Supporting Information on

Controlled fabrication of porous double-walled TiO_2 nanotubes via ultraviolet-assisted anodization

*Ghafar Ali, Hyun Jin Kim, Jae Joon Kim, and Sung Oh Cho**

Department of Nuclear and Quantum Engineering, Korea Advanced Institute of Science and Technology, Daejeon 305-701 Korea, E-mail: socho@kaist.ac.kr

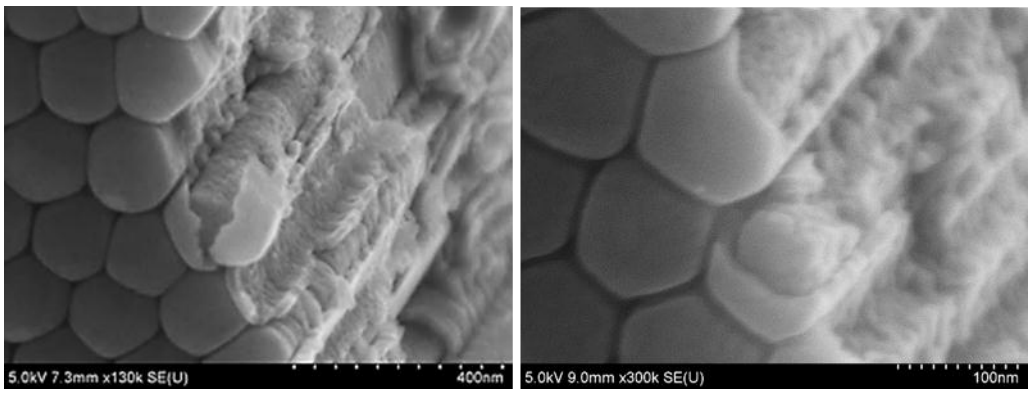

Figure S1. FESEM image (cross-sectional view) of the as-anodized double-walled TiO_2 nanotubes.

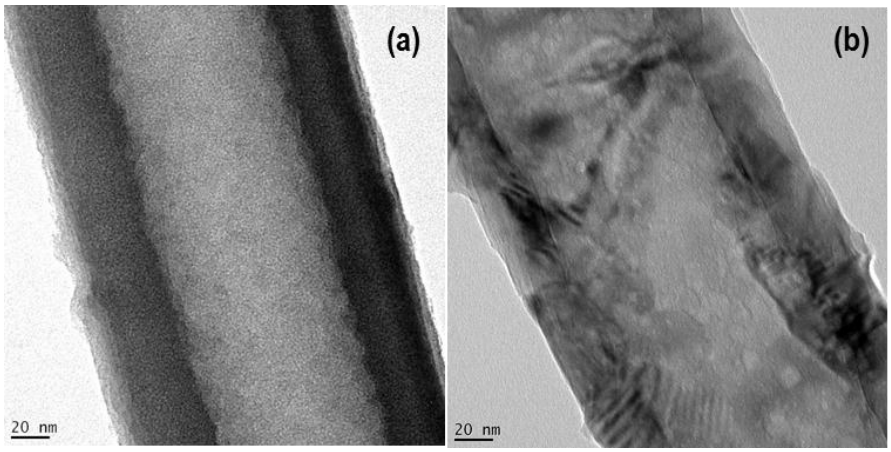

Figure S2. TEM image of the single-walled TiO_2 nanotubes prepared in the EG electrolyte at 60V without UV illumination: (a) as-anodized and (b) annealed nanotubes.

