

# **Interfacial charge doping effect in C8-DNTT/PDIF-CN<sub>2</sub> heterojunction field-effect transistors**

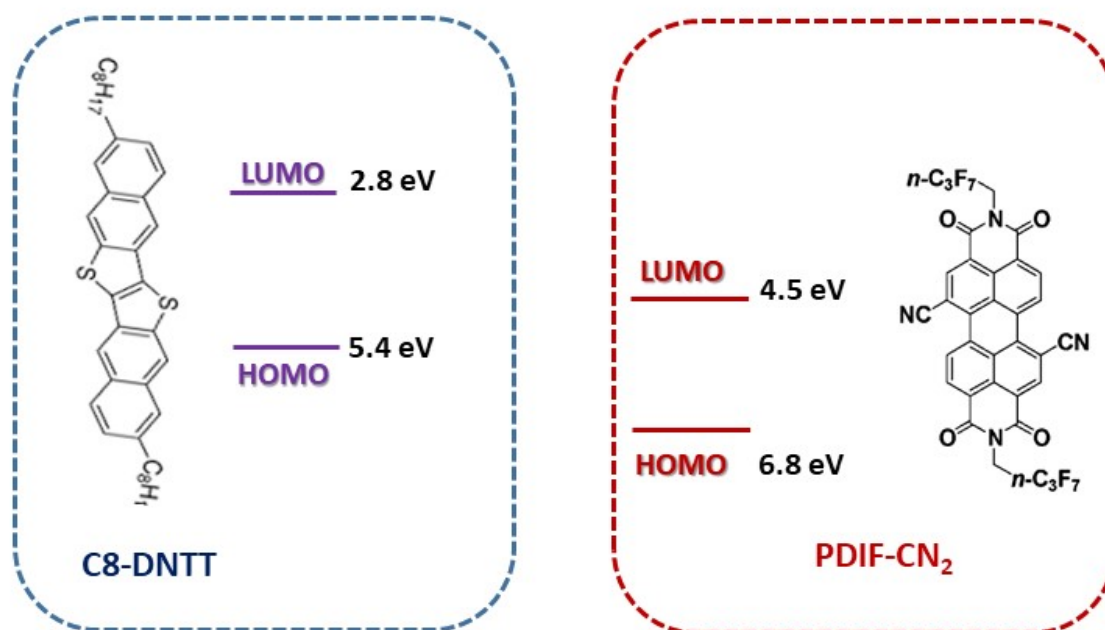
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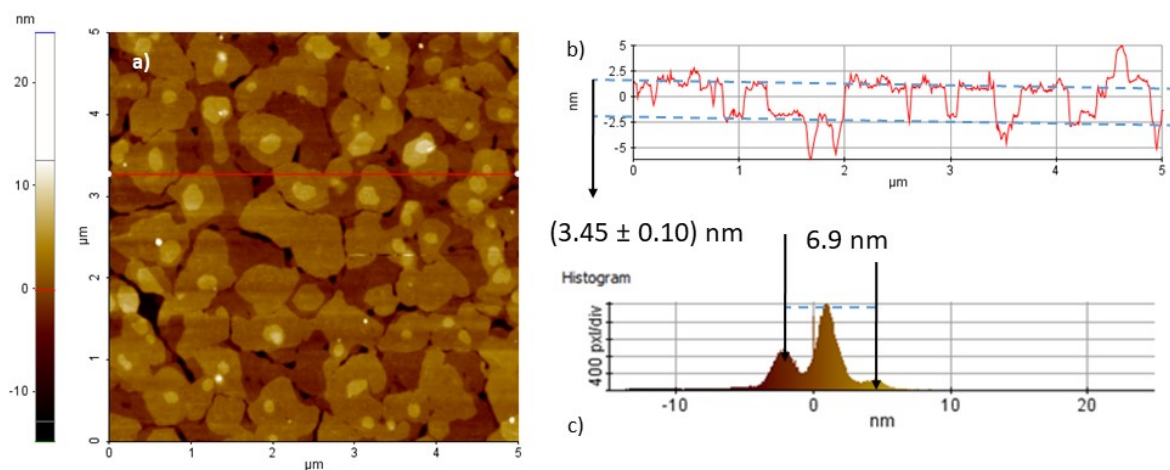
