Supporting Information for

Application of a Dual Functional Blocking Layer for Improvement of the Responsivity in Self-Powered UV Photodetector Based on TiO_2 Nanotubes.

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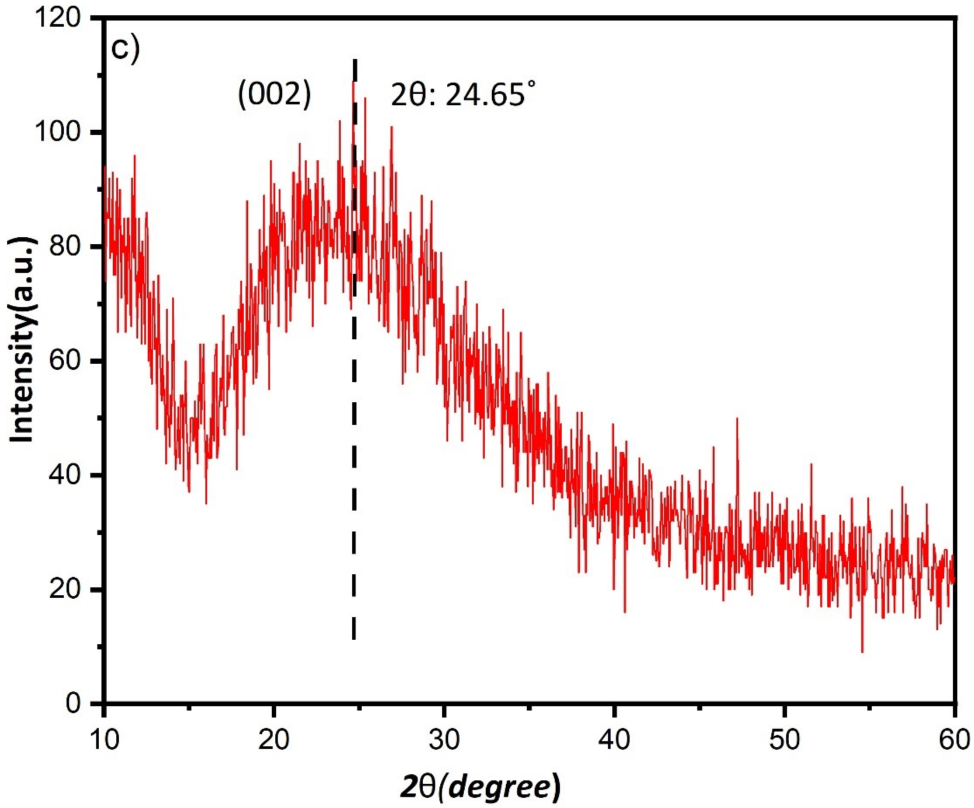


Fig S1. XRD pattern of aqueous GQDs solution.

