Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Bipolar electrodeposition of organic electrochemical transistor arrays

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The experimental setup and characterizations

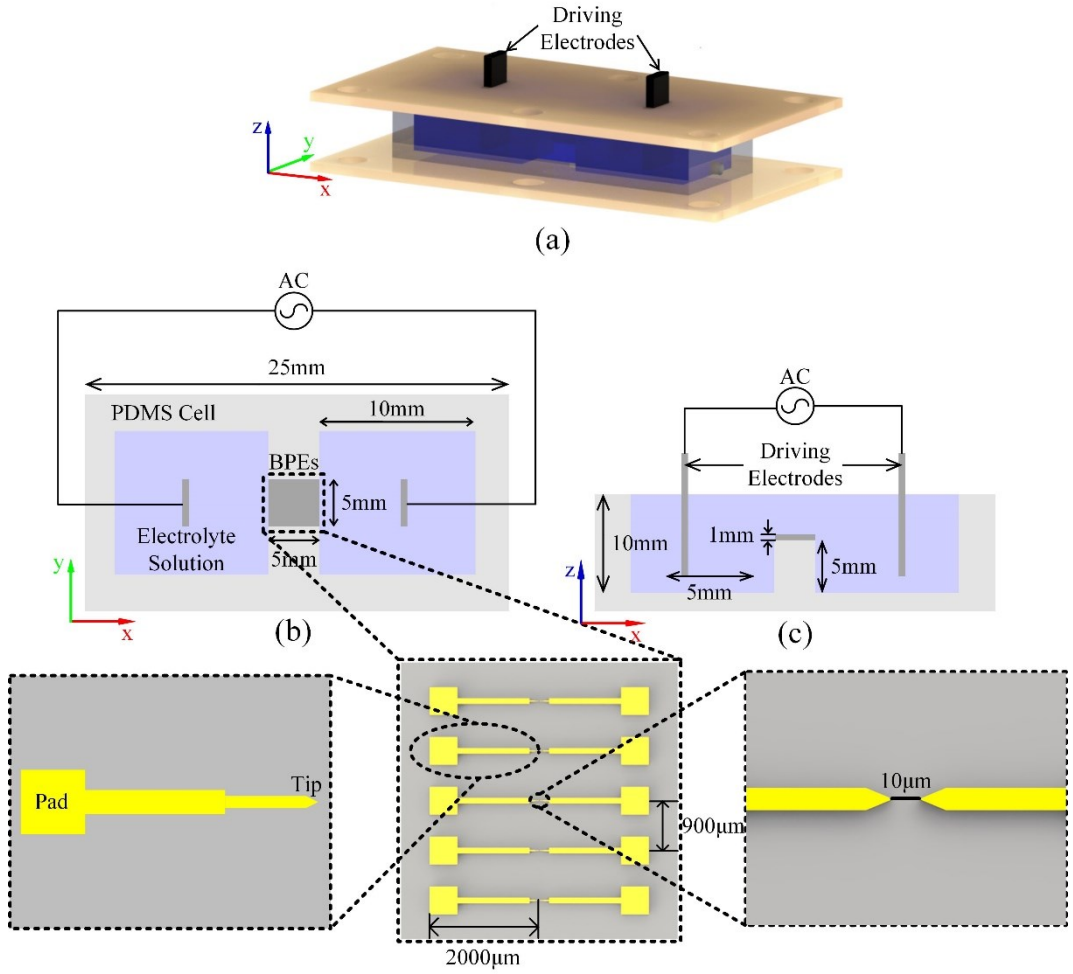


Figure S1. Illustrations of the experimental setup for alternating current bipolar electrodepositions (AC-BED). (a) The scheme of the microfluid chip. (b) Dimensions in the top view. (c) Dimensions in the side view.