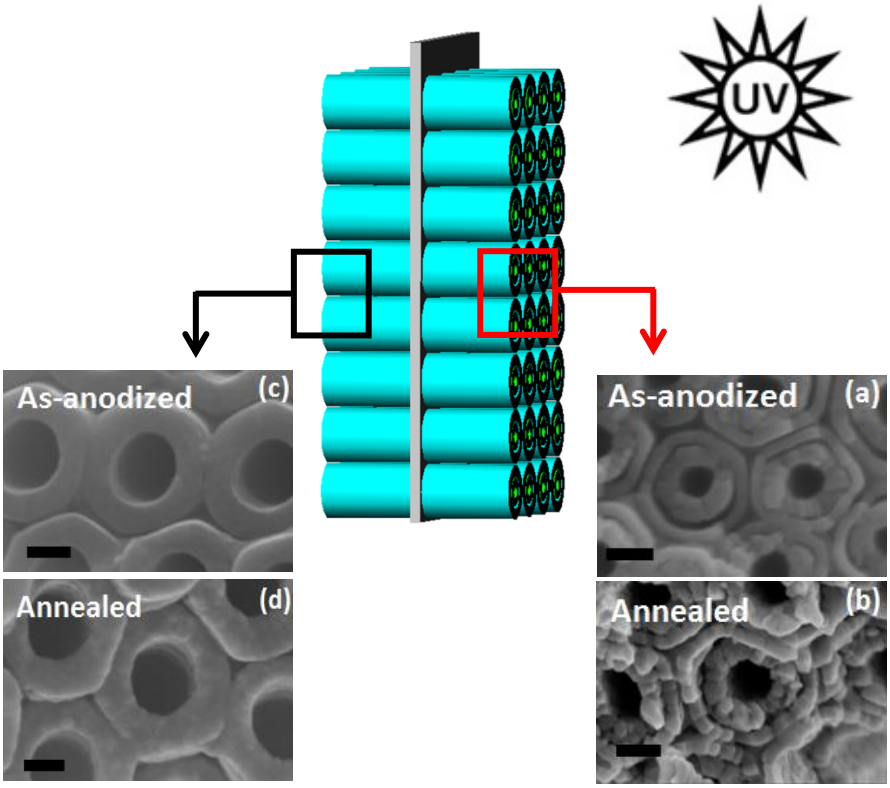

Figure S3. FESEM image of TiO_2 nanotubes formed on the UV-illuminated (a,b) and non-illuminated (c,d) side of a Ti sheet. Scale bars of the SEM images are 100 nm.

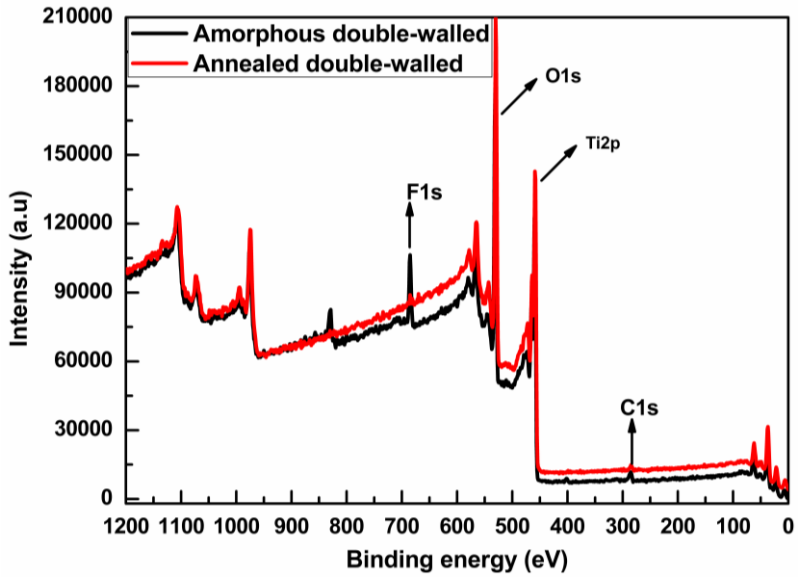

Figure S4. XPS survey spectra of the amophous and annealed double-walled TiO_2 nanotubes.