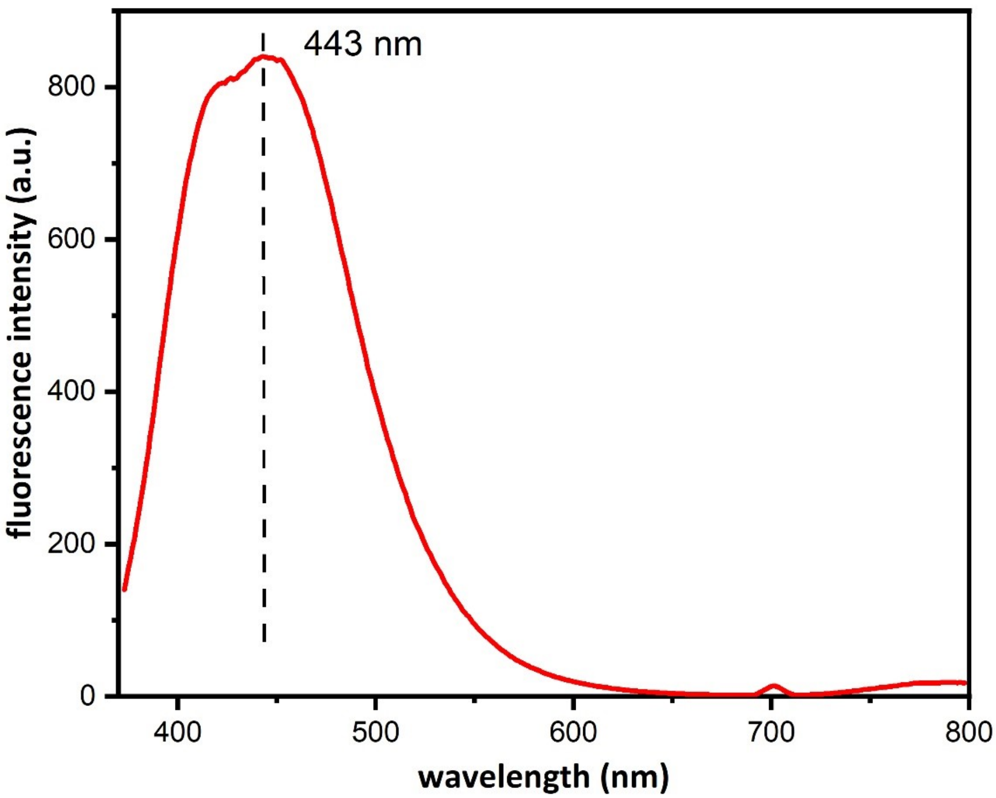


Fig. S2. The Photoluminescence spectrum of aqueous GQD solution.

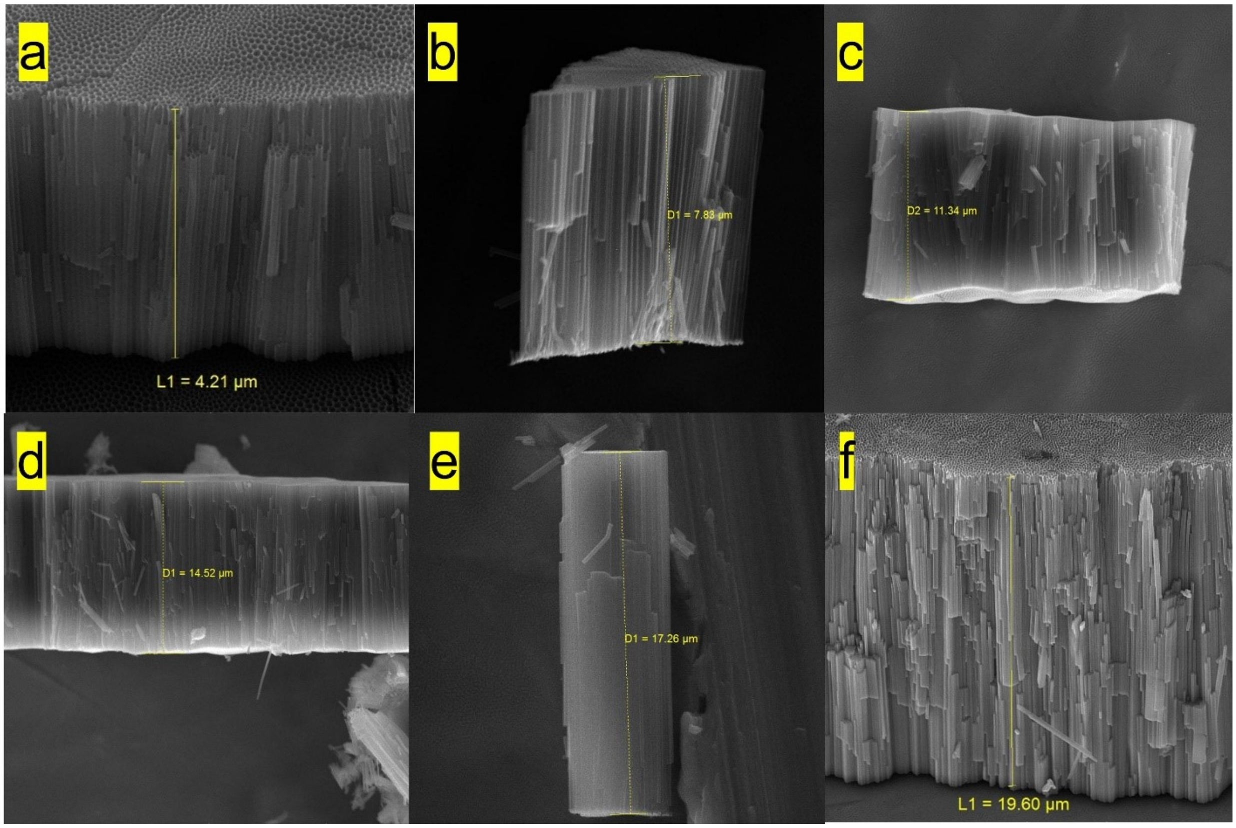


Fig. S3. Cross-sectional FESEM images of TiO_2 NTs synthesized by anodization method. a) 4.21 µm NTs, b) 7.83 µm NTs, c) 11.34 µm NTs, d) 14.52 µm NTS, e) 17.26 µm NTs, f) 16.61 µm NTs.

Table S1. Anodization parameters for the synthesize of TiO2 NTs.

