Supplementary Information

# Synthesis of $TiO_2$ hollow spheres by selective etching of Au@$TiO_2$ core-shell nanoparticles for dye sensitized solar cell applications

*Min-kyeong Song, Prabhakar Rai, Yeon-Tae Yu**

Division of Advanced Materials Engineering and Research Centre for Advanced Materials Development, College of Engineering, Chonbuk National University, Jeonju 561-756, South Korea

*Corresponding Author: Y.-T. Yu (E-Mail: yeontae@jbnu.ac.kr, Tel: +82-63-270-2288, Fax: +82-63-270-2305).

**Fig. S1** Fabrication of DSCs.

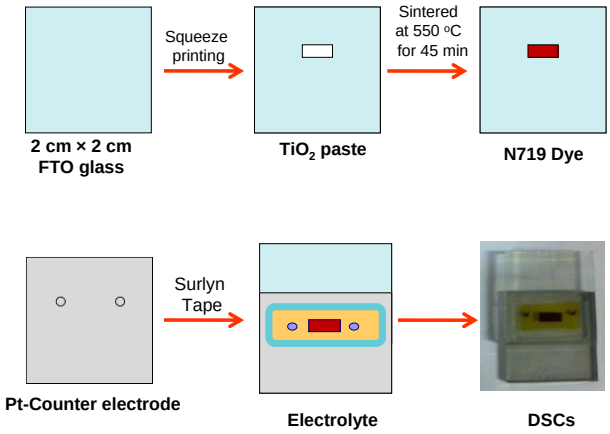



**Fig. S2** Crystallite size of $TiO_2$ in Au@$TiO_2$ core-shell NPs prepared by microwave-assisted hydrothermal method; (a) for 1 h at different reaction temperatures (100-180 $^{o}$C) and (b) at 180 $^{o}$C for different reaction times (1-15 h).

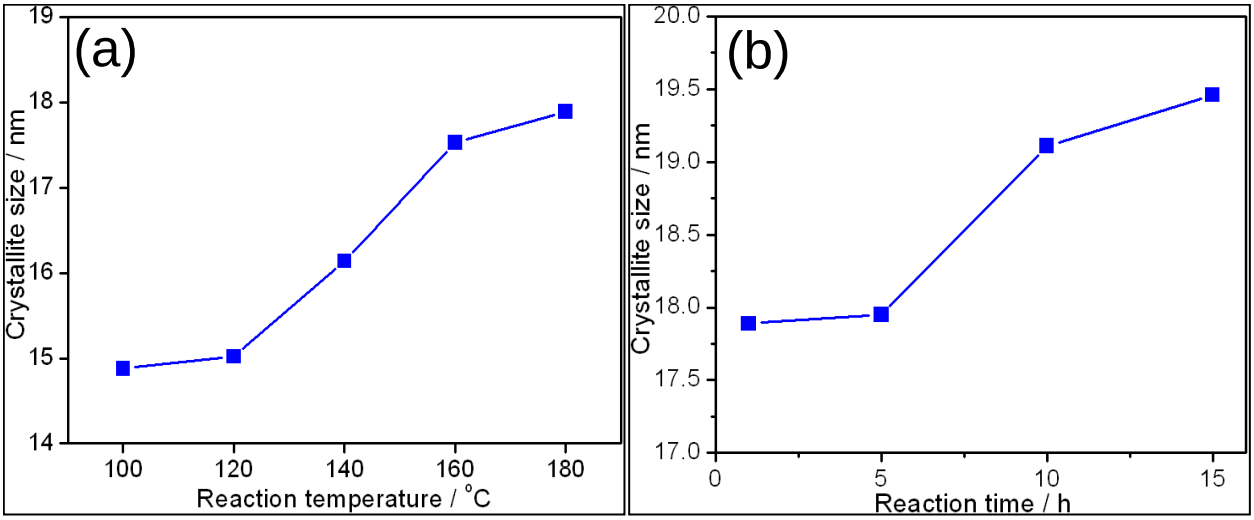


**Fig. S3** TEM images of Au@$TiO_2$ core-shell NPs synthesized at 180 $^oC$ for; (a) 1 h, (b) 5 h, (c) 10 h and (d) 15 h.

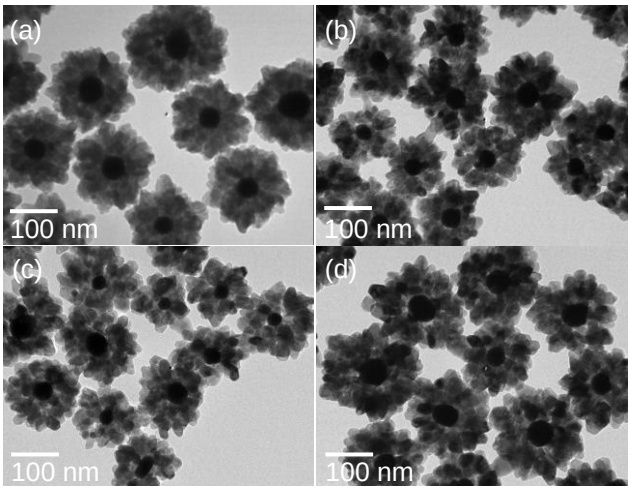
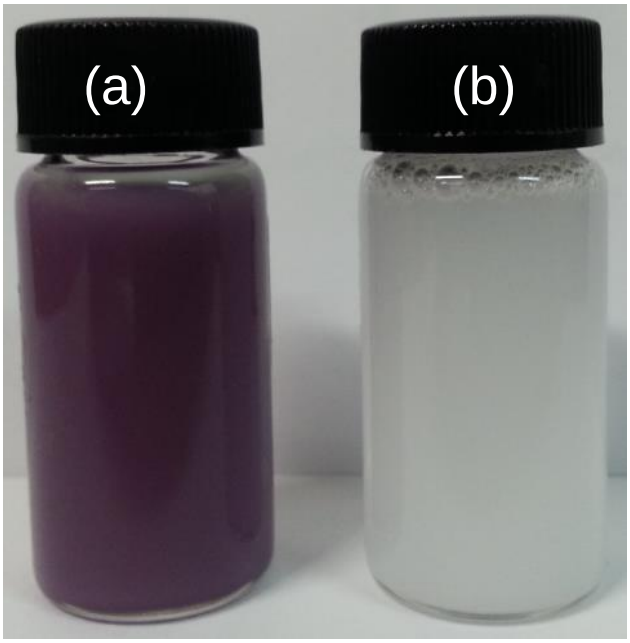



**Fig. S4** Photograph of Au@$TiO_2$ core-shell NPs solution in water (a) before and (b) after electrolyte treatment.



**Stability of Au@$TiO_2$ core-shell NPs in electrolyte**; For this study, 0.02g of Au@$TiO_2$ core-shell NPs was dispersed in 500 µL electrolyte and stir for 30 min and kept for 24 h. Finally, it was washed with acetone and water several time and centrifuged. The precipitate was re-dispersed in water for UV visible spectroscopy and TEM analysis.

**Fig. S5** Comparison with BET surface area of commercial $TiO_2$ and hollow $TiO_2$ NPs.