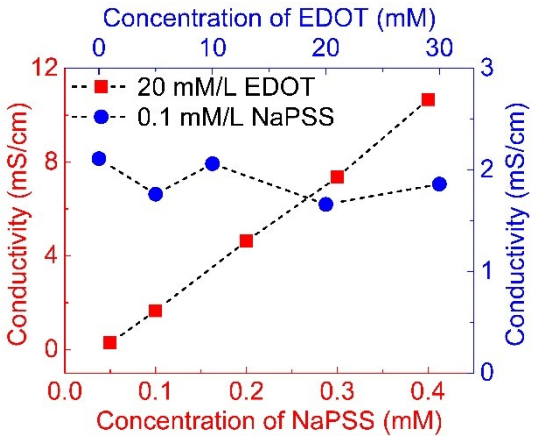


Figure S2. Electrolyte conductivities versus the concentration of EDOT and NaPSS. Red squares were obtained by fixing the concentration of EDOT at 2×10^4 μM. Blue circles were obtained by fixing the concentration of NaPSS at 10^2 μM. The dashed lines are guides to aid visualization.

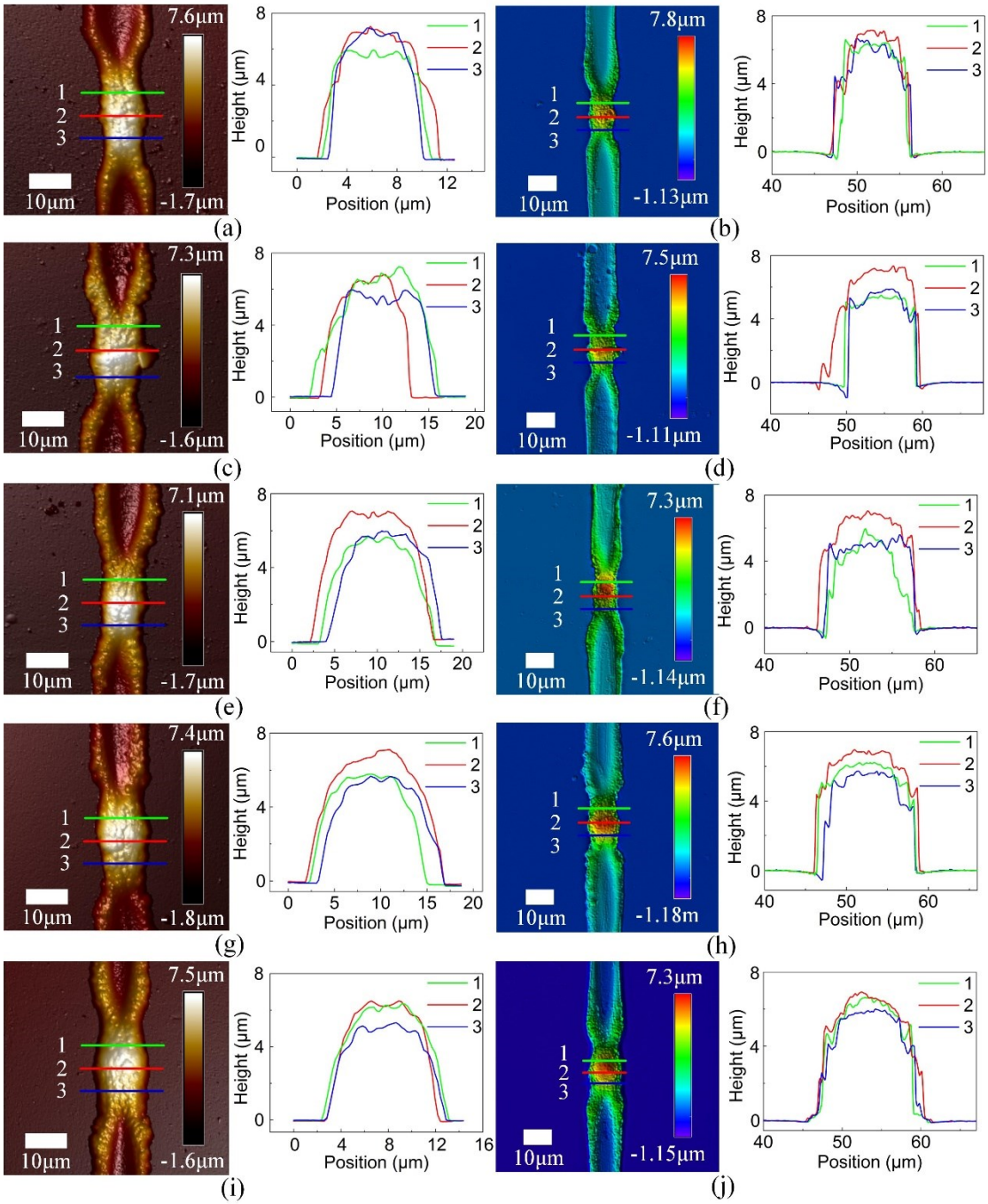


Figure S3. Film morphologies and profiles obtained by the atomic force microscope (AFM) and the laser confocal scanning microscope (LCSM).