NTs length (µm)	Anodization time (minutes)	Temperature (c˚)
3-5	38	23-27
6-8	45	23-27
10-12	76	23-27
14-15	107	23-27
16-17	115	23-27
18-20	135	23-27

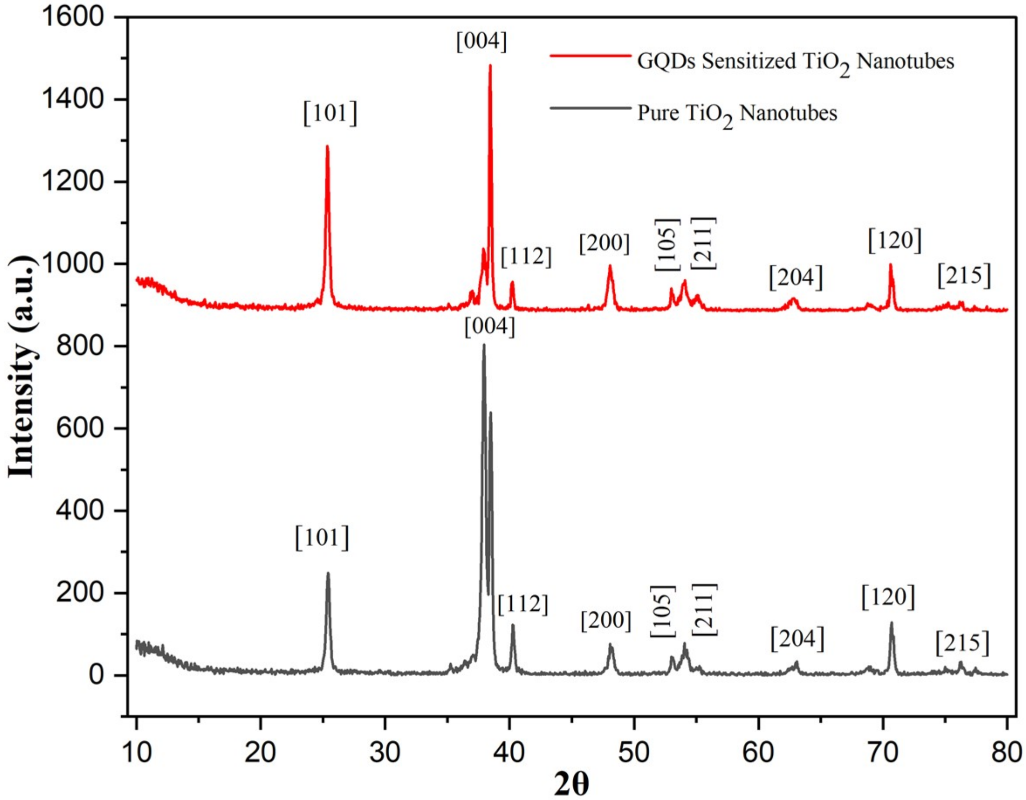


Fig. S4. XRD pattern of Pure TiO_2 NTs and GQDs coated TiO_2 NTs.

