

# Supplementary Information

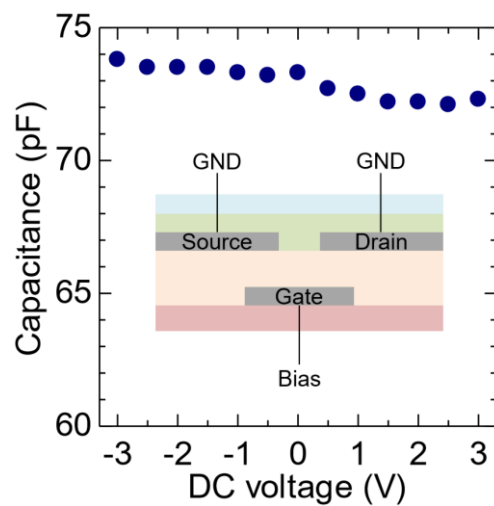
## A Printed Organic Amplification System for Wearable Potentiometric Electrochemical Sensors

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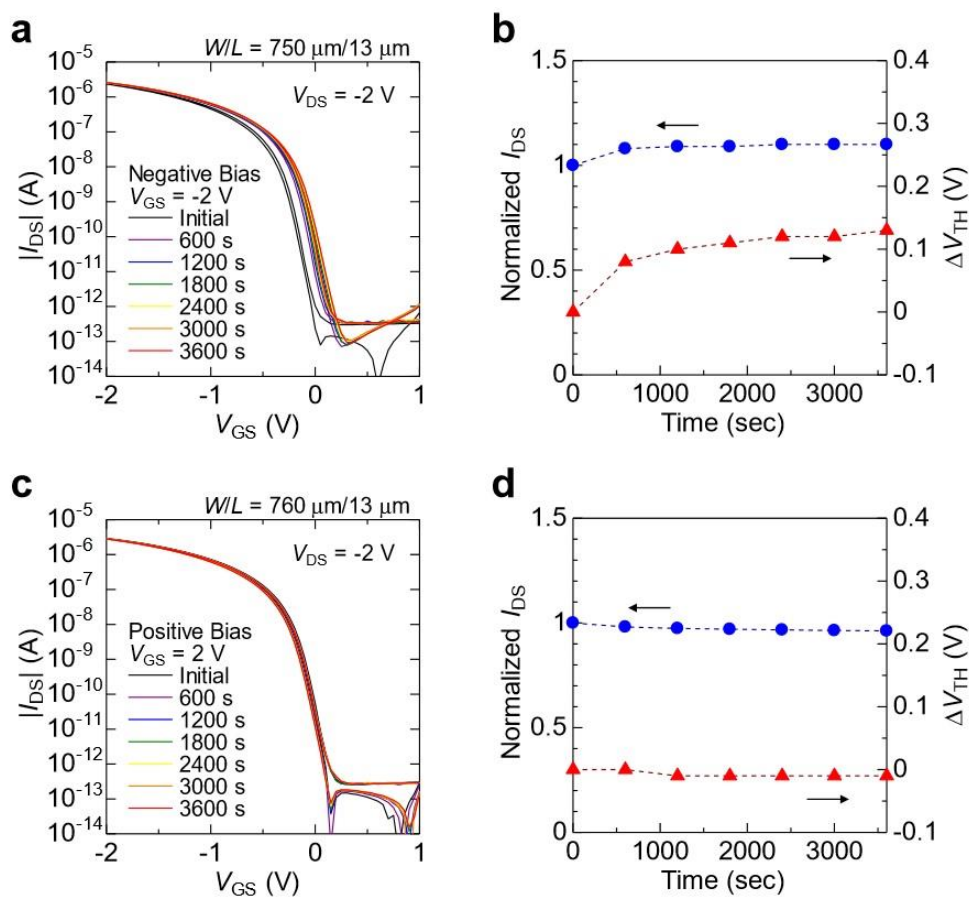
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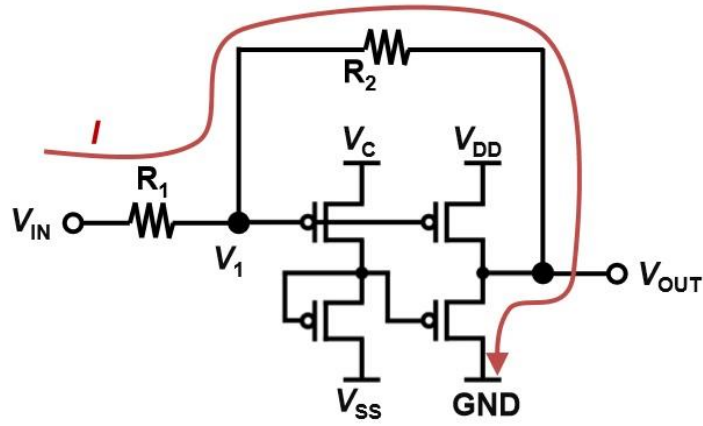
**Figure S1. CV characteristics of the DTBBDT-C<sub>6</sub>:PS blend-based TFTs.**

Each plot was measured at a frequency of 100 Hz. Gate overlap area was 0.3 mm<sup>2</sup>. The channel width ( $W$ ) and length ( $L$ ) were 740  $\mu\text{m}$  and 11  $\mu\text{m}$ , respectively.



