Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.
This journal is © The Royal Society of Chemistry 2019

Electronic Supplementary Information

Supporting Information

A Simple Method for Preparing TiO_2-based Back-Gate Controlled N-Channel MSM-IGFET UV photodetector

Tao Ji[a*], Yongfang Zhang[b], Rujia Zou[b], Enna Ha[a], Junqing Hu[a,b*] and Meiyong Liao[c]

[a] *College of Health Science and Environmental Engineering, Shenzhen Technology University, Shenzhen 518118, China.*

[b] *State Key Laboratory for Modification of Chemical Fibers and Polymer Materials, College of Materials Science and Engineering, Donghua University, Shanghai 201620, China.*

[c] *Research Center for Functional Materials, National Institute for Materials Science (NIMS), 1-1 Namiki, Tsukuba, Ibaraki 305-0044, Japan*

*Corresponding author. E-mail: jitao@sztu.edu.cn (Tao Ji); hujunqing@sztu.edu.cn (Junqing Hu)

Part I: Calculations

1. Relationship between electron concentration (n) and Fermi level (E_F) in semiconductors

$$n = N_C exp(-\frac{E_C - E_F}{kT}) \quad \text{(S1)}$$

$$E_g = E_C - E_V \quad \text{(S2)}$$

$$VBM = E_F - E_V \quad \text{(S3)}$$

$$E_C - E_F = E_g - VBM \quad \text{(S4)}$$

Where k, T are the Boltzmann constant and temperature, E_C, E_V, E_g and N_c are conduction band level, valence band level, band gap and effective state density of conduction band, respectively. According to **Equation S1** and **S4**, n becomes smaller as VBM becomes smaller.

2. Initial photocurrent of MSM devices

$$I_{ph} = q\eta(P_{opt}/hv) \quad \text{(S5)}$$

References

[1] S. M. Sze, *Physics of Semiconductor Devices*, 2nd ed (Wiley, New York, **1981**).

[2] E. A. Kraut, R. W. Grant, J. R. Waldrop, S. P. Eowalczyk, *Phys. Rev. Lett.* **1980**, 44, 1620.

Part II: Supplementary Figures

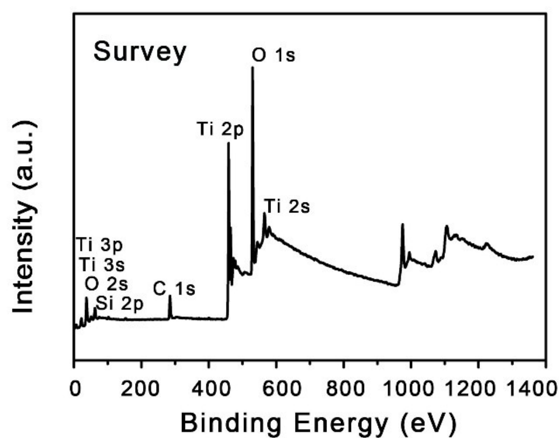

Figure S1. The XPS survey spectrum of the surface of the ALD-TiO_2 film on SiO_2/Si before calcined.

