

Supporting Information for

High Efficiency Wastewater Purification System Based on Coupled Photo-Electric-Catalytic Action Provided by Triboelectric Nanogenerator

Shen Shen ^{1,2,#}, Jiajia Fu ^{2,#}, Jia Yi ¹, Liyun Ma ¹, Feifan Sheng ¹, Chengyu Li ¹,
Tingting Wang ¹, Chuan Ning ^{1,3}, Hongbo Wang ^{2,*}, Kai Dong ^{1,3,*}, Zhong Lin
Wang ^{1,3,4,*}

¹ CAS Center for Excellence in Nanoscience, Beijing Key Laboratory of Micro-Nano Energy and Sensor, Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, Beijing 100083, P. R. China

² Jiangsu Engineering Technology Research Centre for Functional Textiles, Jiangnan University, No.1800 Lihu Avenue, Wuxi, P.R. China

³ School of Nanoscience and Technology, University of Chinese Academy of Sciences, Beijing, 100049, P. R. China

⁴ School of Material Science and Engineering, Georgia Institute of Technology, Atlanta, GA 30332-0245, USA

Shen Shen and Jiajia Fu contributed equally to this work.

*Corresponding authors. E-mail: [wxwanghb@163.com](mailto:wawanghb@163.com) (Hongbo Wang);
dongkai@binn.cas.cn (Kai Dong); zhong.wang@mse.gatech.edu (Zhong Lin Wang)

Supplementary Tables and Figures

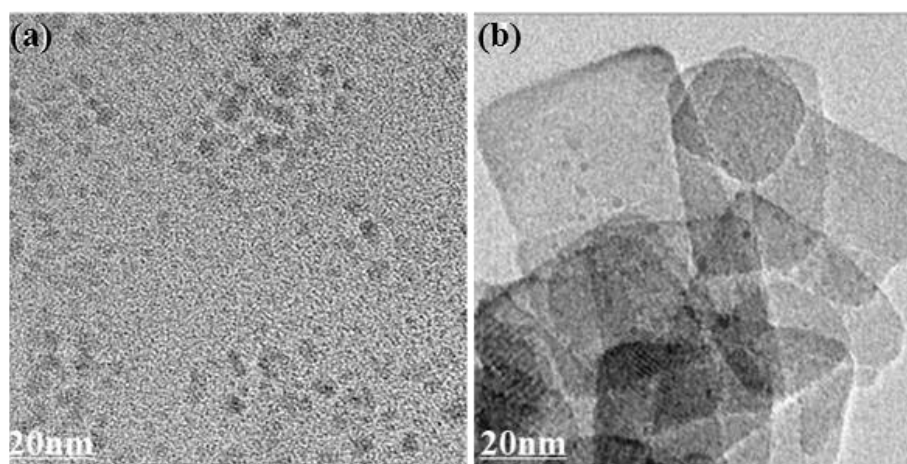


Fig. S1 TEM images of CDs (a) and 0.2CDs/TNs (b)