**Figure S2. DTBDT-C<sub>6</sub>:PS blend TFT stability under gate-bias stress.**

Transfer curves under (a) negative and (c) positive gate-bias stress. Normalized drain-source current and threshold voltage shift under (b) negative and (d) positive gate-bias stress.



**Figure S3. Amplification unit circuit diagram using a pseudo-CMOS logic design.**

A single path for current flow ( $I$ ). Here, the relation between  $V_{OUT}$  and  $V_{IN}$  is shown below.

Taking the voltage drops at each of the section into consideration, following equations can be obtained:

$$V_{OUT} - V_M = -A_{open}(V_1 - V_M), \quad (S1)$$

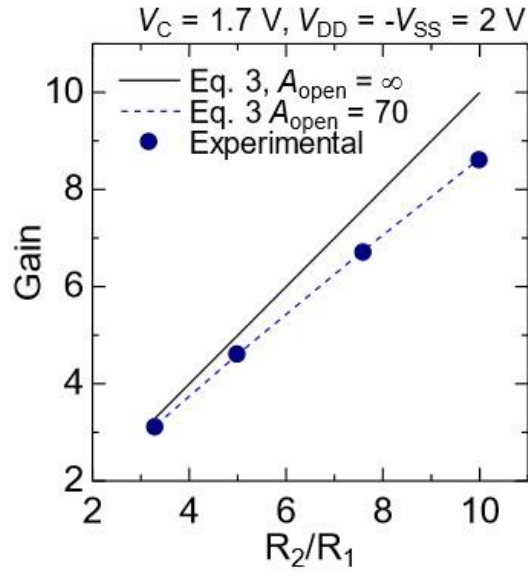
$$V_{IN} - V_1 = R_1 I, \quad (S2)$$

$$V_1 - V_{OUT} = R_2 I, \quad (S3)$$

where  $V_M$  and  $A_{open}$  is the switching voltage and the open-loop gain of the inverter,

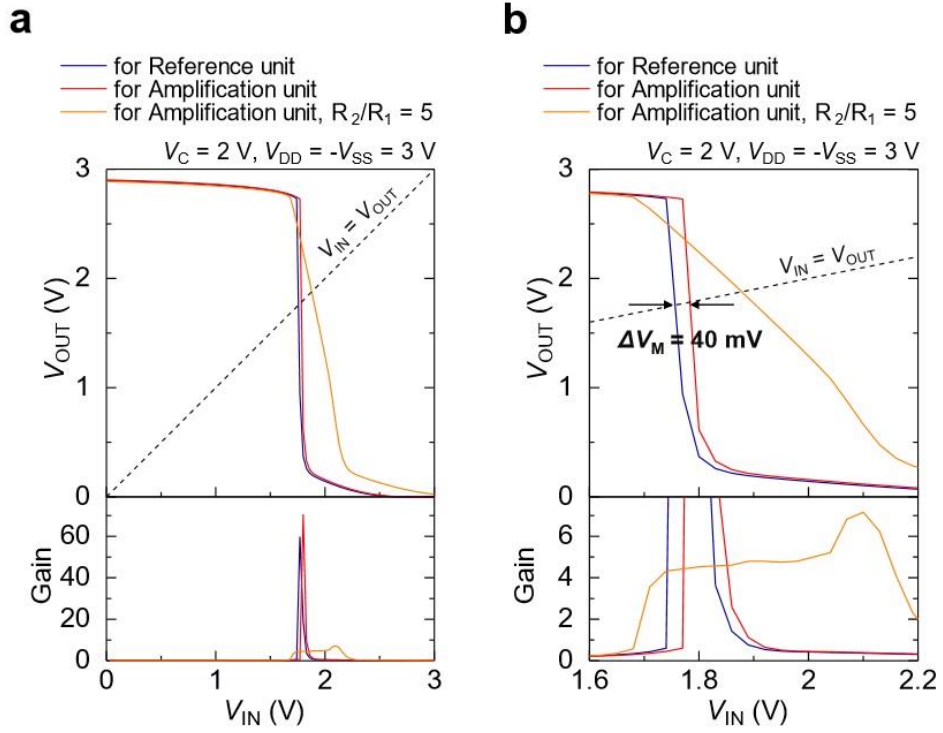
respectively. Removing  $V_1$  and  $I$ ,  $V_{OUT}$  is finally expressed as:

$$V_{OUT} = V_M - \frac{R_2}{R_1 + \frac{R_1 + R_2}{A_{open}}}(V_{IN} - V_M), \quad (S4)$$