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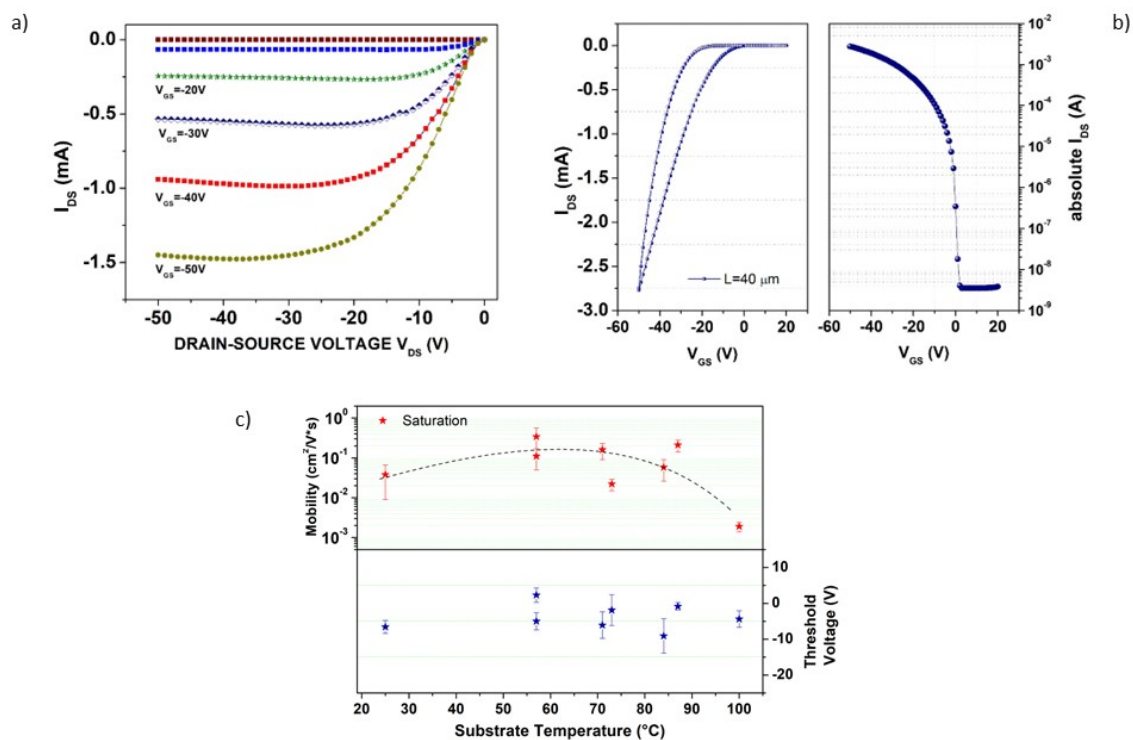
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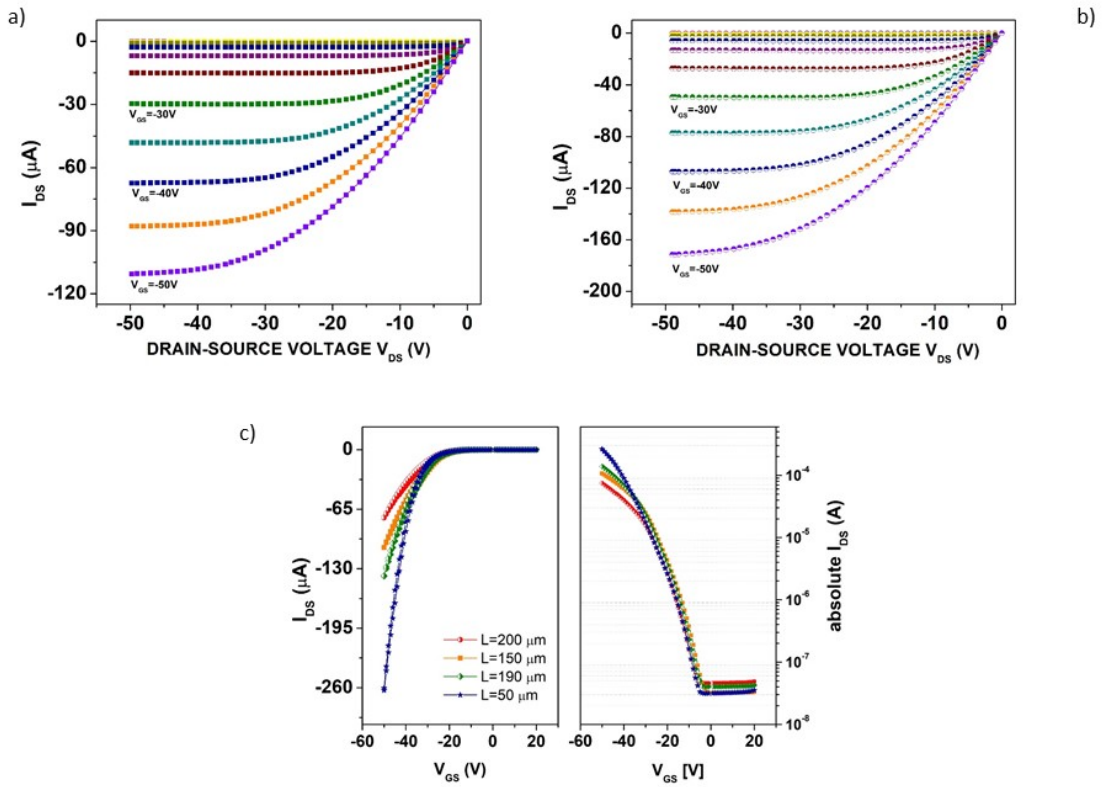
**Figure S1** Molecular structures of C8-DNTT and PDIF-CN<sub>2</sub> with the corresponding HOMO and LUMO levels.