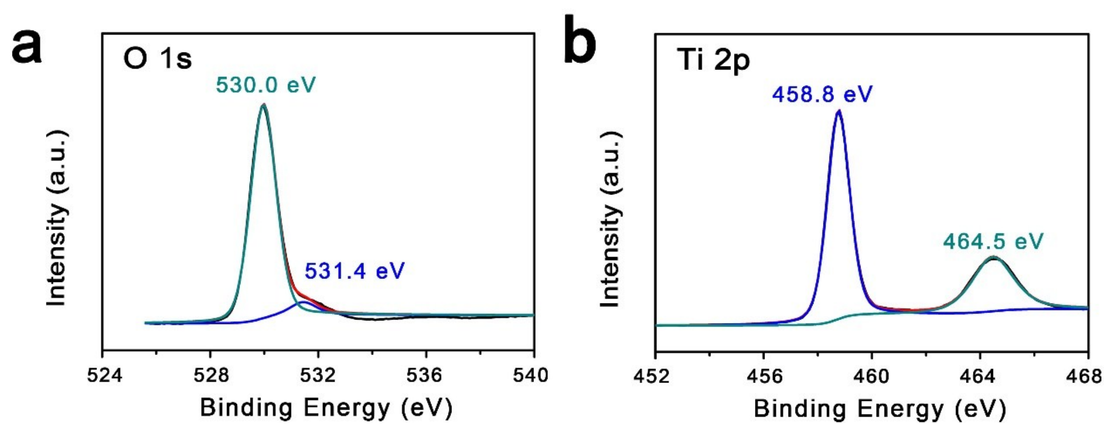

Figure S2. The O 1s (a) and Ti 2p (b) spectra of the surface of the ALD-TiO_2 film on SiO_2/Si before calcined, respectively.

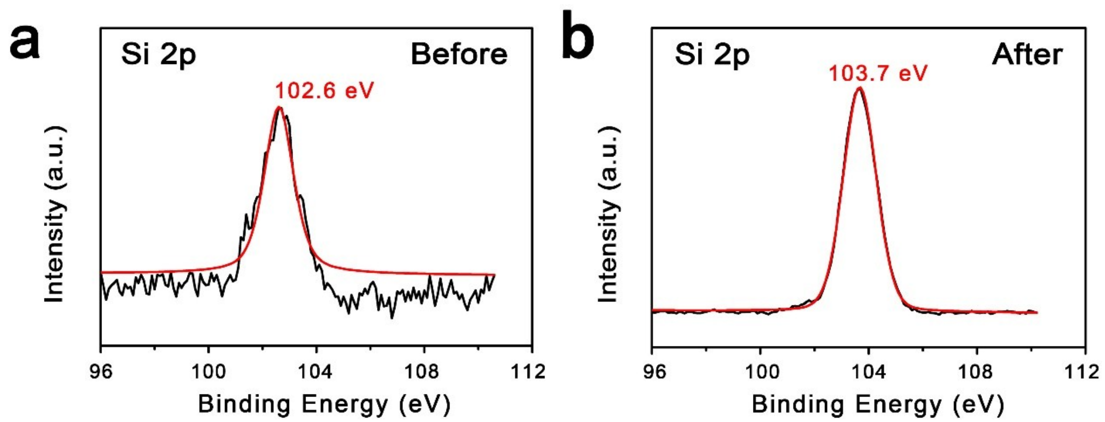

Figure S3. The Si 2p spectra of the surface of the ALD-TiO_2 film on SiO_2/Si before (a) and after (b) calcined, respectively.

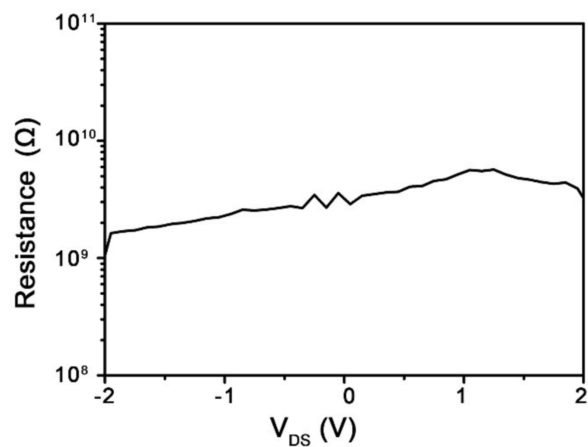

Figure S4. The differential resistance between the source and the drain at the V_G bias of 0 V