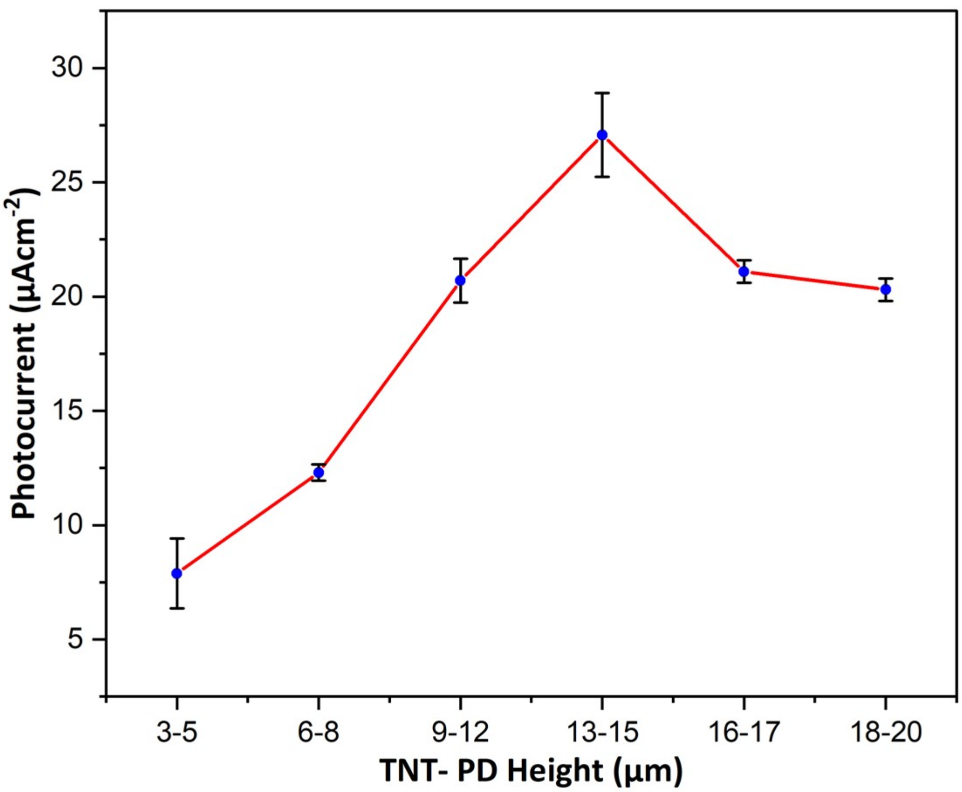


Fig. S5. Photocurrent of the PEC UV photodetectors made with pure TiO_2 NTs of different heights under UV illumination (365nm, 2mW/cm^2)

Table S2. Photocurrent density and responsivity of the PEC UV photodetector made with pure TiO_2 NTs under UV illumination (365nm, 2mW/cm^2)

Tubes' height (µm)	Photocurrent density (µA/cm^2)	Responsivity (µA/W)
3-5	7.88	3.94
6-8	12.3	6.15
10-12	20.7	10.35
14-15	27.07	13.5
16-17	21.09	10.54
18-20	20.3	10.15

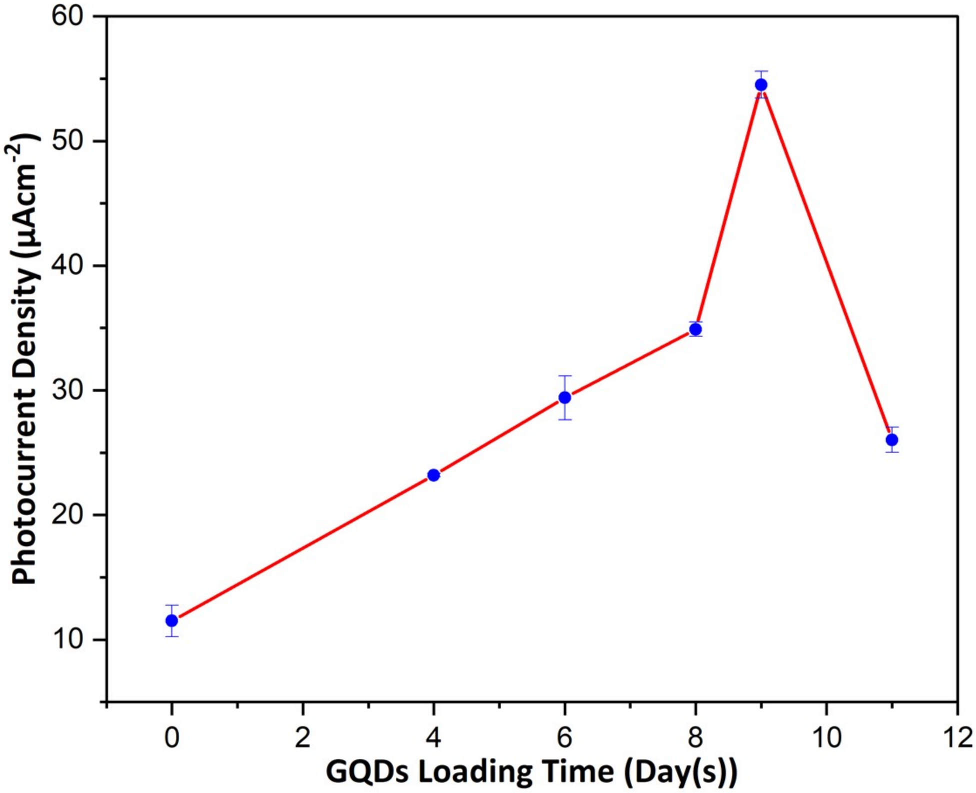


Fig. S6. GQDs loading time and its effect of the photocurrent density of UV PEC photodetector with 7.5 µm TiO_2 NTs in photoanode.

Table S3. GQDs loading time and its effect on the photocurrent density and responsivity of PEC UV photodetector with 7.5 µm TiO_2 NTs in photoanode.