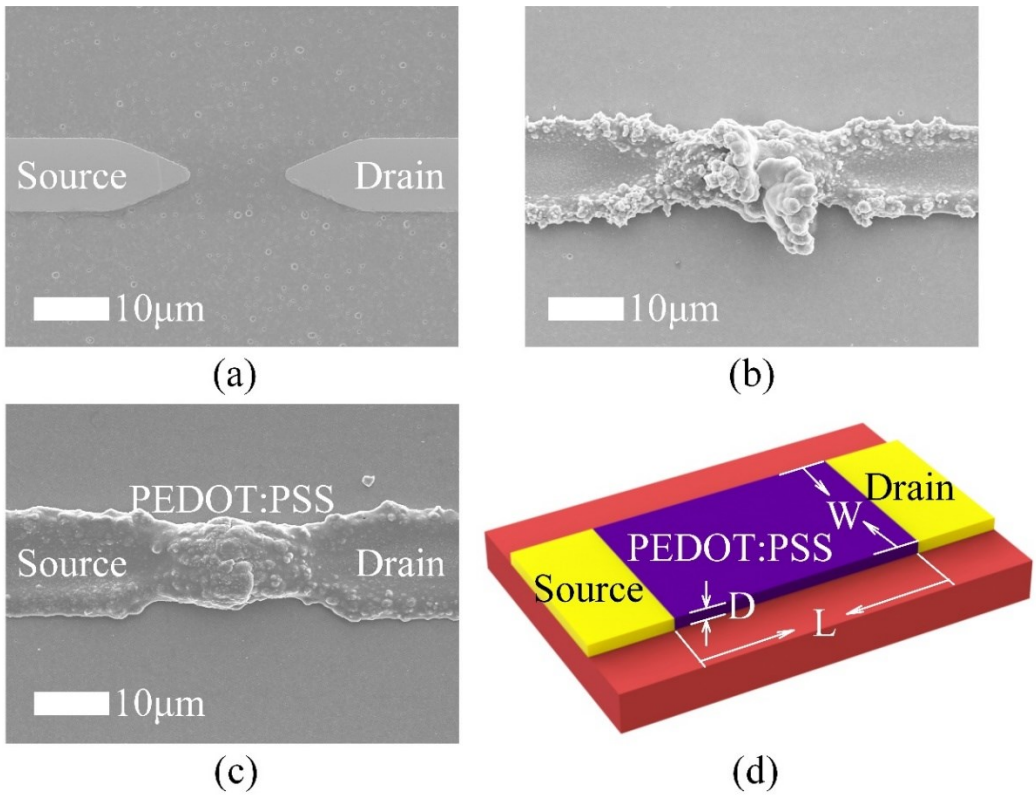


Figure S4. Morphologies of electrodes and electrodeposited films. (a) The scanning electron microscope (SEM) image of electrodes without electrodeposition. (b) and (c) SEM images of electrodes electrodeposited with PEDOT:PSS films. The preparation parameter for (b) was 16 $V_{p\text{-}p}$ at 20 Hz (undesired); for (c) 16 $V_{p\text{-}p}$ at 50 Hz; (d) The definitions of W and D of PEDOT:PSS layer.

