Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

Minimizing Electrode Edge in Organic Transistors with Ultrathin Reduced Graphene Oxide for Improving Charge Injection Efficiency

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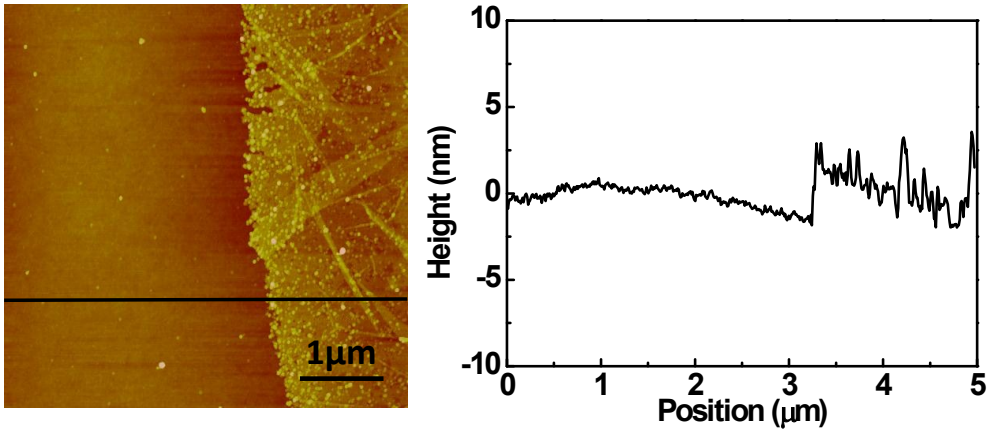

Figure S1 Small area AFM image and section profile of RGO electrode.

From AFM image, the clear edge can be observed and the thickness is about 2.7±0.6 nm. We have tried three batches of GO products that are purchased from Graphene Company. The diameter of GO is 6-13 μm, and layer number is generally about 1-4. The average thickness of assemblied RGO electrode based on three batches of GO is about 2-3.5 nm. The small thickness variation does not influence their performance in OFETs. This feature indicate the assembly strategy in this work does not have stringent requirements for the diameter or layer number of GO, which would be meaningful for practical applications.

