Electronic Supplementary Materials

Facile Synthesis of Hollow Dendritic Ag/Pt Alloy Nanoparticles for Enhanced Methanol Oxidation Efficiency

Ning Sui, Ke Wang, Xinyao Shan, Qiang Bai, Lina Wang, Hailian Xiao, Manhong Liu, Vicki L. Colvin, William W. Yu

Synthesis of Au Colloid. 49 mL 0.25 mM $HAuCl_4$ solution was boiled, 1.0 mL 0.06M sodium citrate was injected quickly to the above boiling $HAuCl_4$, the solution was kept boiling for 20 min. After the heating was stopped, the Au colloid was cooled to room temperature naturally.

Synthesis of Au@Ag Core−Shell Nanoparticles. 60 μL AA (0.1 M), 15 μL $AgNO_3$ (0.1 M), and 10 μL NaOH (0.1 M) were added to the prepared Au colloid (10mL, 0.25 mM) at room temperature. This procedure was repeated every 20 minutes for 10 times, and the reaction was finished after 2 hours.

Synthesis of Au@porous Ag/Pt Yolk-Shell Nanoparticles. 25 mg Brij58 was dispersed in 5 mL of the above prepared Au@Ag solution and stirred for 30 min. A certain volume of H_2PtCl_6 (20 mM, 450 μL) and AA (0.1 M, 450 μL) were added, then reacted for 12 h. The solution was centrifuged with water and ethanol after the reaction, and dried under vacuum.

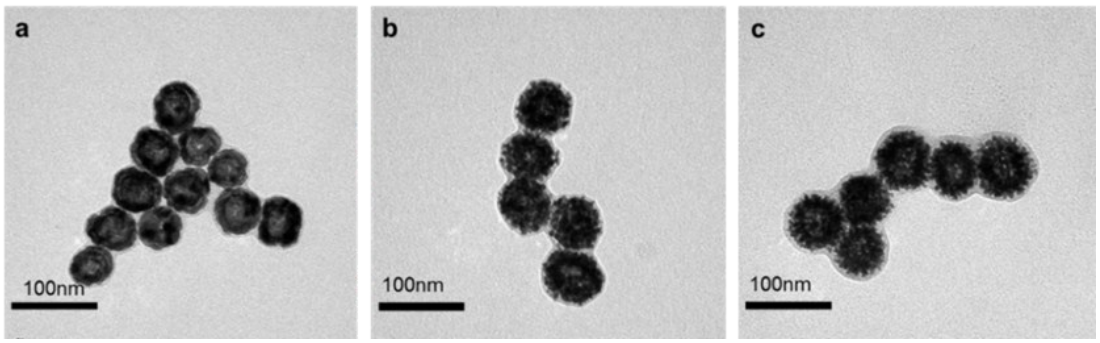

Fig. S1. TEM images of nanoparticles obtained using different surfactants: (a) P123, (b) F127, and (c) Brij58.