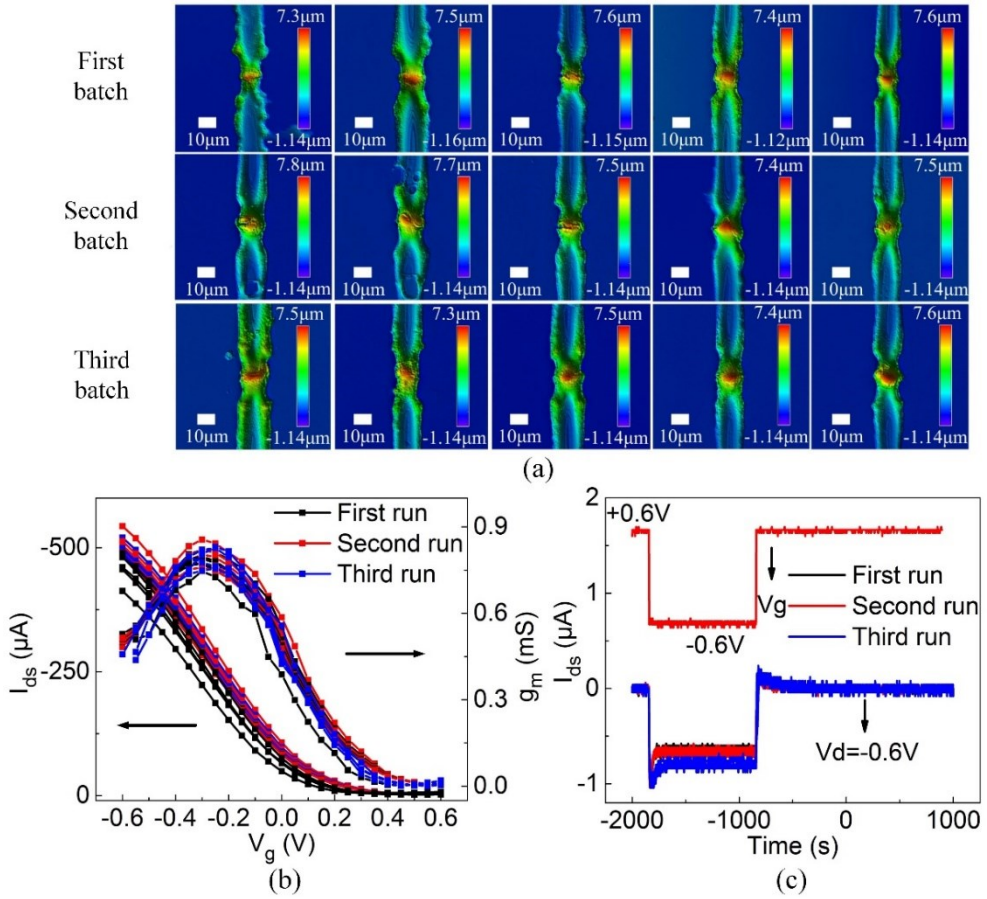


Figure S5. Semiconducting films fabricated by AC-BED in three batches. (a) The LCSM images. (b) The transfer and transconductance curves. (c) The transient responses.

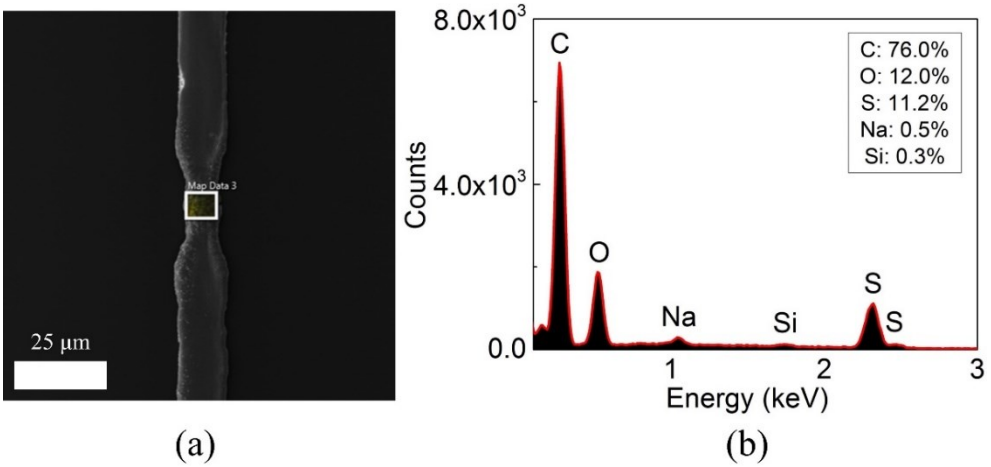


Figure S6. The elemental analysis of as-prepared PEDOT:PSS film, which indicates the residual of sodium cations. (a) The SEM image. (b) The energy dispersive spectrometry spectrum.