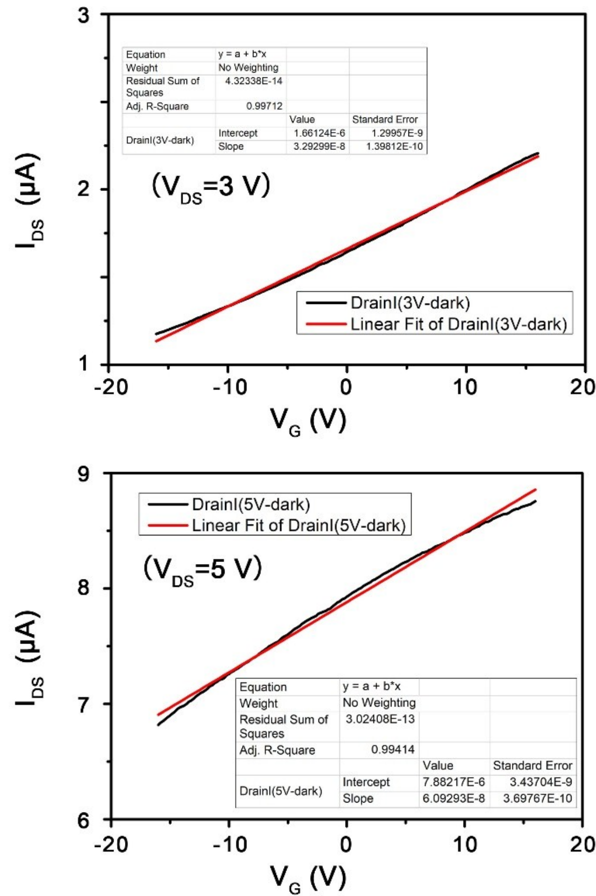

Figure S5. The transfer curves and their linear fit results of MSM-IGFET at V_D of 3 V and 5 V, respectively.

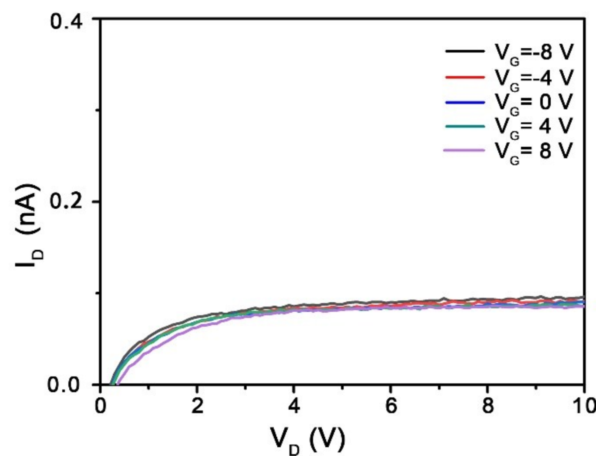

Figure S6. I_{DS}-V_D characteristics of the MSM-IGFET without calcination at room temperature in dark.