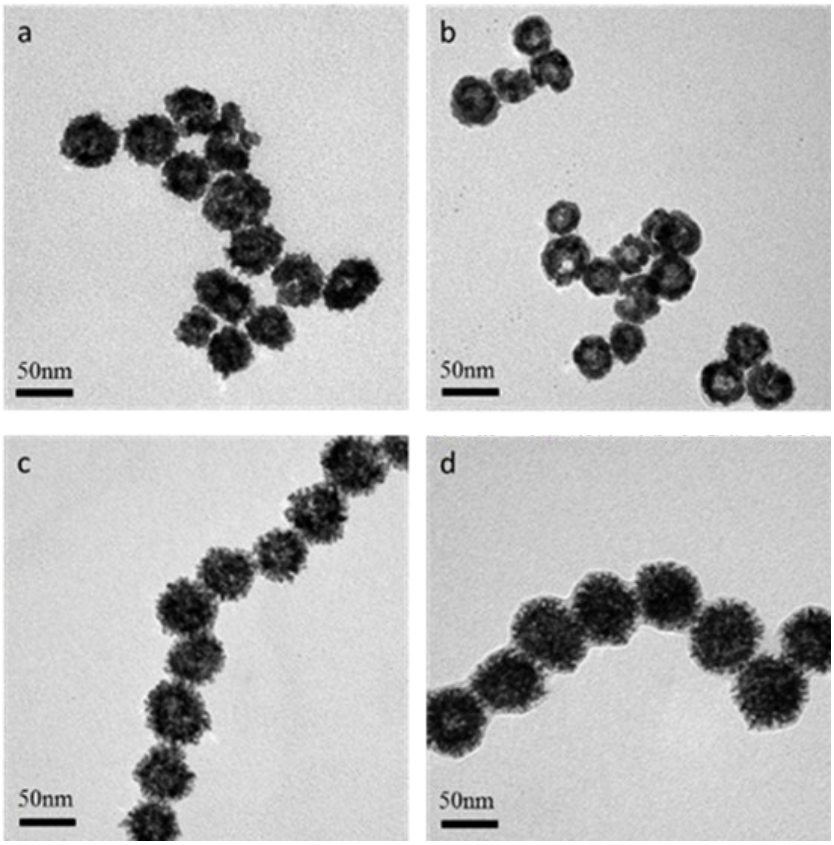

Fig. S2. TEM images of nanoparticles obtained at different surfactant concentrations: (a) 0 mg/mL, (b) 0.1 mg/mL, (c) 1 mg/mL, and (d) 10 mg/mL.

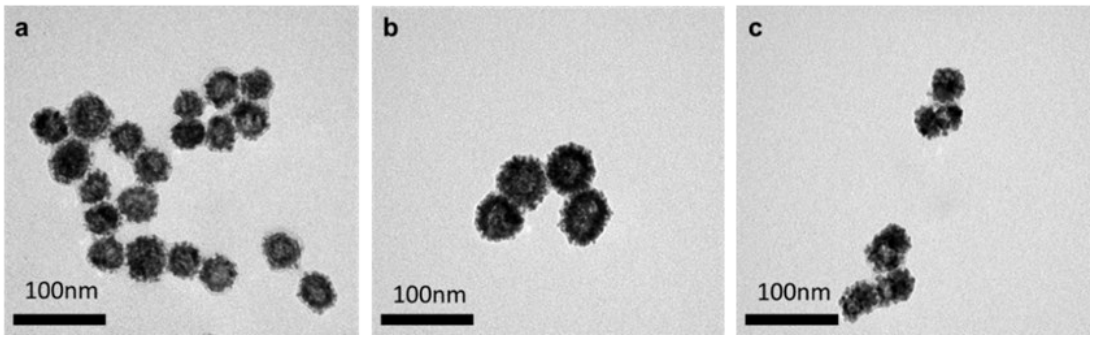

Fig. S3. TEM images of nanoparticles synthesized at different reaction temperatures: (a) 25 °C, (b) 50 °C, and (c) 80 °C.

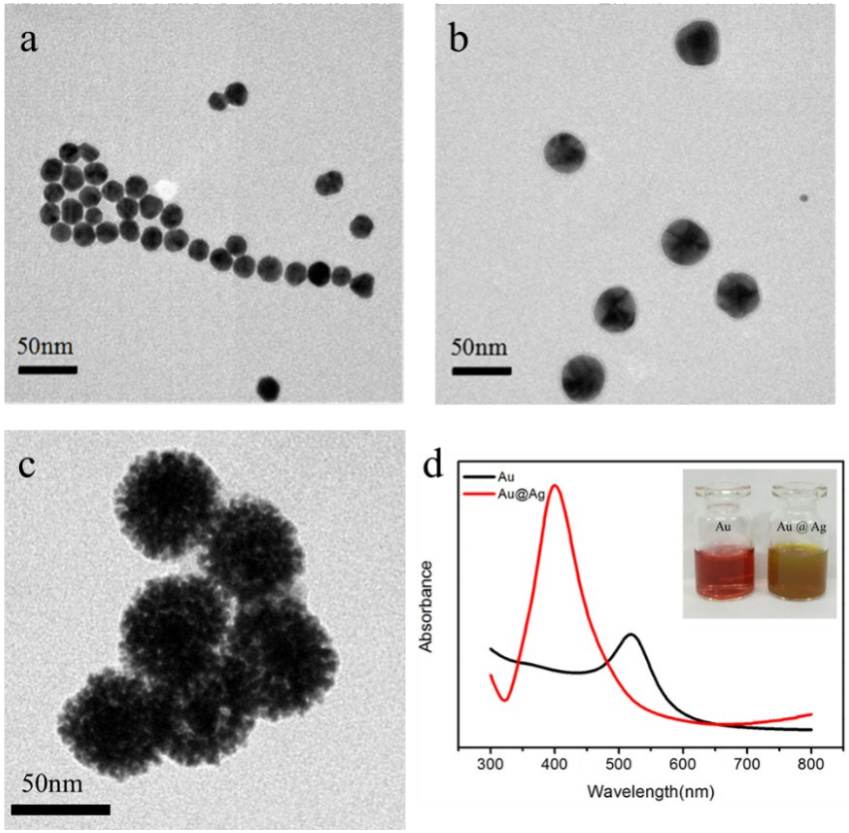

Fig. S4. TEM images of nanoparticles: (a) Au, (b) Au@Ag, (c) Au@porous Ag/Pt yolk-shell. (d) UV-vis absorption spectra of Au@Ag and Au.