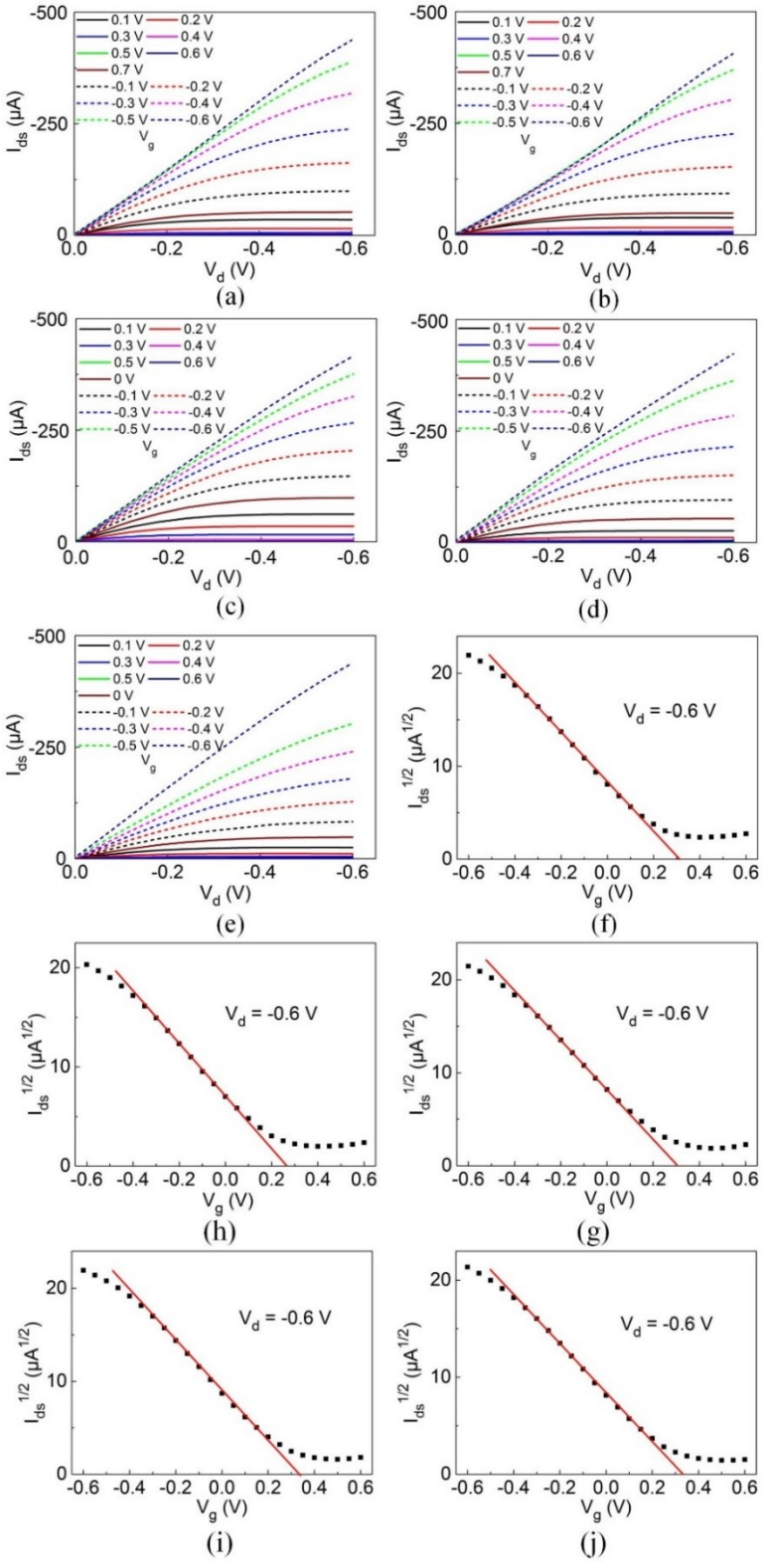


Figure S7. Steady-state characteristic curves of OECTs. The output curves (a–e) and the diagrams of $I_{ds}^{1/2}$ versus V_g (f–j) of five transistors fabricated in the first run. The corresponding film morphologies and profiles are shown in Figures 2(b) and S3.