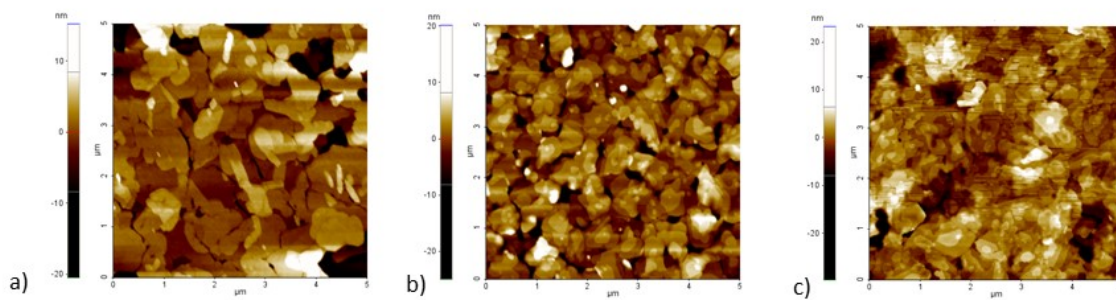
**Figure S2** a) AFM image ( $5 \times 5 \mu\text{m}^2$ ) of a 15 nm thick C8-DNTT film grown on HMDS-functionalized  $\text{SiO}_2$ ; b) acquired profile at line 335 (see red line in the image), an average of the terrace steps evidenced with the dashed blue lines, measured line by line is  $(3.45 \pm 0.10) \text{ nm}$ ; c) histogram of the height distribution referred to the whole image in (a).