GQDs loading time (days)	Short circuit photocurrent density (µA/cm^2)	Responsivity (mW/cm^2)
Pure 7.5 µm TiO2 NTs	11.5	5.75
4	23.2	11.6
6	29.4	14.7
8	34.9	17.45
9	54.5	27.25
11	26.03	13.01

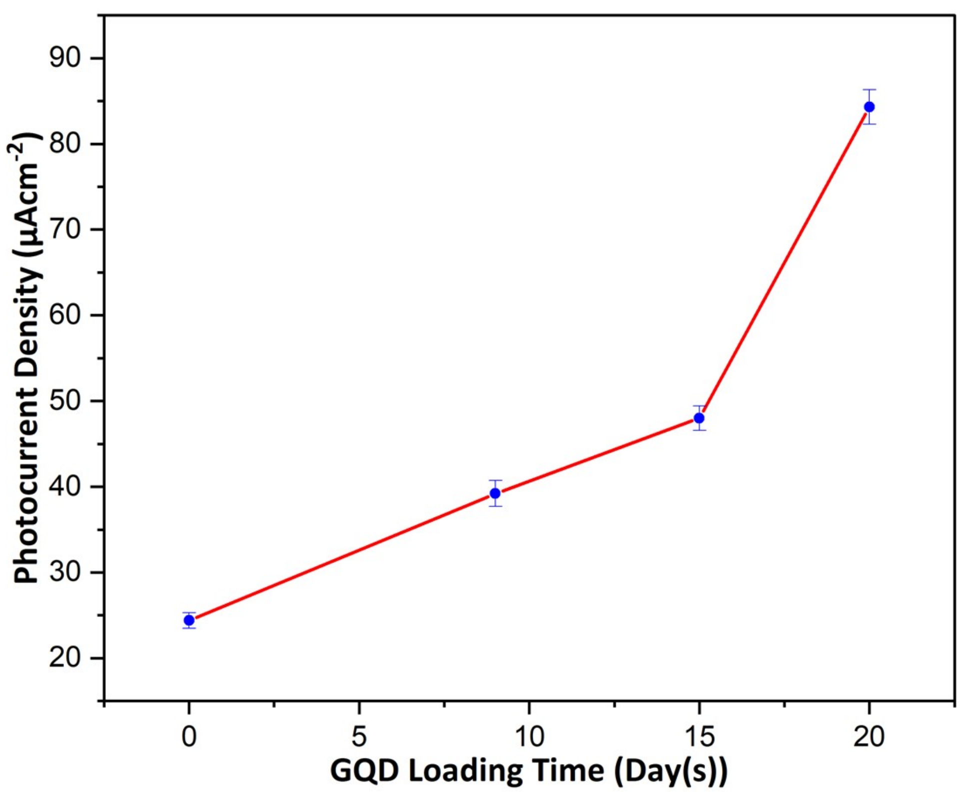


Fig. S7. GQDs loading time and its effect of the photocurrent density of UV PEC photodetector with 15 µm TiO_2 NTs in photoanode.