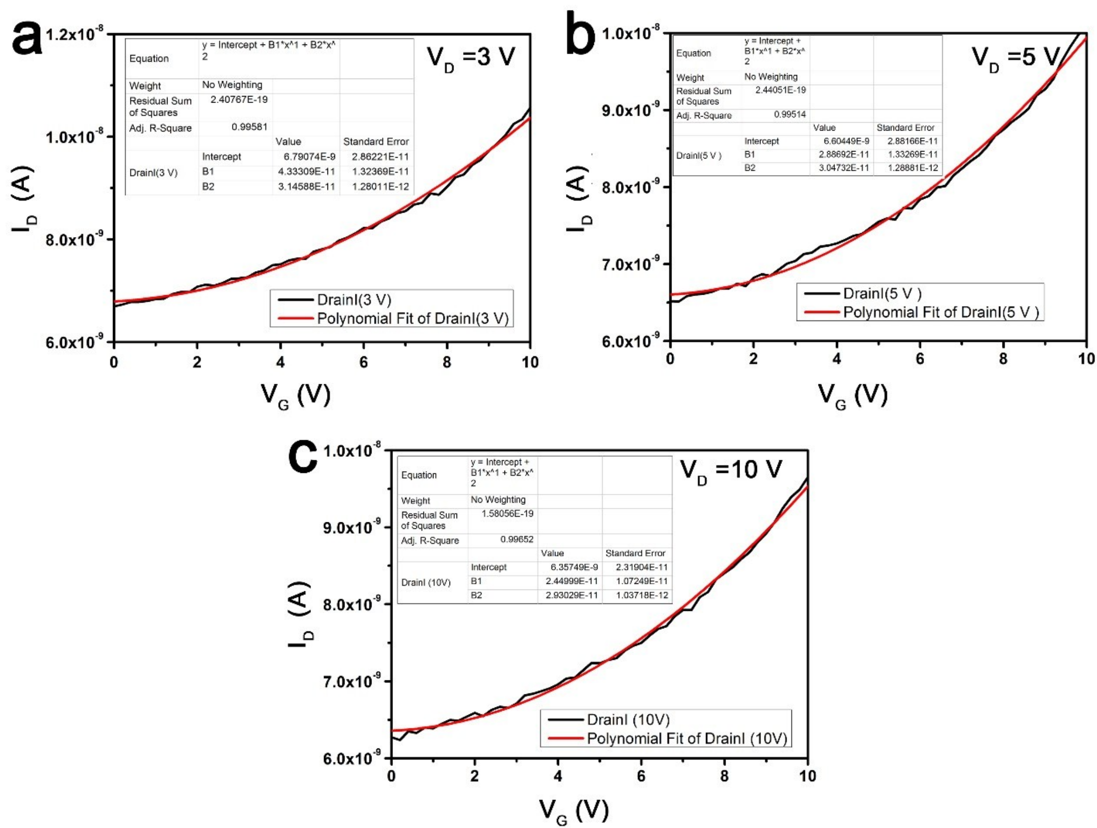

Figure S7. The transfer curves of the device before the calcination and their polynomial fit results of MSM-IGFET at 3 V (a), 5 V (b), and 10 V (c), respectively.

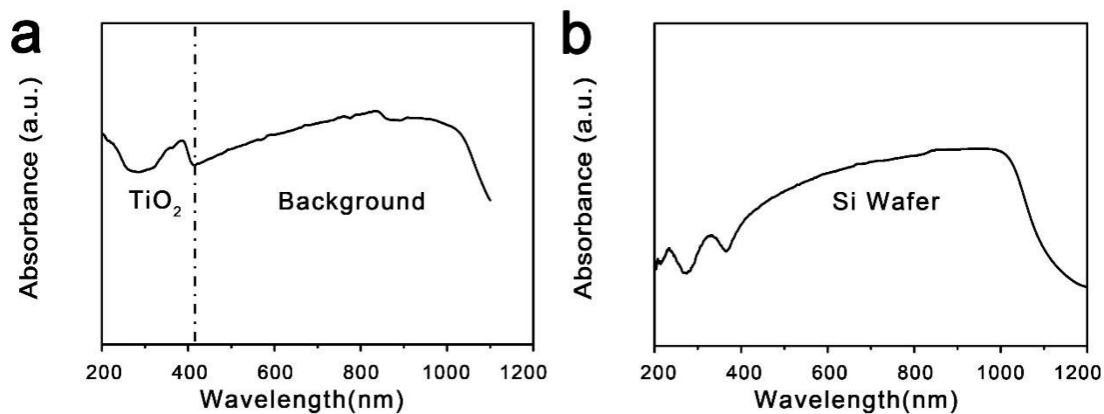

Figure S8. UV-vis absorption spectrum of as-prepared TiO_2 film on the surface of the SiO_2/Si (a) and Si wafer (b).

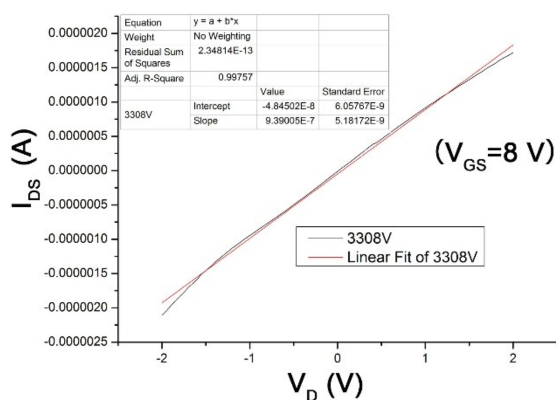

Figure S9. The slope of the linear fit to the I_{DS} - V_D curves at the V_G of 8 V upon 330 nm light (~ 0.5 mW/cm^2).

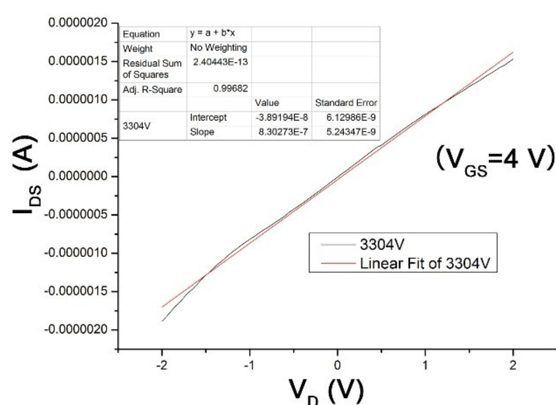

Figure S10. The slope of the linear fit to the I_{DS} - V_D curves at the V_G of 4 V upon 330 nm light (~ 0.5 mW/cm^2).