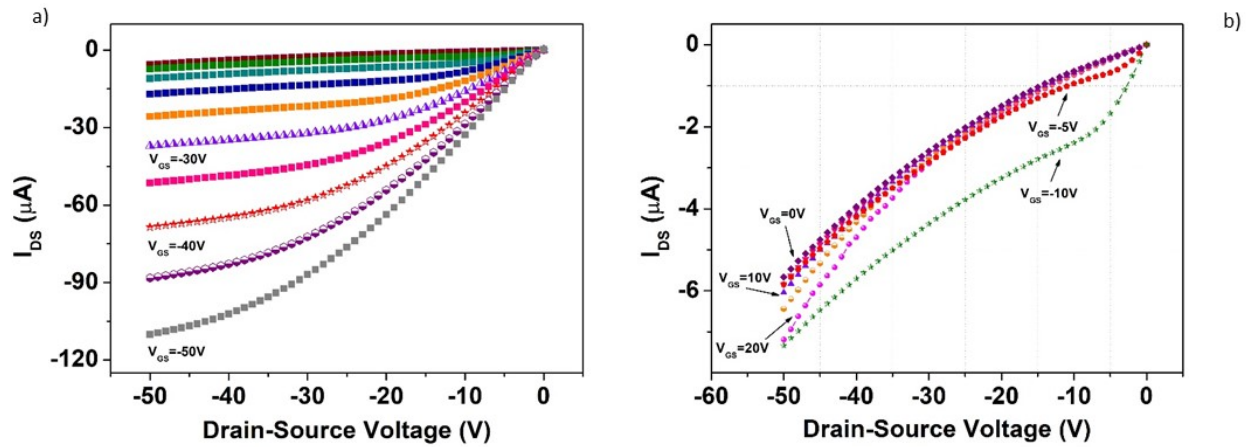
**Figure S3** Electrical response of bottom-contact C8-DNTT transistors: a) output curves and b) transfer-curves measured for a device with channel length  $L=40 \mu m$ ; c) mobility and threshold voltage values extracted in the saturation regime ( $V_{DS}=-50 V$ ) as a function of the substrate temperature ( $T_{sub}$ ) held during the C8-DNTT evaporation.



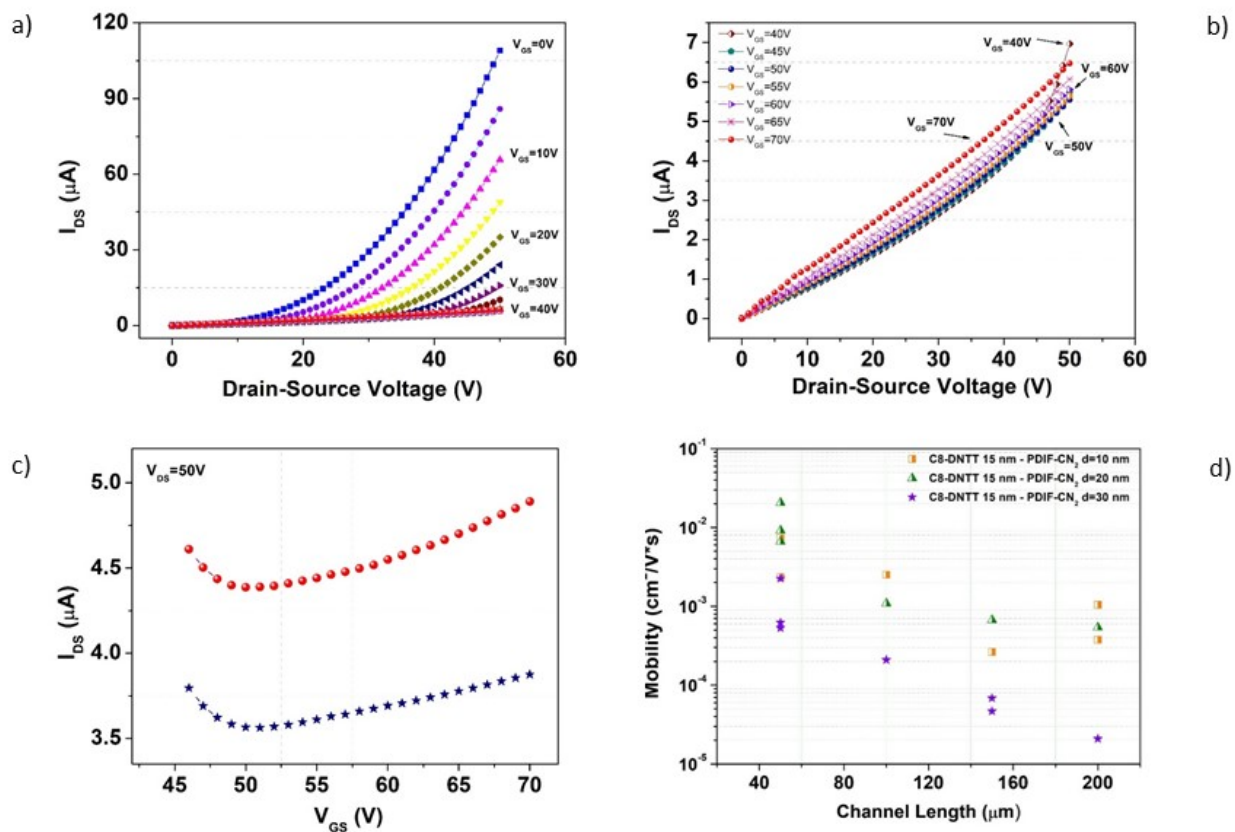
**Figure S4** Electrical response of top-contact C8-DNTT single-layer transistors with 15 nm thick active channels deposited at  $T_{\text{sub}} = 85^\circ\text{C}$ : output curves of devices with channel length (a)  $L = 100$  and (b)  $150 \mu\text{m}$ ; c) transfer-curves measured in the saturation regime ( $V_{DS} = -50\text{V}$ ) for devices having different channel length.