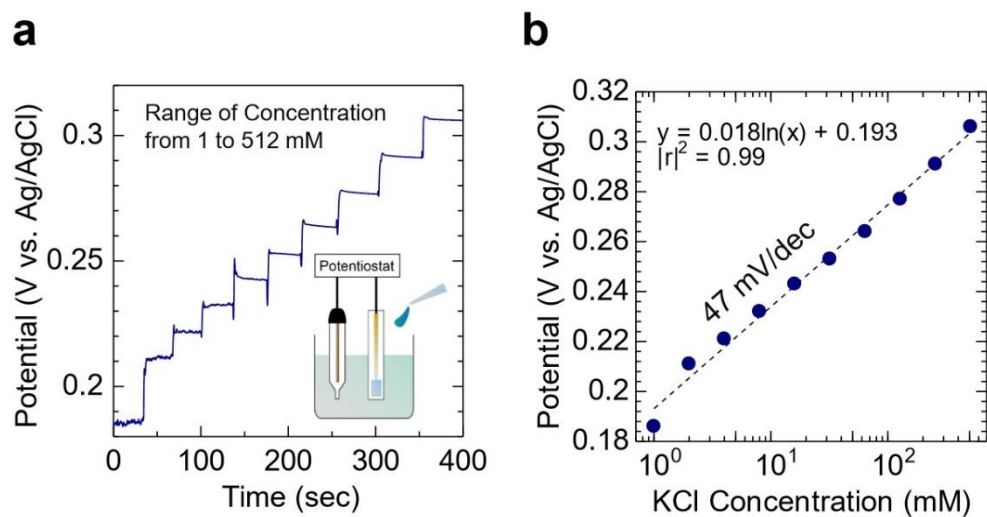
**Figure S4. Calculated vs. experimental gain comparisons.**

Gain calculated from Eq. 3 and from experiment measurements, as a function of the resistance ratio.

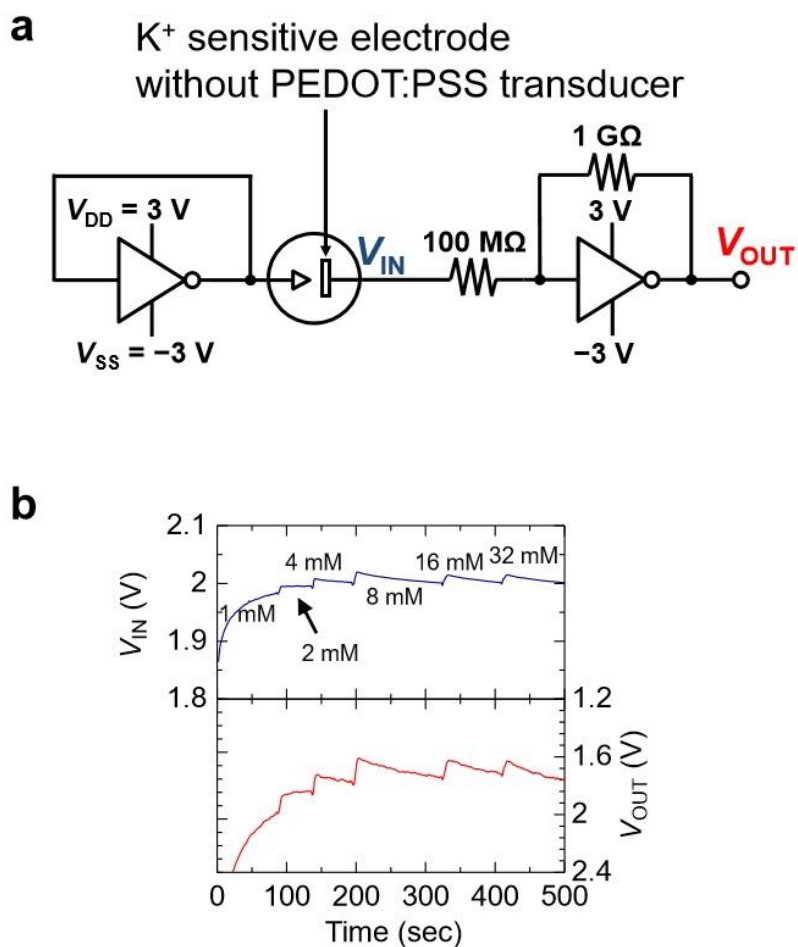


**Figure S5. Input-output characteristics of the inverter pair that was used for the  $K^+$  sensing system.**

(a)  $V_{OUT}$  and gain as a function of  $V_{IN}$ . (b) Magnified characteristics of (a). The difference between the reference and amplification inverters was 40 mV, which was less than the  $K^+$  sensor signal of 70 mV.



**Figure S6. Potentiometric curve of  $K^+$  sensor without a PEDOT:PSS ion-electron transducer.** (a) The open circuit potential responses of  $K^+$  sensor without a PEDOT:PSS layer. (b) Potential plots extracted from (a) as a function of KCl concentration (1 to 512 mM).



**Figure S7. Amplification of small signals from a  $K^+$  sensor without ion-electron transducer.** (a) Circuit diagram of the amplifier. Supply voltage ( $V_{DD} = -V_{SS}$ ) and control voltage ( $V_C$ ) of the reference inverter and the amplification inverter were set to 3 V and 2 V, respectively. (b) Input voltage ( $V_{IN}$ ) and output ( $V_{OUT}$ ) from the amplifier system. The voltages were not stable owing to the current flow through the ion-sensitive electrode (ISE).