Supporting Information

Superior electrocatalytic activity of ultrathin PtPdBi nanowires towards ethanol electrooxidation

Xiao-Ting Zhang,[a] Lin-Nan Zhou,[a] Yan-Yan Shen,[a] Hong-Tao Liu*[b] and Yong-Jun Li*[a]

[a]*State Key Lab of Chemo/Biosensing and Chemometrics, School of Chemistry and Chemical Engineering, Hunan University, Changsha 410082, China. E-mail: liyje@hnu.edu.cn*

[b]*College of Chemistry and Chemical Engineering, Central South University, Changsha 410082, China. E-mail: liuht@csu.edu.cn*

Synthesis of PtPdBi tri-metallic nanowires [1]**.** Typically, PVP (55 mg) was dissolved into 9.4 mL of EG in a flask (solution1); a specified amount of $Na_2PtCl_4{\cdot}3H_2O$, $Bi(NO_3)_3{\cdot}5H_2O$(3.6 mg) and EG (1.0 mL) were dissolved into a specified amountof 0.01 $mol{\cdot}L^{-1}$ H_2PdCl_4 aqueous solution (solution 2). Solution 1 was heated to 170 ^oC under a flow of argon gas and then solution 2 was rapidly injected. The reaction solution was kept at 170 ^oC under magnetic stirring for 15 min and then cooled to room temperature. The atomic ratios of Pt to Pd in tri-metallic composites can be tuned by changing the feeding molar ratio of $Na_2PtCl_4{\cdot}3H_2O$ to H_2PdCl_4 when other conditions were kept unchanged. When 21.3 mg of $Na_2PtCl_4{\cdot}3H_2O$ and 2.441 mL of 0.01 $mol{\cdot}L^{-1}$ H_2PdCl_4 was used, the as-prepared samplewas referred to as $Pt_{55}Pd_{38}Bi_7$; 16.0 mg of $Na_2PtCl_4{\cdot}3H_2O$ and 3.662 mL of 0.01 $mol{\cdot}L^{-1}$ H_2PdCl_4 constituted $Pt_{41}Pd_{52}Bi_7$. According to the approach above, $Pt_{70}Pd_{23}Bi_7$ nanowires were also prepared when 24 mg of $Na_2PtCl_4{\cdot}3H_2O$, 3.6 mg of $Bi(NO_3)_3{\cdot}5H_2O$ and 1.88 mL of 0.01 $mol{\cdot}L^{-1}$ H_2PdCl_4 were used.

Synthesis of $Pd_{92}Bi_8$ nanowires [1]**.** 27.5 mg of PVP was dissolved into 9.4 mL of ethylene glycol and heated to 170 ^oC under a flow of argon gas. Subsequently, the mixture of 3.662 mL of 0.01 $mol{\cdot}L^{-1}$ H_2PdCl_4 aqueous solution and 1.8 mg of $Bi(NO_3)_3{\cdot}5H_2O$ was injected rapidly. The reaction solution was kept at 170 ^oC under magnetic stirring for 30 min before being cooled to room temperature.

Synthesis of $Pt_{50}Pd_{50}$ nanoparticles [1]**.** Ethylene glycol (9.4 mL) and PVP (55 mg) were mixed in a flask (solution 1); $Na_2PtCl_4{\cdot}3H_2O$ (16.0 mg), ethylene glycol (1.0 mL) were dissolved into 3.662 mL of 0.01 $mol{\cdot}L^{-1}$ H_2PdCl_4 aqueous solution (solution 2). Solution 1 was heated to 170 ^oC under a flow of argon gas and then solution 2 was rapidly injected. The reaction solution was kept at 170 ^oC under magnetic stirring for 15 min before being cooled to room temperature.

To remove EG and excess PVP, all resultant colloids were centrifuged at 3000 rpm for 15 min. The solid product was redispersed into acetone and centrifuged at 9000 rpm. After discarding the supernatant, the

product was washed twice with ethanol by centrifugation at 9000 rpm. The final product was dried naturally in air for characterization and use.

Table S1 ECSAs of $Pt_xPd_{93-x}Bi_7/C$ or RGO estimated by integrating the adsorption-desorption peaks of hydrogen in Figure S2.