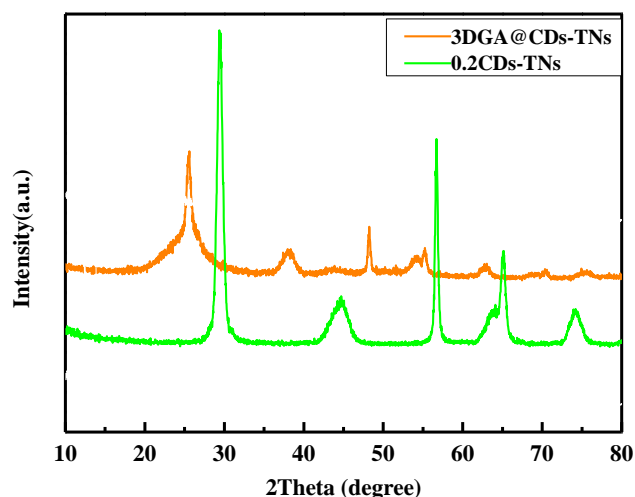


Fig. S2 XRD patterns of 3DGA@CDs-TNs and CDs-TNs after reaction

Table S1 Respective atomic content of 3DGA@CDs-TNs

Elements	Atomic %
C	69.65
N	1.18
O	24.38
Ti	4.79

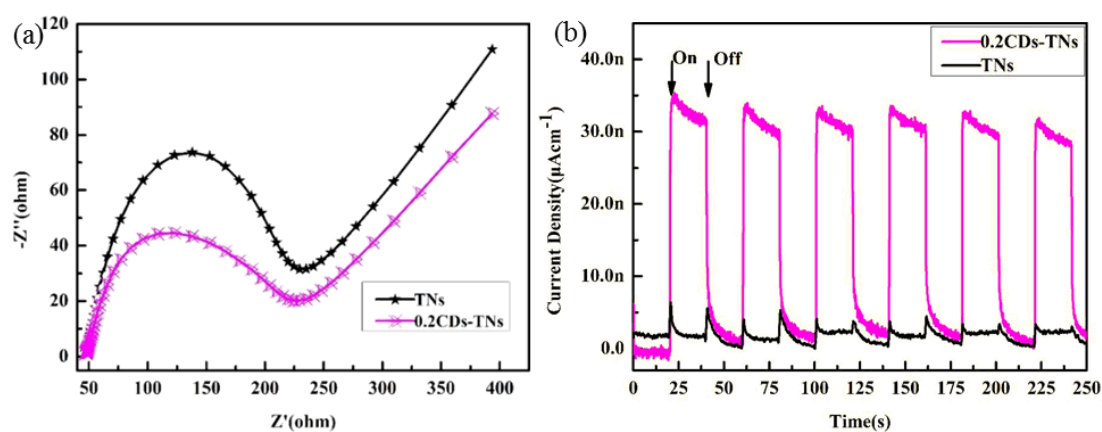


Fig. S3 EIS curves (a) and transient photocurrent density (b) of TNs and 0.2CDs/TNs under visible light irradiation

Table S2 Comparison of BG and DB degradation over different methods

Dyes	Ppm	E_{TENG}	$E_{Photocatalysts}$	$E_{TENG-3DGA@CDs-TNs}$
DB	5	59.2% (6h)	73.23% (3h)	89.6% (1.5h)
BG	20	59.59% (4h)	81.66% (2h)	88.26% (40min)

Table S3 Degradation kinetic parameters of BG over 3DGA@CDs-TNs, TENG and TENG/3DGA@CDs-TNs

Methods	k(10 ⁻³ /min)	Formula	R ²
TENG	3.41	y=-0.00341x+0.0009847	0.96148
3DGA@CDs-TNs	16.59	y=-0.01659x-0.27983	0.96638
TENG-Photocatalysts	27.03	y=-0.02703x-0.55186	0.53102

Table S4 Degradation kinetic parameters of DB over 3DGA@CDs-TNs, TENG and TENG/3DGA@CDs-TNs

Methods	k(10 ⁻³ /min)	Formula	R ²
TENG	2.22	y=-0.00222x+0.00578	0.95317
3DGA@CDs-TNs	6.2	y=-0.0062x-0.03946	0.88643
TENG-Photocatalysts	23.72	y=-0.02372x-0.46223	0.83139

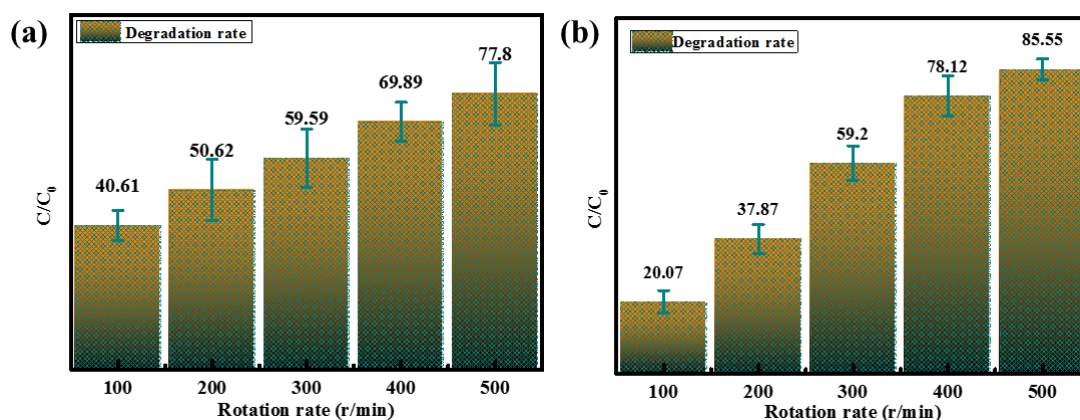
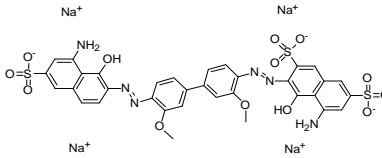
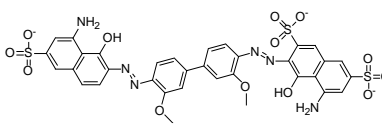
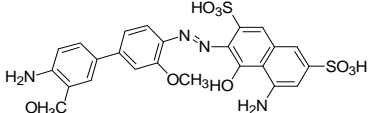
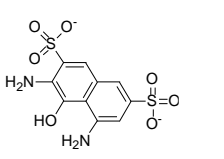
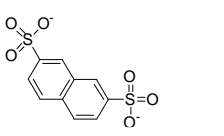
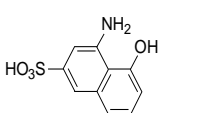
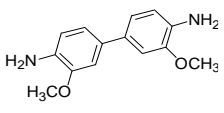
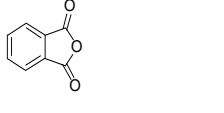
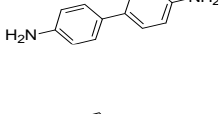
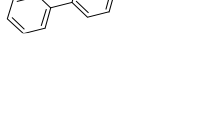
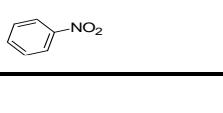
**Fig. S4** Influence of different rotation rates on the removal of (a) BG and (b) DB