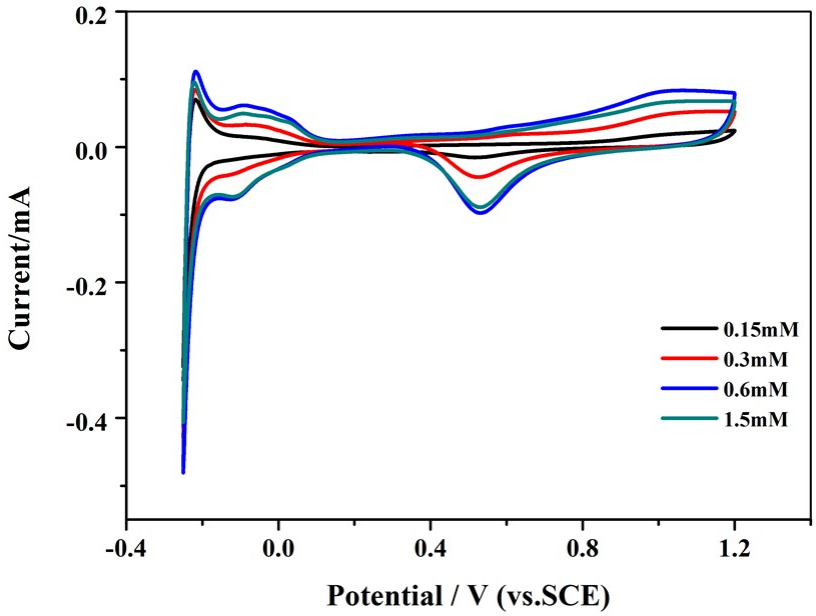

Fig. S5. CV curves of four different catalysts in the electrolytic solution of 0.5 M H_2SO_4.

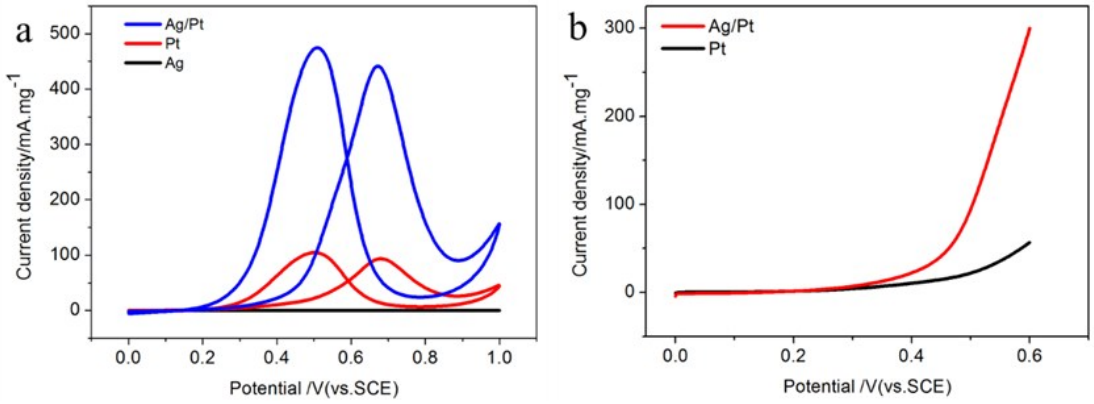

Fig. S6. CV (a) and LSV (b) curves for methanol oxidation over hollow dendritic Ag/Pt alloy nanoparticles, pure Pt and pure Ag nanoparticles in 0.5 M H_2SO_4 containing 1 M CH_3OH.

