Electronic Supplementary Material (ESI) for Nanoscale.
This journal is © The Royal Society of Chemistry 2018

Supporting Information

Defects-induced betavoltaic enhancement in black titania nanotube arrays

Na Wang,[a,b] Yang Ma,[a,b] Jiang Chen,[a,b] ChangsongChen,[a,b] Haisheng San,*[,a,b,c] JigeChen,[c] and ZhengdongCheng,[c,d]

[a] *Pen-Tung Sah Institute of Micro-Nano Science and Technology, Xiamen University, Xiamen 361005, Fujian, China*

[b] *Shenzhen Research Institute of Xiamen University, Shenzhen, 518000, Guangdong, China*

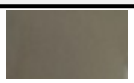
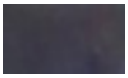
[c] *Shenzhen Betary Energy Technologies Co., Ltd., Shenzhen, 518063, Guangdong, China*

[d] *Artie McFerrin Department of Chemical Engineering, Texas A&M University, College Station, TX 77843-3122, USA*

**Corresponding author: sanhs@xmu.edu.cn*

1. Fabrication of TiO_2 NTAs samples

Table S1. Annealing conditions and photographs of TiO_2 NTAs samples

Samples TiO_2 NTAs	Annealing condition			Sample color	Powder color
	Method	Atmosphere	Temperature		
1	unannealing	—	—		
2	annealing	Air	450 ºC		
3	annealing	Ar	450 ºC		
4	annealing	Air	650 ºC		
5	annealing	Ar	650 ºC		

2.The SEM images of TiO_2 NTAs before and after thermal treatment.

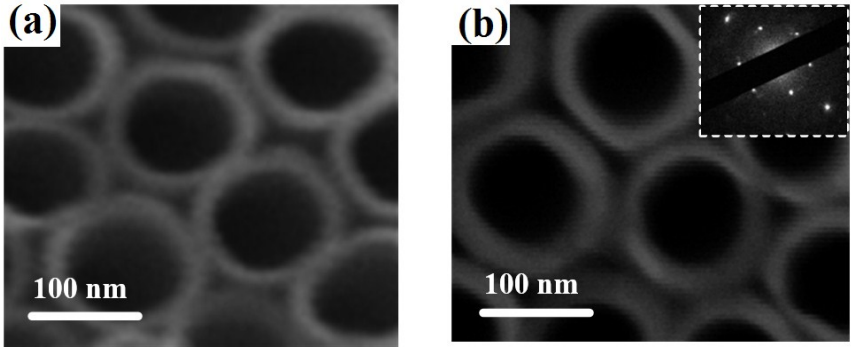


Fig.S1 The SEM images of TiO_2 NTAs (a) before and (b) after thermal treatment

3.The HRTEM images of TiO_2 and reduced TiO_{2-x}.