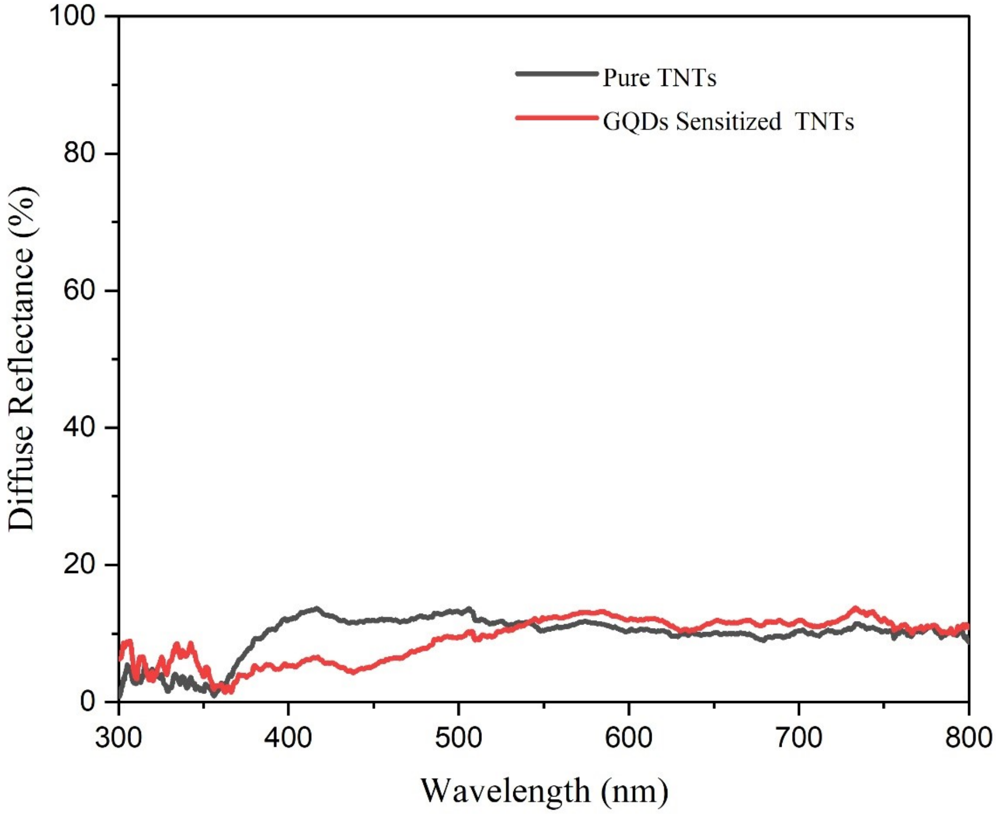
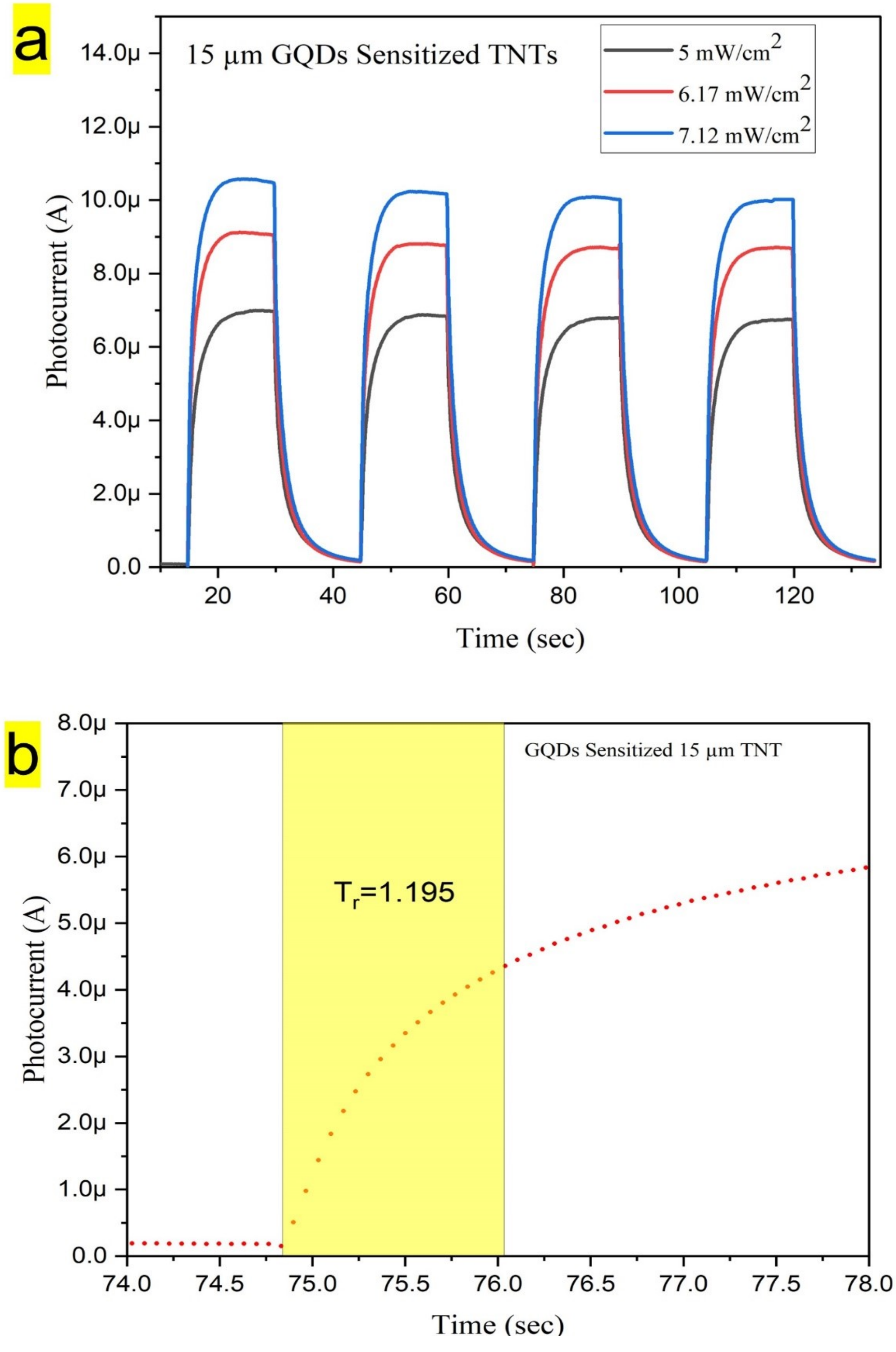


Fig. S8. DRS spectra of pure and GQDs coated TiO_2 NTs in photoanode.


a
15 µm GQDs Sensitized TNTs
5 mW/cm2
6.17 mW/cm2
7.12 mW/cm2
Photocurrent (A)
Time (sec)
b
GQDs Sensitized 15 µm TNT
Tr=1.195
Photocurrent (A)
Time (sec)