**Figure S5** AFM images ( $5 \times 5 \mu\text{m}^2$ ): a) surface of a 15 nm thick C8-DNTT film grown on HMDS-treated  $\text{SiO}_2$ ; b) and c) surfaces of a 20 nm thick PDIF-CN<sub>2</sub> film grown on HMDS-treated  $\text{SiO}_2$  and C8-DNTT bottom layer, respectively. C8-DNTT and PDIF-CN<sub>2</sub> were sequentially deposited with the substrate temperature held at  $T_{\text{sub}}=85 \text{ }^\circ\text{C}$  and  $T_{\text{sub}}=100 \text{ }^\circ\text{C}$ , respectively.

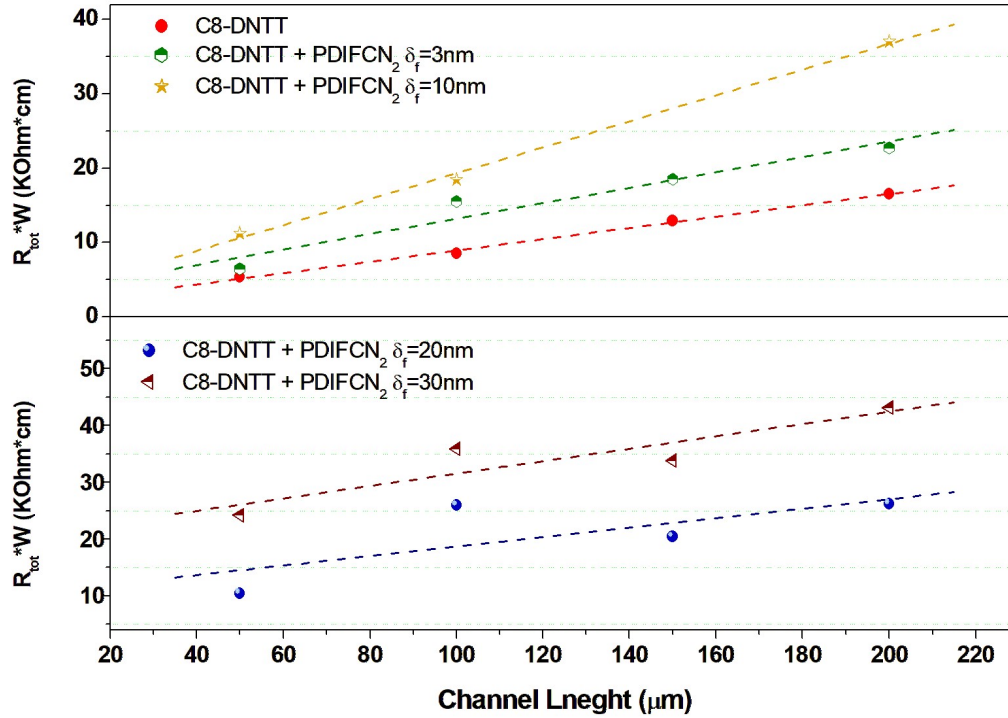


**Figure S6** a) Output curves measured in the hole accumulation region for a C8-DNTT (15 nm) /PDIF-CN<sub>2</sub> (20 nm) heterojunction transistor with active channel deposited at  $T_{\text{sub}}=85$  °C and channel length  $L=100$   $\mu\text{m}$ ; b) zoomed view of the output curves shown in (a) and recorded for  $V_{GS}$  voltages between 20 and -10 V.