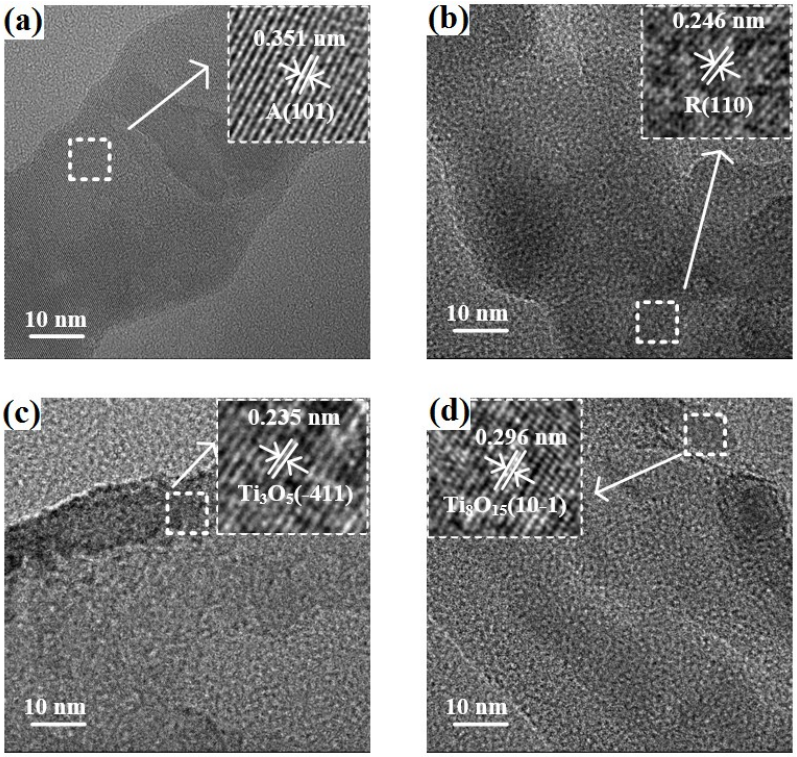


Fig.S2 HRTEM images of (a) anatase TiO_2 , (b) rutile TiO_2, (c) Ti_3O_5, and (d) Ti_8O_{15} in reduced TiO_{2-x} NTAs sample annealed in Ar at 650℃

4. Current density of the betavoltaic cells

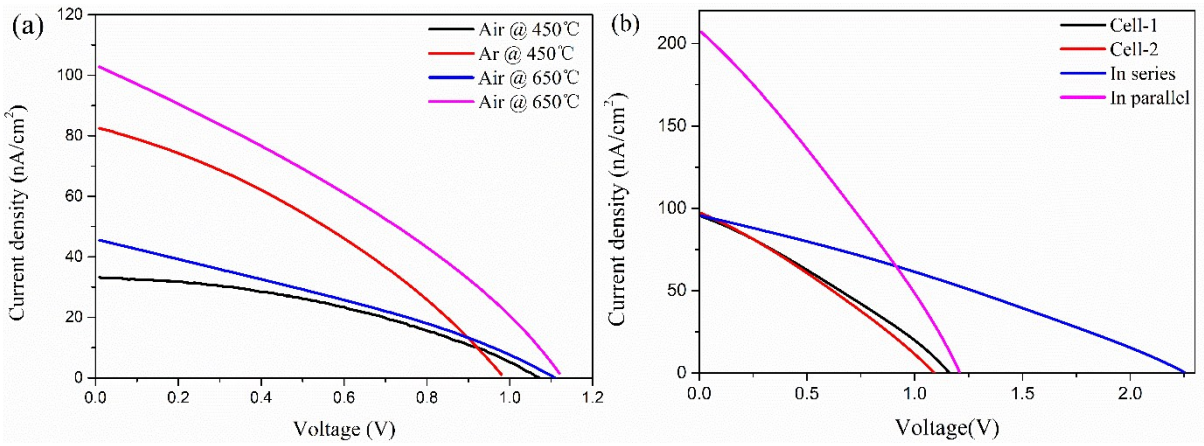


Fig. S3 (a)*J-V* characteristics of betavoltaic cells based on TiO_2 NTAs annealed in different condition (Air @ 450 ºC, Ar @ 450 ºC, Air @ 650 ºC, and Ar @ 650 ºC); (b) *J-V* characteristics of two betavoltaic cells and their connection in series/parallel.

5. Measurement of betavoltaic cells in series and in parallel

Table S2 Electrical parameters of two betavoltaiccells in series and in parallel

Betavoltaics cells TiO_2 NTAs /Ar@650℃	**Open-circuit voltage**	**Short-circuit current**	**Max power**	**Filling factor**	**Total efficiency**
	V_{oc}**(V)**	I_{sc}**(nA)**	P_{max}	FF	η
Cell-1	1.16	191.36	64.37	0.29	3.23%
Cell-2	1.10	195.34	62.31	0.29	3.07%
Twocells in series	2.26	191.71	125.65	0.29	3.14%
Twocells in parallel	1.21	416.27	146.06	0.29	3.56%