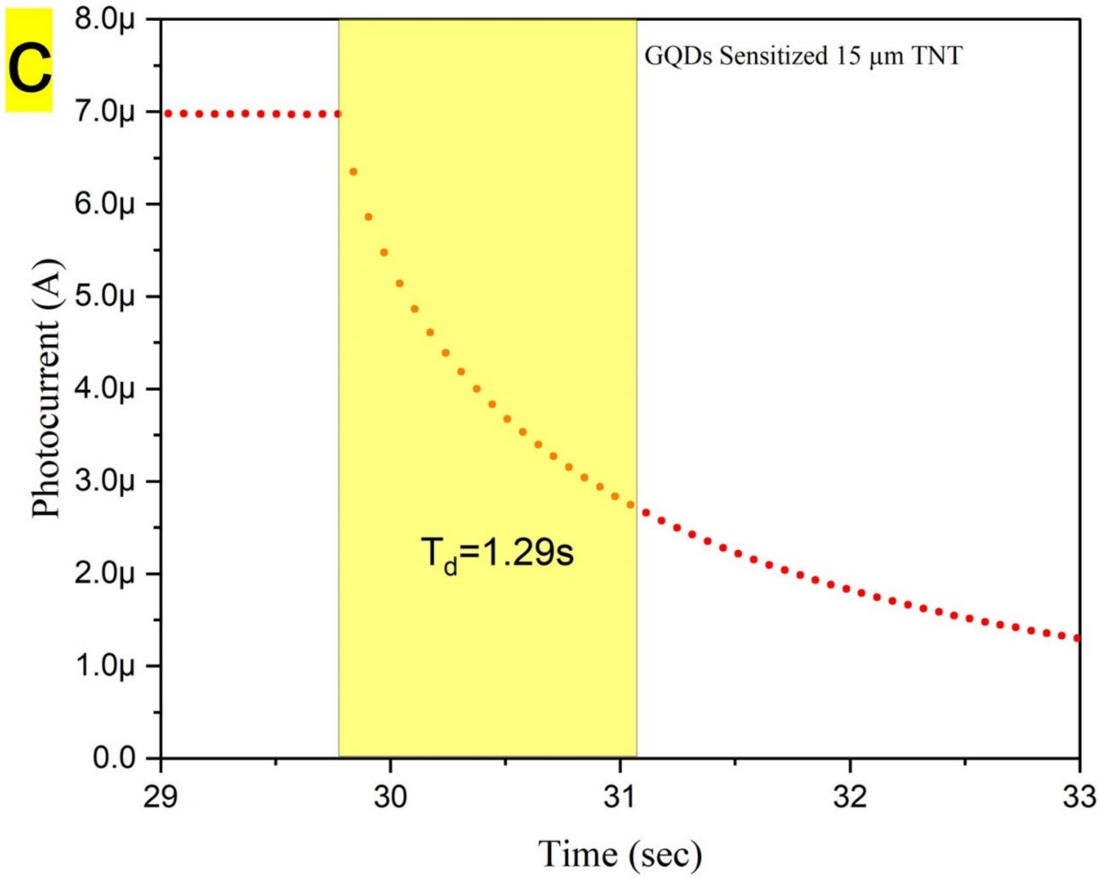


Fig. S9. a) photocurrent response of the 15 µm GQDs sensitized TiO_2 NTs PEC UV photodetector under on/off switching UV LEDs with the power intensity of 5, 6.17 and 7.12 mW cm^{-2} at 0 V bias. b,c) enlarged rising and decaying edge of GQDs sensitized 15 µm TiO_2 NTs PEC UV photodetector photo response.