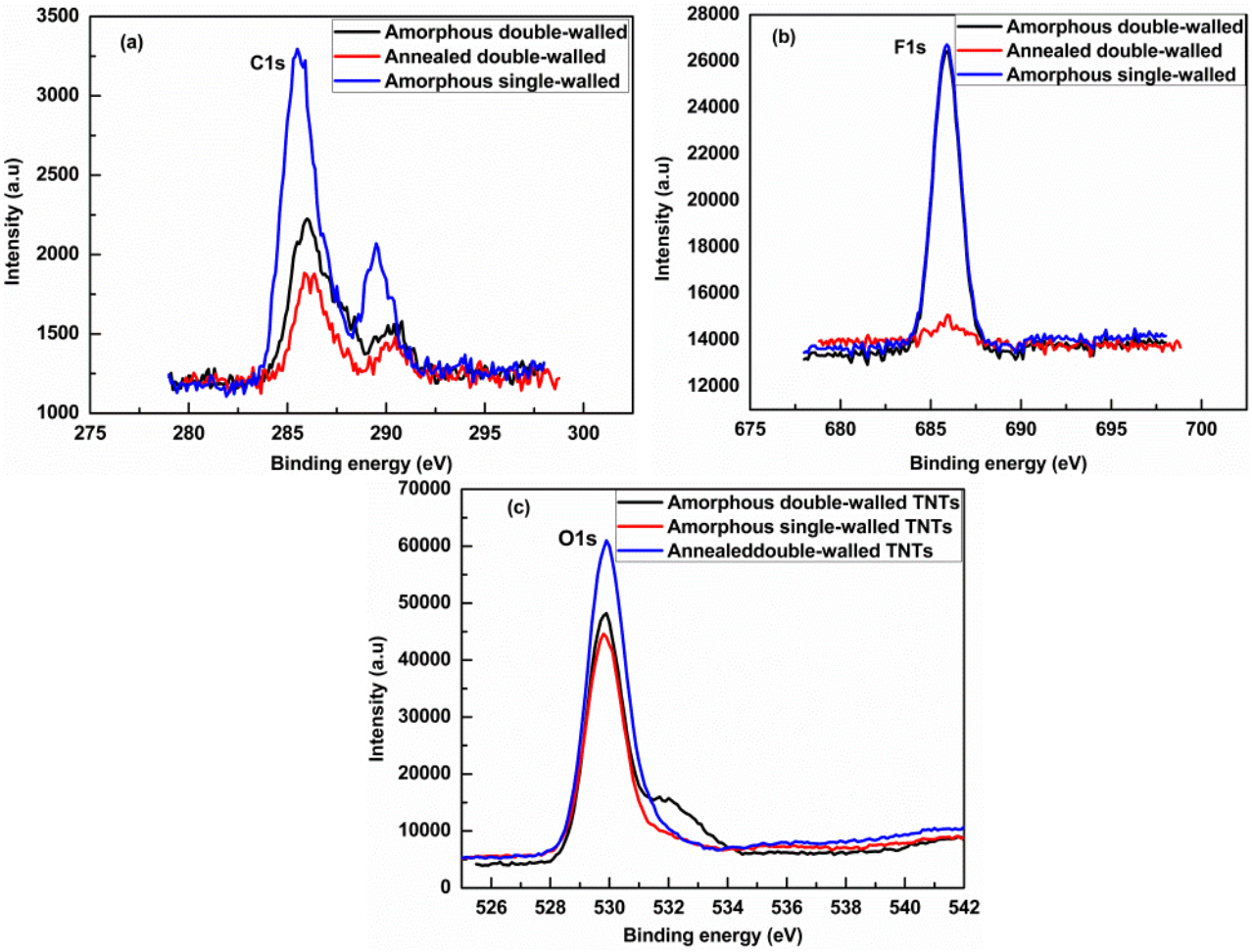

Figure S5. High resolution spectra of (a) C1s, (b) F1s and (c) O1s of amorphous single, amorphous double-walled, and annealed double-walled TiO_2 nanotubes (TNTs).

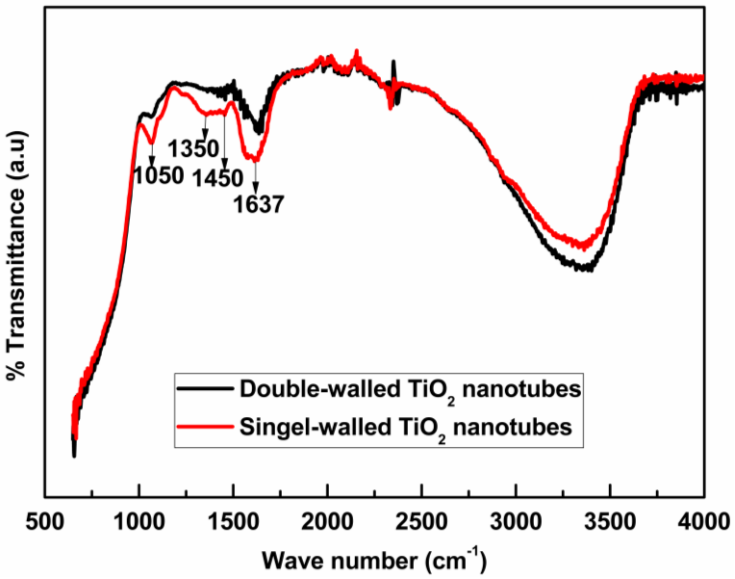

Figure S6. FTIR spectra of an as-anodized single-walled TiO_2 nanotubes prepared without UV-illumination and a double-walled TiO_2 nanotubes prepared under UV-illumination.