Table S5 Degradation intermediates of DB in the presence of TENG and 3DGA@CDs-TNs under visible light irradiation, detected by LCMS in the positive ion mode

	Retention time (min)	Theoretical mass (m/z)	Molecular Formula	Supposed structure
5B	5.259	992.89	$C_{34}H_{24}N_6S_4O_{16}Na_4$	
	7.997	903	$C_{34}H_{27}N_6S_4O_{16}$	
B	6.388	575.58	$C_{24}H_{23}N_4O_9S_2$	
C	6.22	332.29	$C_{10}H_8N_2O_7S_2$	
D	5.548	286.27	$C_{10}H_6O_6S_2$	
E	1.669	239.25	$C_{10}H_9NO_4S$	
F	4.877	214.26	$C_{14}H_{14}O_2$	
G	4.402	148.11	$C_8H_4O_3$	
H	3.464	184.24	$C_{12}H_{12}N_2$	
I	1.617	169.22	$C_{12}H_{11}N$	
J	5.699	123.11	$C_6H_5NO_2$	

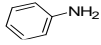
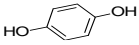
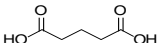

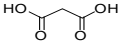
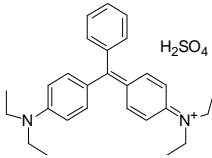
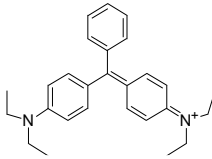
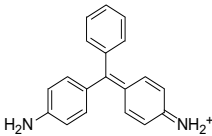
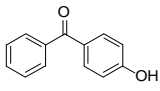
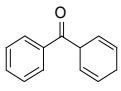

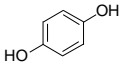





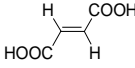
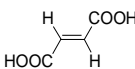
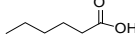
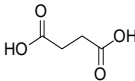
K	6.822	93.14	C ₆ H ₇ N	
L	6.752	110.1	C ₆ H ₆ O ₂	
M	0.743	132.11	C ₅ H ₈ O	
N	11.57	90.03	C ₂ H ₂ O ₄	
O	0.83	104.06	C ₃ H ₄ O ₄	

Table S6 Degradation intermediates of DB in the presence of TENG and 3DGA@CDs-TNs under visible light irradiation, detected by LCMS in the positive ion mode

Intermediate products	Retention time (min)	Theoretical mass (m/z)	Molecular Formula	Supposed structure
BR	5.259	482.63	C ₂₇ H ₃₄ N ₂ O ₄ S	
A	6.057	384	C ₂₇ H ₃₂ N ₂	
B	3.206	272.12	C ₁₉ H ₁₆ N ₂	
C	1.205	198.21	C ₁₃ H ₁₀ O ₂	
D	1.184	182.22	C ₁₃ H ₁₀ O	
E	1.238	106.12	C ₇ H ₆ O	

				
F	1.205	110.1	$C_6H_6O_2$	  
G	1.453	108.09	$C_6H_4O_2$	 
H	1.808	116.07	$C_4H_4O_4$	 
I	0.743	116.17	$C_6H_{12}O_2$	
J	2.162	118.1	$C_4H_6O_4$	
K	1.281	90.03	$C_2H_2O_4$	