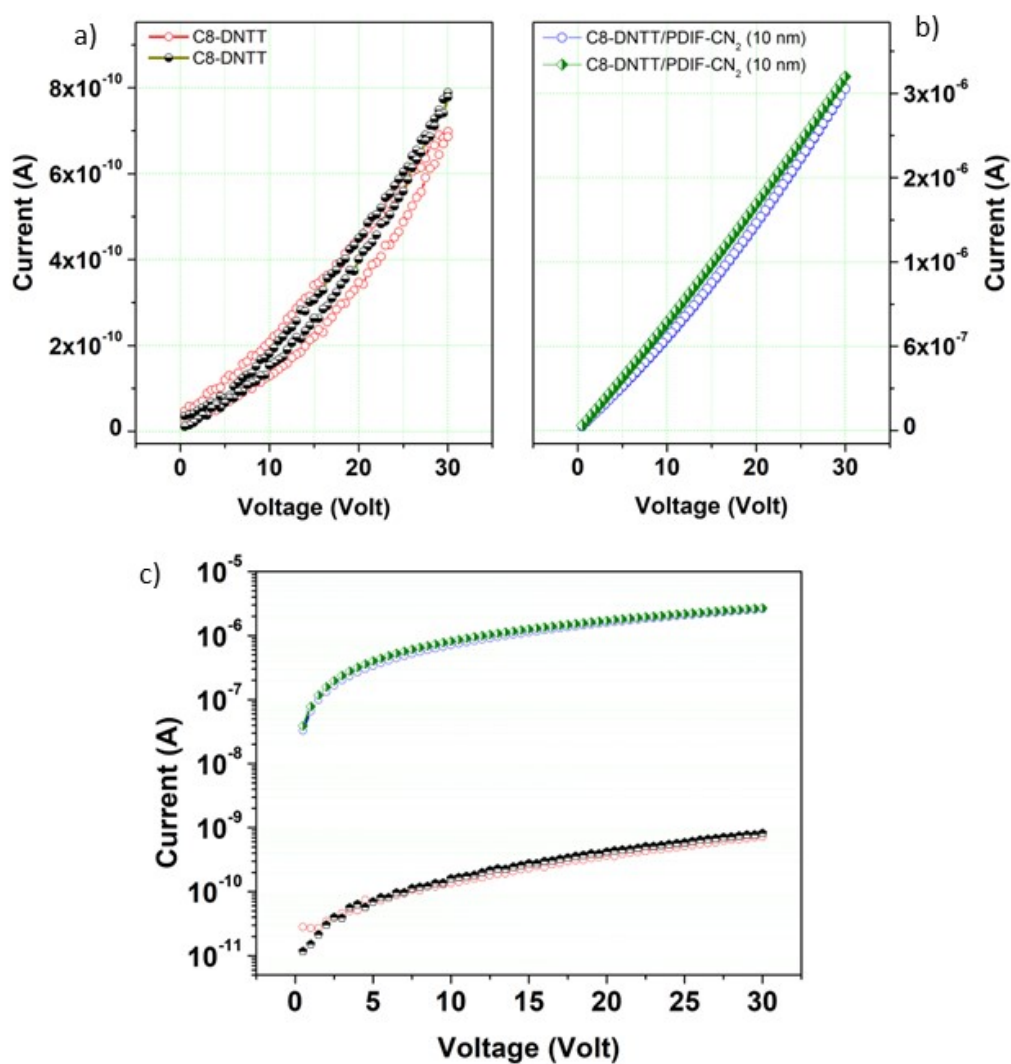


**Figure S7** a) Output curves measured in the electron accumulation region for a C8-DNTT (15 nm) /PDIF-CN<sub>2</sub> (20 nm) heterojunction transistor with active channel deposited at  $T_{\text{sub}}=85^\circ\text{C}$  and channel length  $L=100\ \mu\text{m}$ ; b) zoomed view of the output curves recorded in (a) for  $V_{\text{GS}}$  voltages ranging between 40 and 70 V; c) typical transfer-curves recorded in the electron accumulation region ( $V_{\text{DS}}=50\text{V}$ ); d) a set of mobility values extracted in the electron accumulation region as a function of the transistor channel length.