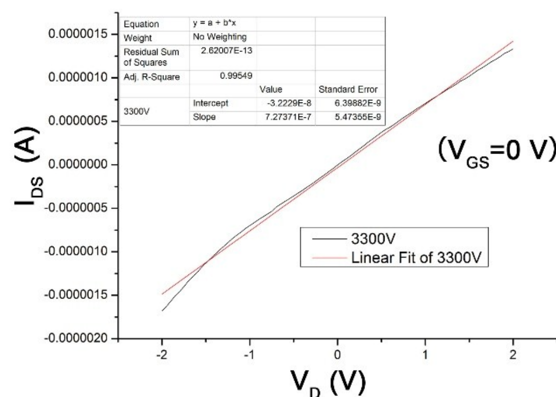

Figure S11. The slope of the linear fit to the I_{DS} - V_D curves at the V_G of 0 V upon 330 nm light (~ 0.5 mW/cm^2).

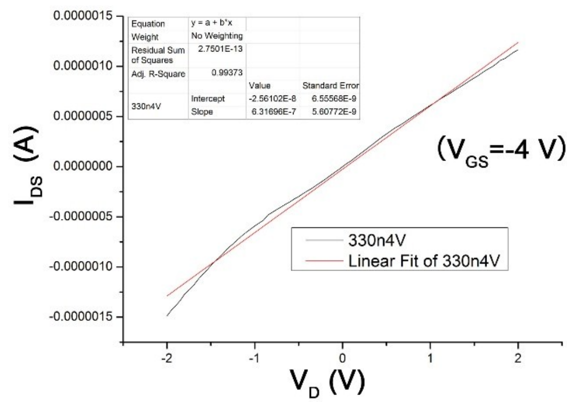

Figure S12. The slope of the linear fit to the I_{DS} - V_D curves at the V_G of -4 V upon 330 nm light (~ 0.5 mW/cm^2).

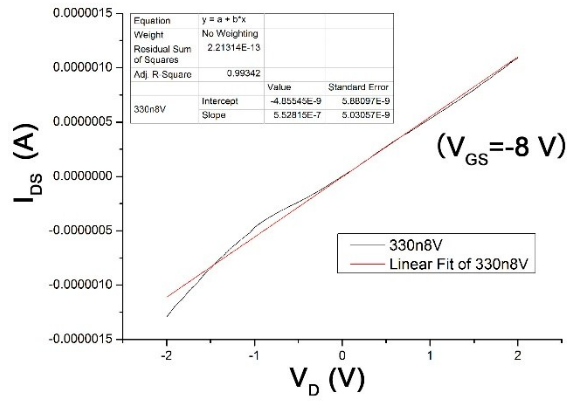

Figure S13. The slope of the linear fit to the I_{DS} - V_D curves at the V_G of -8 V upon 330 nm light (~ 0.5 mW/cm^2).

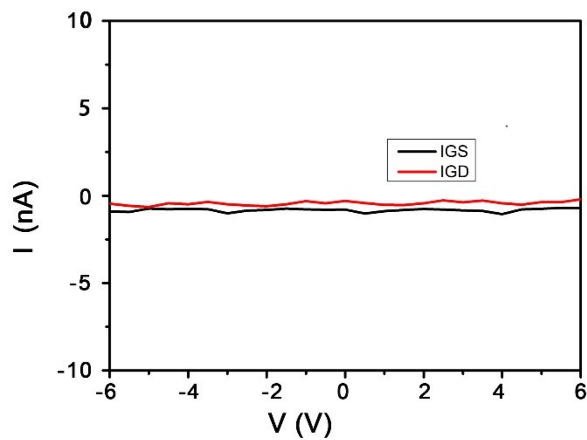

Figure S14. The leakage currents between Drain and Gate (red), between Source and Gate (black), respectively.