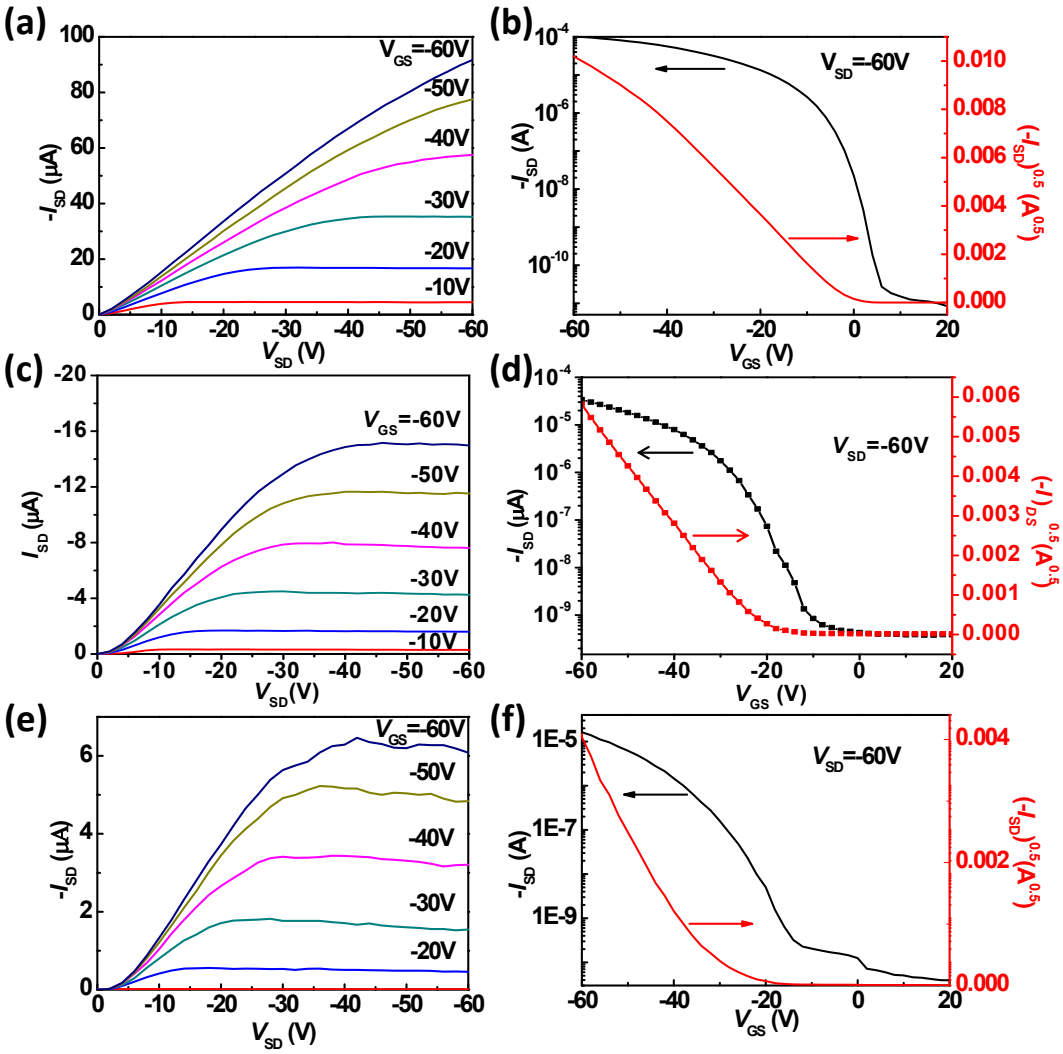

Figure S2 (a) Output and (b) Transfer curves of OFET with 6 nm RGO electrodes. (c) Output and (d) Transfer curves of OFET with 20 nm Au-RGO electrodes. (e) Output and (f) Transfer curves of OFET with 20 nm Au electrodes.

From the output curves of OFET with 6 nm RGO, weak contact resistance (nonlinear curves at small V_{SD} regime) can be observed (Figure S2a), while clear contact resistance effect appears in the OFET with 20 nm Au-RGO electrodes (Figure S2c). These results clearly indicate that the height of electrode edge plays an important role on the charge injection in organic transistors.

Au-RGO electrodes were fabricated as follows: the pristine Au electrodes are defined via photolithography, on which RGO was modified. Mercaptoethylamine was used to link the Au and GO in substitution of APTES for assembly of GO on SiO_2 surface, in which the SH- and NH_2- groups of mercaptoethylamine are used as functional sites to covalently link Au and GO. After that, the assembly of GO, PPD,

GO was realized with similar method as reported in the Experimental section.

OFET with pure Au bottom electrode (about 20) are fabricated as well. From electrical curves (Figure S2e), the apparent contact resistance effect can be seen. The contact resistance and mobility are calculated to be 432.7 kΩ cm and 0.03-0.2 $cm^2 V^{-1} s^{-1}$, respectively, both of which are significantly inferior to those (49.8 kΩ cm and 0.1-0.8 $cm^2 V^{-1} s^{-1}$) of OFET with ultrathin RGO electrode. These comparative results denote that ultrathin RGO electrode behaves much better than the common-used Au electrode.

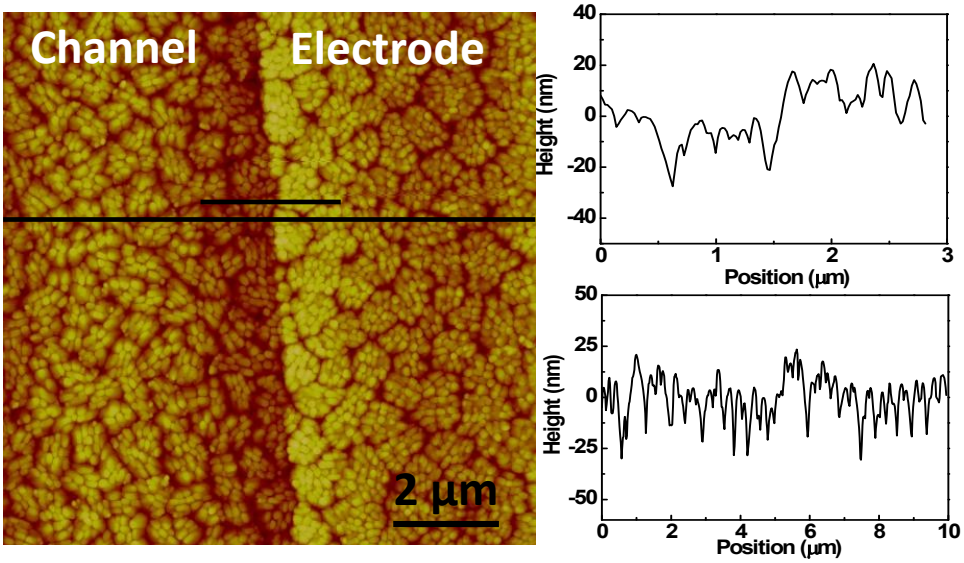

Figure S3 AFM image and section profile of DNTT film on the junction area between Au electrode and channel

From the AFM image of DNTT film on the Au electrode/channel junction area, it can be seen that DNTT form intermediate zone in the vicinity of electrode edge. In addition, the section line profile indicates that the surface of DNTT film shows a sharp height change at the electrode edge. The high electrode edge is unfavorable for the growth of organic semiconductors. All these features are detrimental for the charge injection