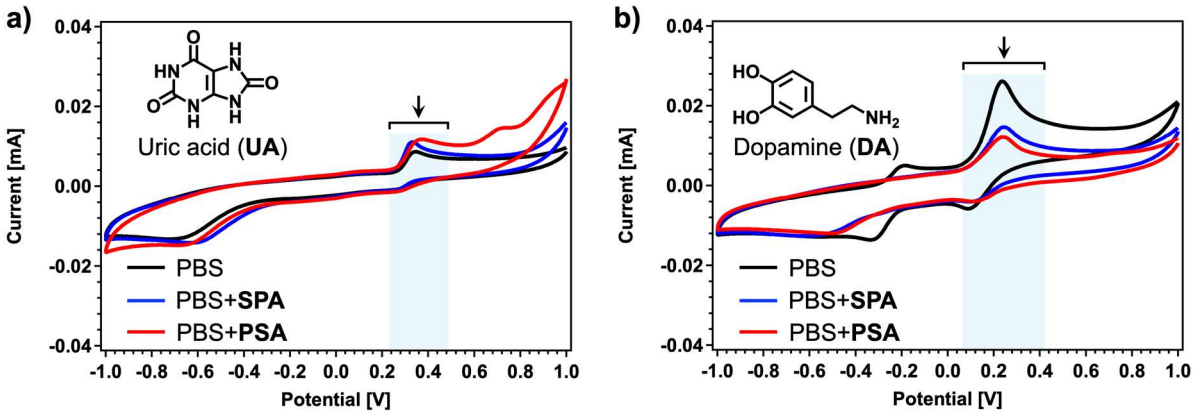

Fig. S7 Cyclic voltammograms of electrolytes containing a) 1 mM **UA** and b) 1 mM **DA**, measured in PBS (black), PBS + **SPA** (blue), and PBS + **PSA** (red). Conditions: scanning range −1.0 to 1.0 V, scan rate 50 mV s^{-1}. The cyclic voltammograms correspond to the second cycle after stabilization during the first scan.

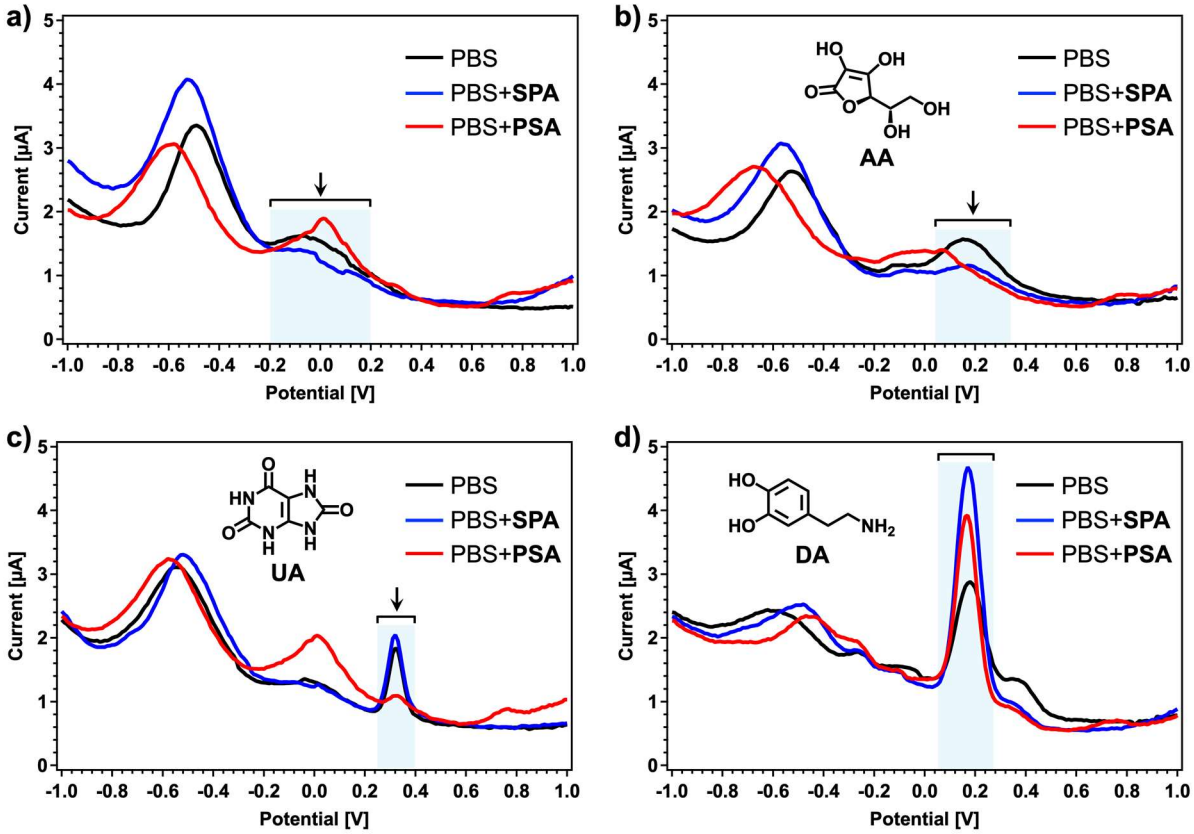

Fig. S8 Differential pulse voltammograms of electrolytes containing a) only PBS, b) **AA** (1 mM), c) **UA** (1 mM), and d) **DA** (1 mM) in PBS (black), PBS + **SPA** (blue), and PBS + **PSA** (red). Measurements were carried out over the potential range −1.0 to 1.0 V with a step potential of 10 mV s^{-1}, amplitude 0.025 V, pulse width 0.06 ms, and pulse interval 0.5 s.