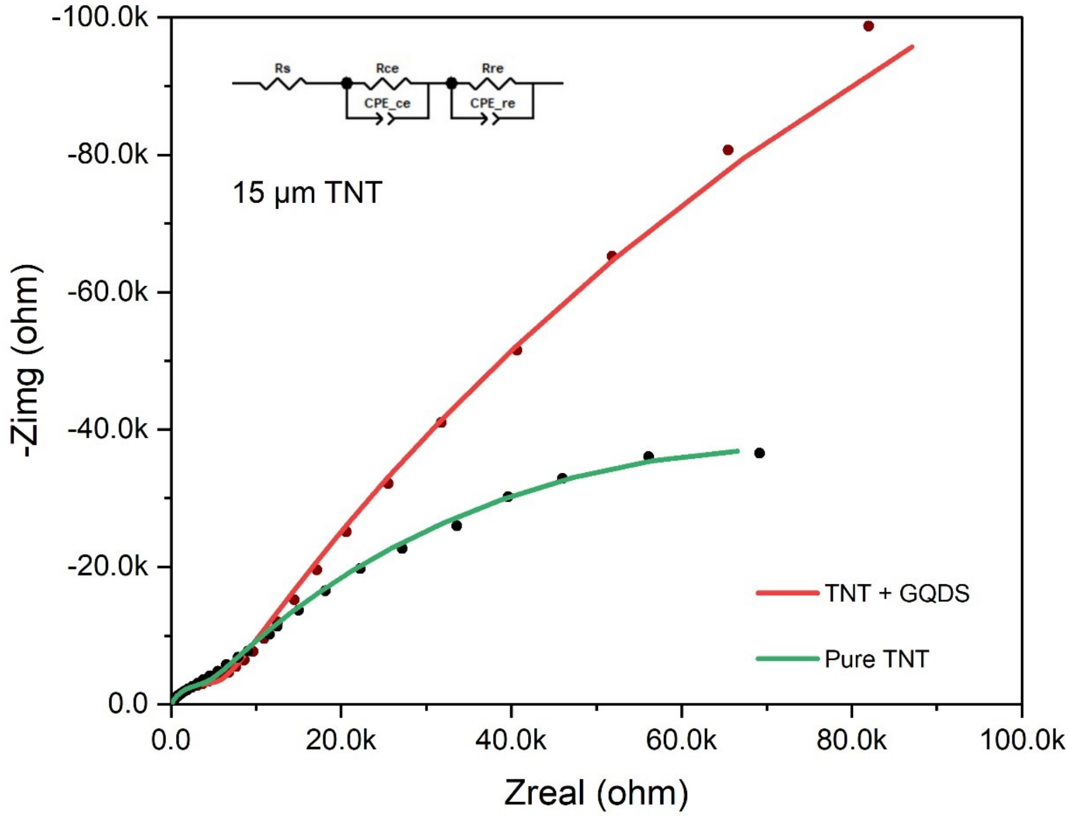


Fig. S10. EIS Nyquist plot for the PEC UV photodetector with 15 µm TiO_2 NTs in photoanode before and after sensitization with GQDs.

Table S4. Quantity of charge recombination resistance at Electrolyte/Photoanode interface.

	7.5 µm TNT		15 µm TNT	
	TNT-PD	GQD-TNT-PD	TNT-PD	GQD-TNT-PD
Charge Recombination resistance Rrc (KΩ)	182.2	526.8	141.7	489.67

Table S5. The photo response performance comparison of various self-powered PEC UV photodetectors reported recently.

Nanostructures	**Condition**	**Electrolyte type**	**T_r(s)**	**T_d(s)**	**R_λ (mA/W)**	**refs**
TiO2/Ag/ZnS nanotubes	365 nm, 40 $mWcm^{-2}$, 0 V	polysulfide	0.16	0.18	12.42	[1]
TiO_2 nanotube arrays	365 nm, 3 $mWcm^{-2}$, 0 V	S^{2-}/Sx^{2-}	0.004	0.004	22	[2]
Titanium Dioxide Nanotube	360 nm, 115 $mWcm^{-2}$, 1 V	Na_2So_4	0.88	1.28	0.73	[3]
GQDs coated 7.5 µm TiO_2 NTs	365 nm, 2$mWcm^{-2}$ 0 V	I^-/I_3^-	0.73	0.88	27.5	This work
GQDs coated 15 µm TiO_2 NT	365 nm, 2$mWcm^{-2}$ 0 V	I^-/I_3^-	1.195	1.29	42.5	This work

References

[1] X. Li, S. Gao, G. Wang, Z. Xu, S. Jiao, D. Wang, Y. Huang, D. Sang, J. Wang, Y. Zhang, A self-powered ultraviolet photodetector based on TiO2/Ag/ZnS nanotubes with high stability and fast response, J. Mater. Chem. C. 8 (2020) 1353–1358. https://doi.org/10.1039/c9tc05326c.

[2] J. Chen, B. Hu, C. Chen, X. Lv, H. San, W. Hofmann, A HIGH-PERFORMANCE SELF-POWERED UV PHOTODETECTOR BASED ON SELF-DOPING TIO 2 NANOTUBE ARRAYS Pen-Tung Sah Institute of Micro-Nano Science and Technology , Xiamen University , CHINA and Institute of Solid State Physics , Technical University of Berlin , Ber, 2019 20th Int. Conf. Solid-State Sensors, Actuators Microsystems Eurosensors XXXIII (TRANSDUCERS EUROSENSORS XXXIII). (2019) 1329–1332.

[3] S. Ng, F.K. Yam, S.N. Sohimee, K.P. Beh, S.S. Tneh, Y.L. Cheong, Z. Hassan, Photoelectrochemical ultraviolet photodetector by anodic titanium dioxide nanotube layers, Sensors Actuators, A Phys. 279 (2018) 263–271. https://doi.org/10.1016/j.sna.2018.06.030.