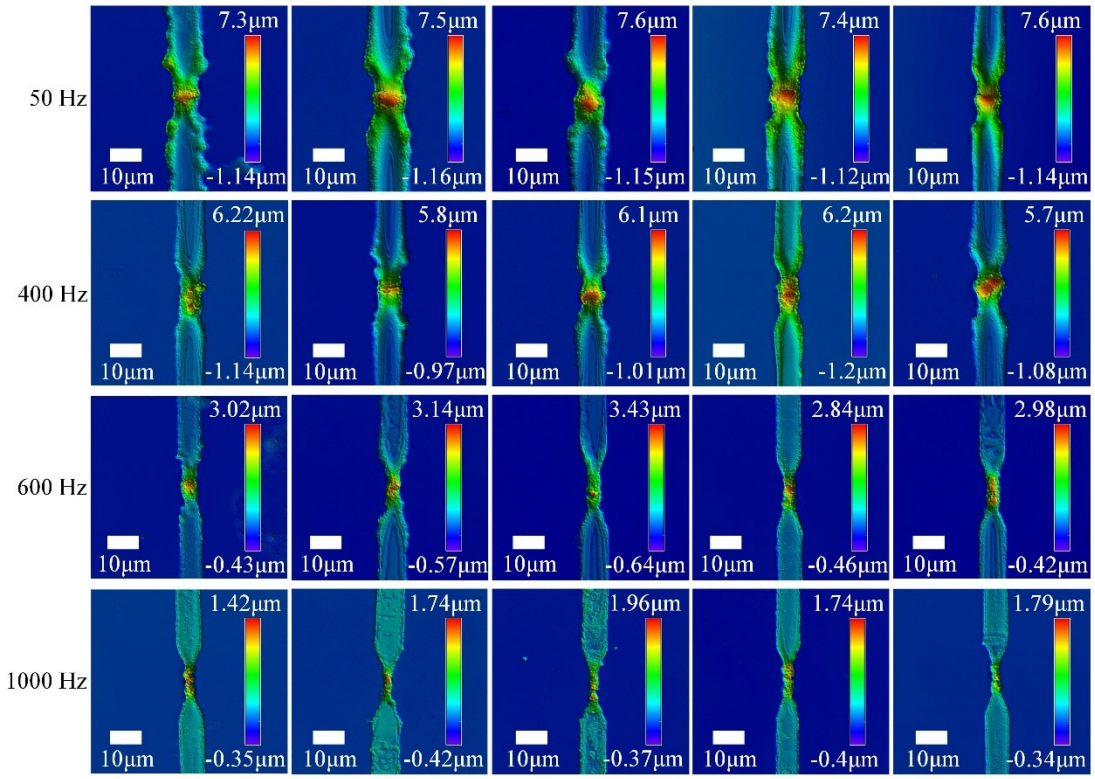


Figure S8. The LCSM image of PEDOT:PSS films prepared by different frequencies. The geometry parameters are reported in Figure 3(a).

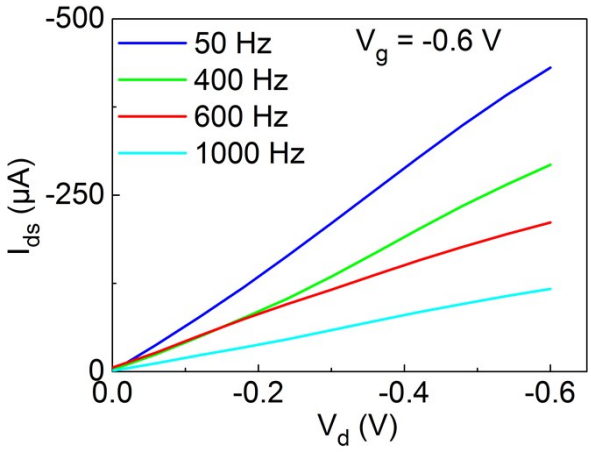


Figure S9. The output characteristic curve of OECTs (V_g=-0.6V) which was prepared using different freque