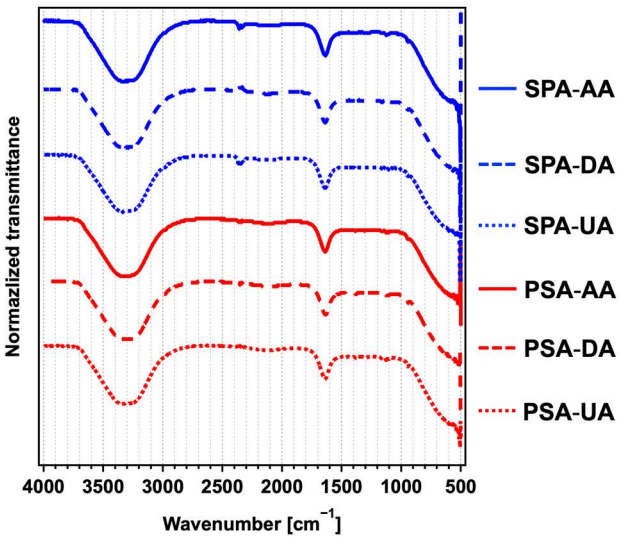

Fig. S9 Full FT-IR spectra of biomolecule-sulfonic acid mixtures in deionized water.

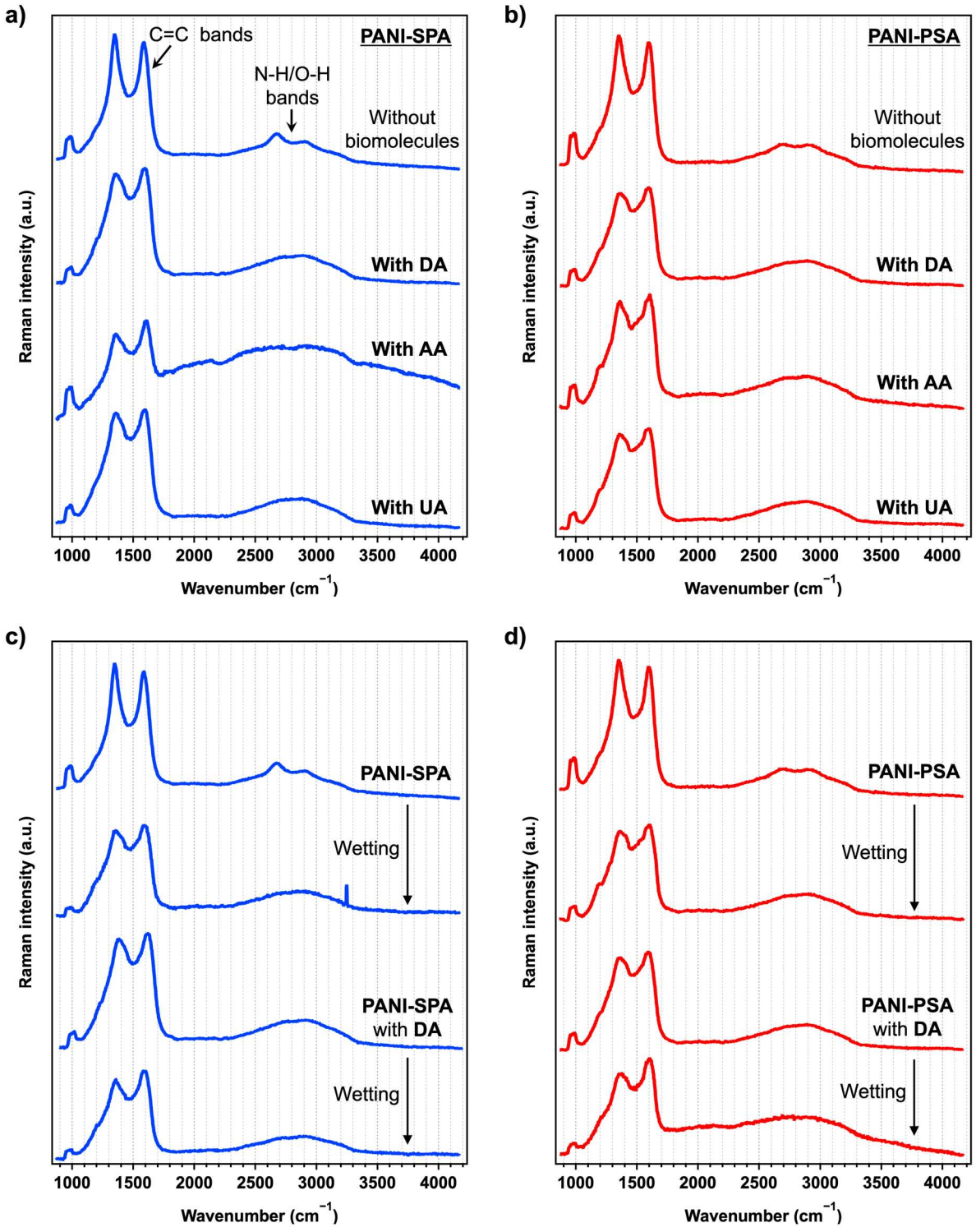

Fig. S10 Raman spectra of (a,c) **PANI-SPA** and (b,d) **PANI-PSA**. The measured films with biomolecules were prepared by dropping them into the aqueous solution followed by annealing at 130 °C for 5 min. For the spectra shown in (c) and (d), films were wetted by exposing them to water vapor. The excitation laser wavelength was 532 nm.