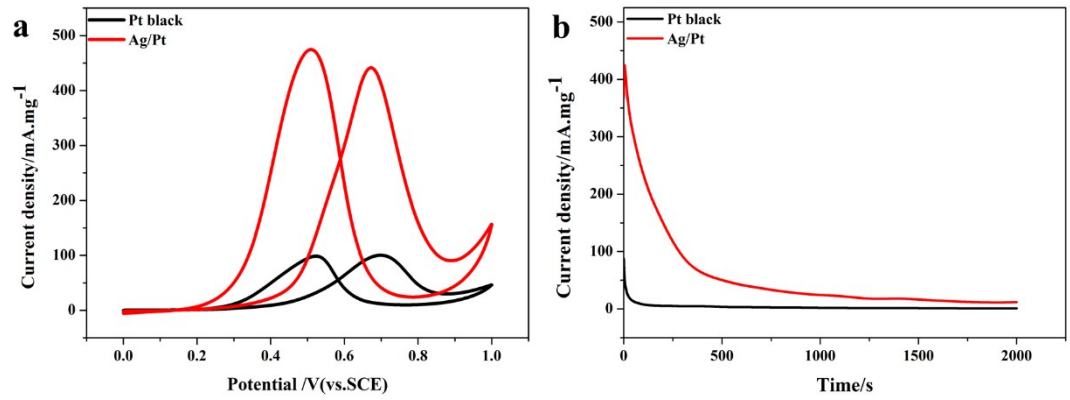

Fig. S7. CV (a) and CA (b) curves for methanol oxidation over commercial Pt black and hollow dendritic Ag/Pt alloy nanoparticles in 0.5 M H_2SO_4 containing 1 M CH_3OH.

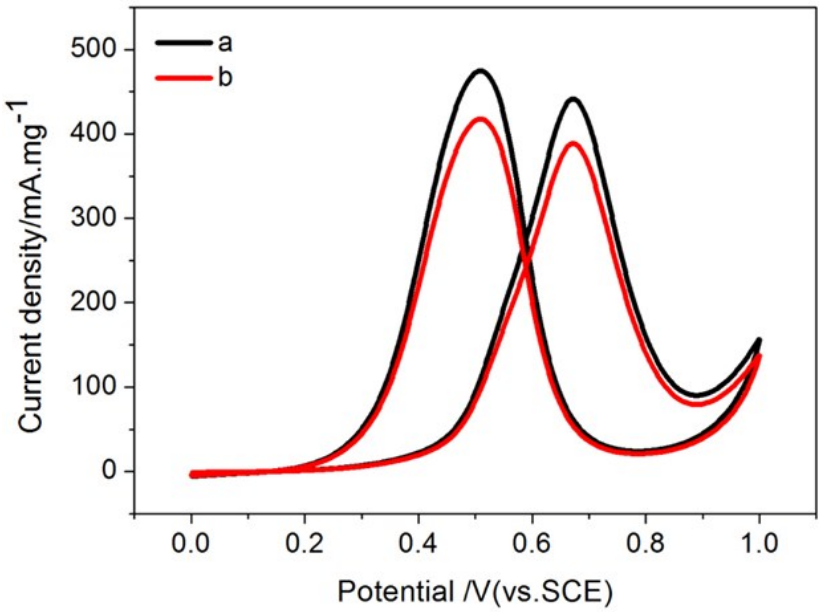

Fig. S8. CV curves for methanol oxidation over Ag/Pt nanoparticles: (a) fresh electrode, (b) the same electrode stored after a week.

Table S1 Peak current densities of different catalysts (0.5 M H_2SO_4 and 1 M CH_3OH)

Catalyst	Current density ($mA \cdot mg^{-1}$)	Reference
Au@porous Pt	107.5	1
Pd@Pt/C	111.3	2
PtPd hollow nanosphere	275.2	3
Dendritic Pt/macroporous carbon	300	4
Pt hollow nanophere	220	5
PtRu/graphene	339.2	6
Au@Pd@Pt	430	7
Pt-on-Pd bimetallic nanodendrite	490	8
Hollow dendritic Ag/Pt alloy nanoparticle	440	This work

References

1 H. Zhang, H. Wang, K. Eid and L. Wang, *Part. Part. Syst. Char.*, 2015, **32**, 863-868.

2 Q. Wang, Y. Li, B. Liu, G. Xu, G. Zhang, Q. Zhao and J. Zhang, *J. Power Sources*, 2015, **297**, 59-67.

3 Q. Lu, H. Wang, K. Eid, Z.A. Alothman, V. Malgras, Y. Yamauchi and L. Wang, *Chem-Asian J.*, 2016, **11**, 1939-1944.

4 X. Yu, Y. Zhang, L. Guo and L. Wang, *Nanoscale*, 2014, **6**, 4806-4811.

5 M. Yang, Q. Cai, C. Liu, R. Wu, D. Sun, Y. Chen, Y. Tang and T. Lu, *J. Mater. Chem. A*, 2014, **2**, 13738-13743.

6 Z. Bo, D. Hu, J. Kong, J. Yan and K. Cen, *J. Power Sources*, 2015, **273**, 530-537.

7 L. Wang and Y. Yamauchi, *Chem. Mater.*, 2011, **23**, 2457-2465.

8 L. Wang, Y. Nemoto and Y. Yamauchi, *J. Am. Chem. Soc.*, 2011, **133**, 9674-9677.