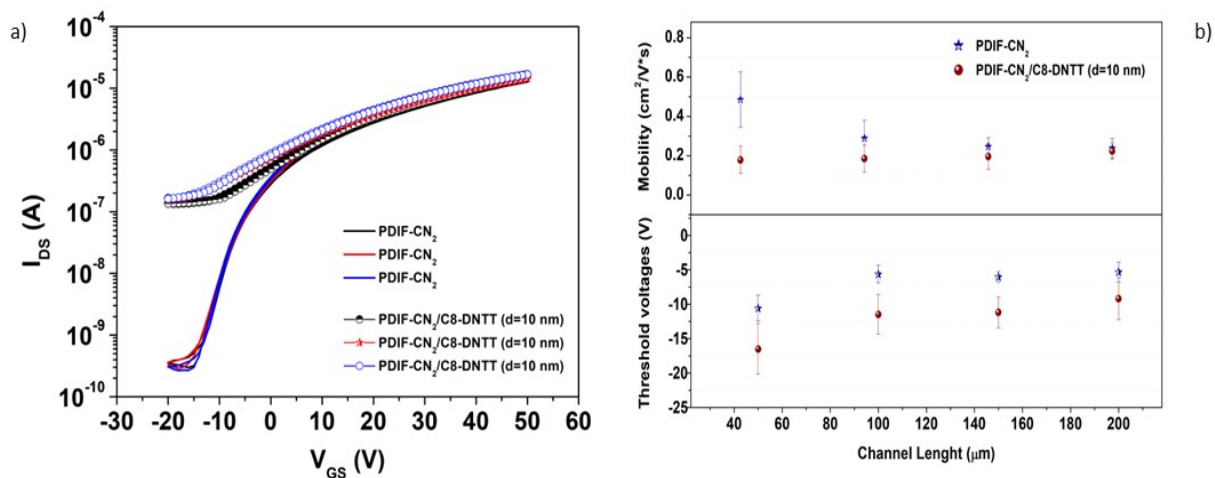




**Figure S8** Channel-width-normalized total resistances ( $R_{\text{tot}} \cdot W$ ) estimated in the linear regime ( $V_{\text{DS}} = -1\text{V}$ ,  $V_{\text{GS}} = -40\text{V}$ ) as a function of the channel length for C8-DNTT single-layer and C8-DNTT/PDIF-CN<sub>2</sub> heterojunction devices with different PDIF-CN<sub>2</sub> overlayer thickness ( $\delta_f$ ). The dashed lines represent the best linear fitting used to estimate the corresponding contact resistance ( $R_c$ ) values by the Transmission Line Method (TLM).



**Figure S9** IV curves measured for (a) C8-DNTT (15 nm) and (b) C8-DNTT (15 nm)/PDIF-CN<sub>2</sub> (10 nm) films deposited at  $T_{\text{sub}}=85$  °C on glass substrates. c) The same curves are reported in a semi-log plot. The width and length of the active channels were 500  $\mu\text{m}$  and 200  $\mu\text{m}$ , respectively.



**Figure S10** a) Transfer curves in semi-log plot measured in the saturation regime ( $V_{DS}=50$  V) for PDIF-CN<sub>2</sub> (15 nm) single-layer and PDIF-CN<sub>2</sub> (15 nm)/C8-DNTT (10 nm) heterojunction transistors with active channel  $L=200$   $\mu\text{m}$ ; b) comparison between mobility (top) and threshold voltage (bottom) values extracted, for the electron accumulation region, in the saturation regime as a function of the channel length. Here, PDIF-CN<sub>2</sub> and C8-DNTT films were sequentially deposited at  $T_{\text{sub}}=100$  °C and 85 °C, respectively.