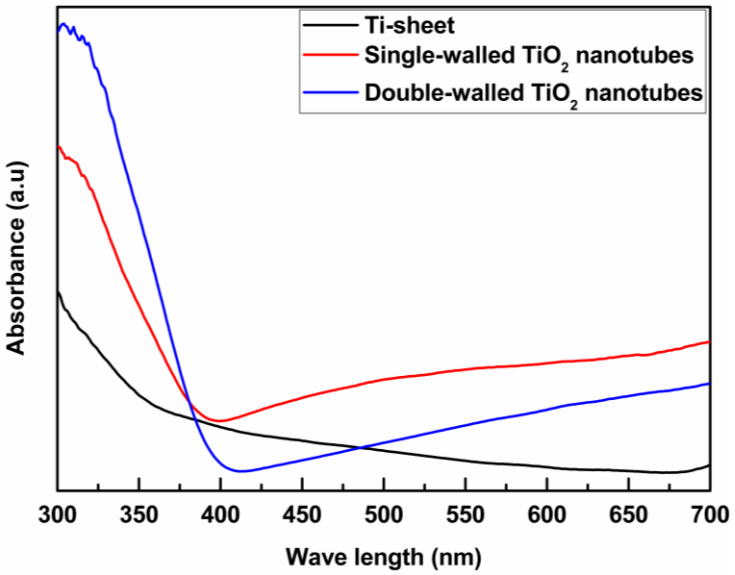

Figure S7. UV-vis absorption spectra of the single and doubled-wall TiO_2 nanotubes and Ti-sheet.

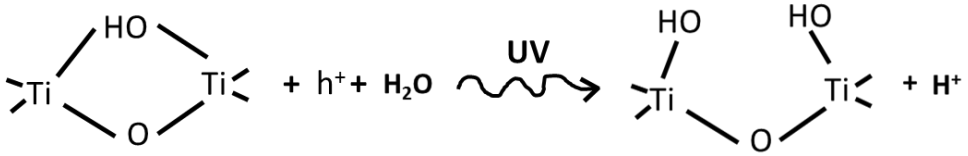

Figure S8. Hole-induced conversion of a single hydroxide bond to double hydroxide bonds through the interactio with a water molecule [21, 25, 26].

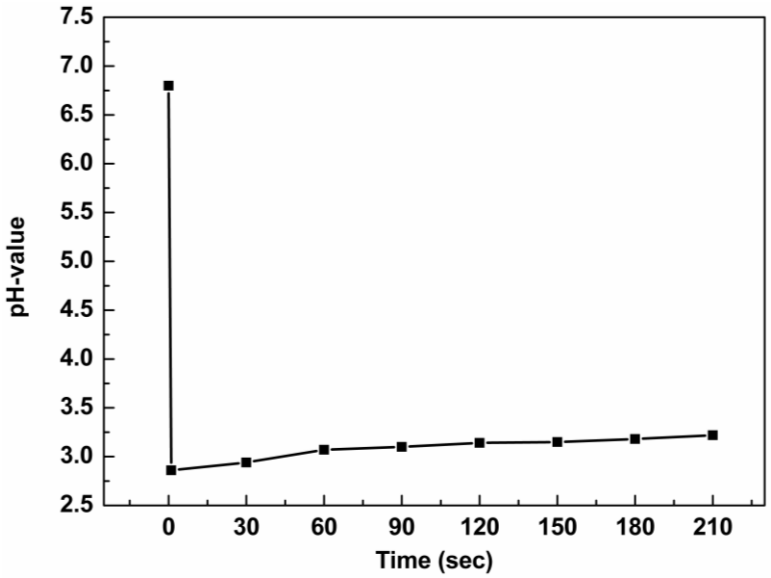

Figure S9. pH value of the electrolyte during the anodization with UV-illumination.

BET specific surface measurement and pore size distribution:

The BET measurement show the specific surface area of the single and double-walled TiO_2 nanotubes attached on Ti-substrate is 1.8 m^2/g and 2.8 m^2/g, respectively. However, it should be noted that these results have large error and can show only the relative surface area between the two nanotubes. This is because the TiO_2 nanotubes are attached on a Ti metal substrate, and hence, the exact weight of only the TiO_2 nanotubes can't be determined [1]. In order to measure the specific surface area and the pore size distribution of TiO_2 nanotubes accurately and more precisely, TiO_2 nanotubes have to be separated from the substrates [1-3] which is beyond the scope of the present manuscript.