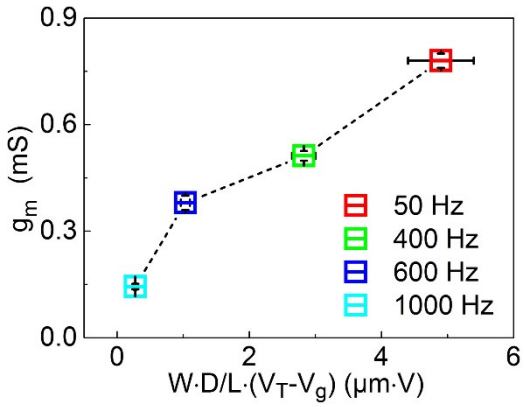
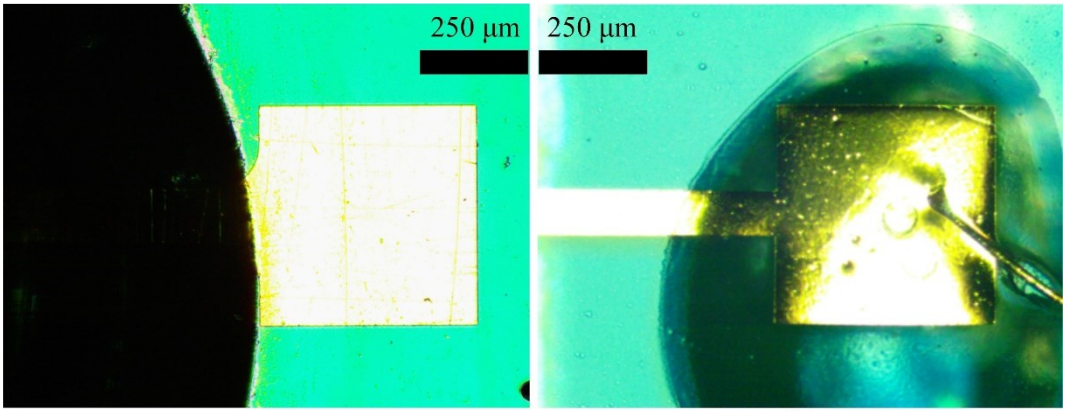


Figure S10. According to the Bernards-Malliaras model[1, 2], g_m of the OECT could de represented as $\mu \cdot C^* \cdot W \cdot D/L \cdot (V_T - V_g)$ in the saturation region. Thus, $\mu \cdot C^*$ can be obtained by fitting the diagram of g_m versus $W \cdot D/L \cdot (V_T - V_g)$. Here, the fitting result of $\mu \cdot C^*$ was 1.3±0.1 $Fcm^{-1}V^{-1}S^{-1}$.



(a) (b)

Figure S11. Using the UV-sensitive glue to define the exposure area for electrochemical impedance spectrum (EIS) tests. (a) The target area is a pad. (b) The target area is a tip.

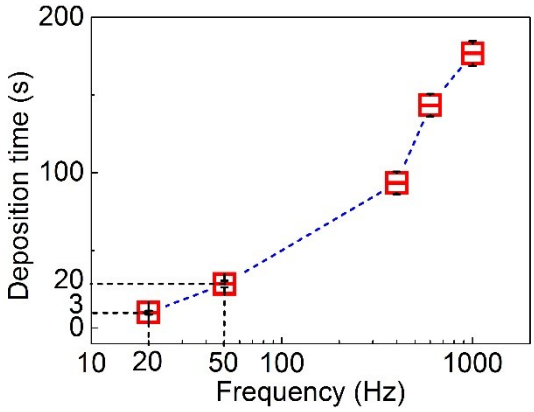


Figure S12. The plot of the deposition time versus the AC frequency, n=3 for the standard error bar.

Table S1. The fitting results of Figure 4(a)–4(c).

	R_S (Ω)	R_{ct} (Ω)	Q ($FS^{(\alpha-1)}$)	α	C_{eff} (F)
Electrolyte/Driving electrode	28	6.5×10^4	3.3×10^{-5}	0.7	4.5×10^{-6}
Electrolyte/BPE pad	14	6.9×10^4	2.2 × 10-5	0.9	9.0×10^{-6}
Electrolyte/BPE tip	24	2.9×10^5	1.6×10^{-5}	0.85	4.0×10^{-6}

REFERENCE:

1. J. T. Friedlein, R. R. McLeod and J. Rivnay, *Organic Electronics*, 2018, **63**, 398-414.
2. D. A. Bernards and G. G. Malliaras, *Advanced Functional Materials*, 2007, **17**, 3538-3544.