Figure S10a give the N_2 adsorption-desorption isotherm of the single and doubled-wall TiO_2 nanotubes. The isotherm shows the typical behavior of the mesoporous and macroprous morphology [3, 4]. The isotherm exhibit that the double-walled TiO_2 nanotubes have high specific surface area compared to the single-walled TiO_2 nanotubes [4]. Figure S10b displays the Barrett–Joyner–Halenda (BJH) pore-size distributions of the single and doubled-wall TiO_2 nanotubes. The pore size distributions are relatively wide, ranging between 2.6 and 160 nm. The doubled-wall TiO_2 nanotubes exhibit the presence of multi-modal porosity ranging from mesoporous to macroporous morphology, which is consistence with our SEM results.

References

[1]. D. R. Baker and P. V. Kamat, *J. Phys. Chem. C,* 2009, 113, 17967 – 17972.

[2]. M. Paulose, H. E. Prakasan, O. K. Varghese, L. Peng, K. C. Popat, G. K. Mor, T. A. Desai, and C. A. Grimes, *J. Phys. Chem. C,* 2007, 111, 14992 – 14997.

[3]. K. Wang, M. Wei, M. A. Morris, H. Zhou, and J. D. Holmes, *Adv. Mater.*, 2007, 19, 3016-3020.

[4]. Chien-C. Tsai and H. Teng, *Chem. Mater.*, 2004, *16,* 4352- 4358.

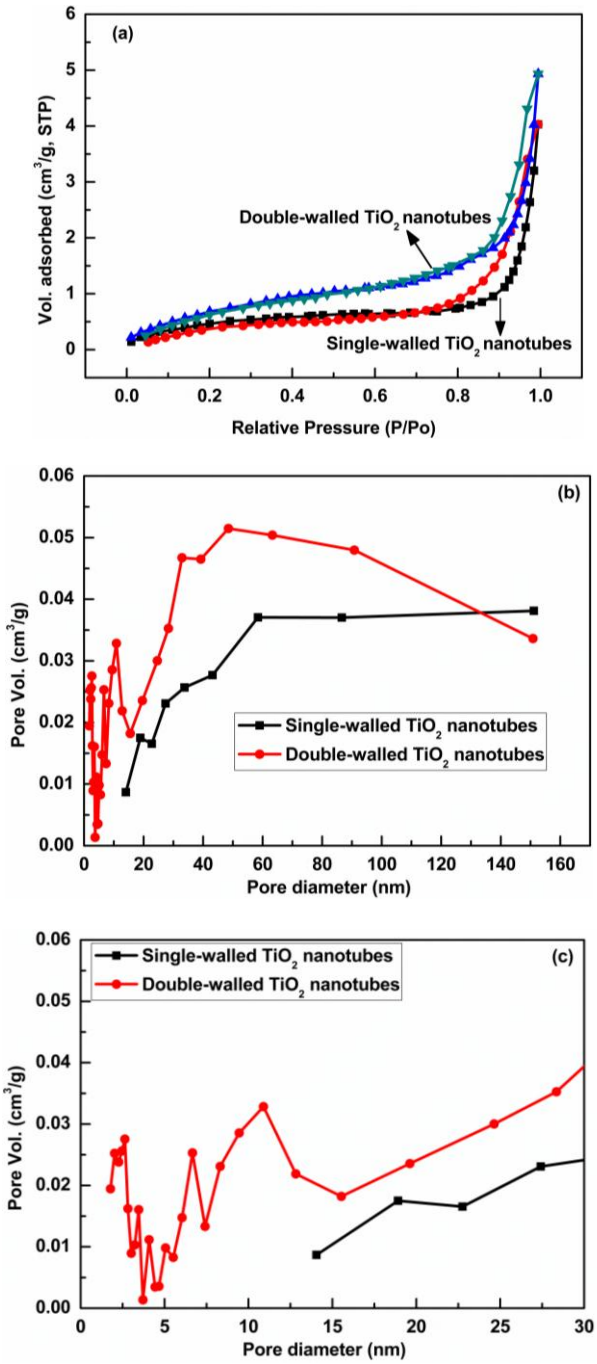

Figure S10. a) Nitrogen adsorption-desorption isotherm plots, and b) pore size distributions curve of the single and double-walled TiO_2 nanotubes, c) magnified part of (b).