Samples	**ECSA/ $m^2.g^{-1}$**
$Pt_{70}Pd_{23}Bi_7/C$	54.6
$Pt_{55}Pd_{38}Bi_7/C$	73.7
$Pt_{41}Pd_{52}Bi_7/C$	50.5
$Pt_{70}Pd_{23}Bi_7/RGO$	80.6
$Pt_{55}Pd_{38}Bi_7/RGO$	136.6
$Pt_{41}Pd_{52}Bi_7/RGO$	57.1

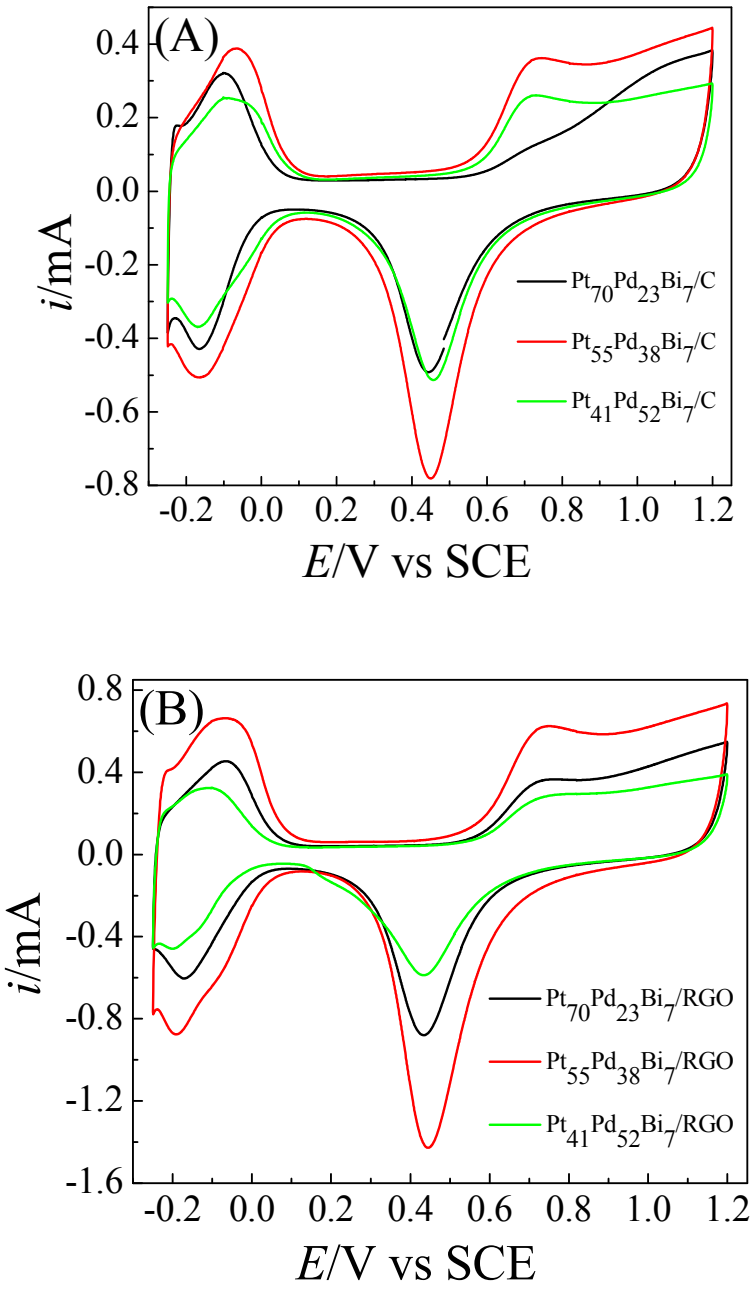

Figure S1 Cycle voltammograms of $Pt_{70}Pd_{23}Bi_7$, $Pt_{55}Pd_{38}Bi_7$ and $Pt_{41}Pd_{52}Bi_7$ catalysts supported on Vulcan XC72 carbon (A) and RGO (B) in 0.5 mol/L H_2SO_4 at a scan rate of 50 $mV \cdot s^{-1}$.

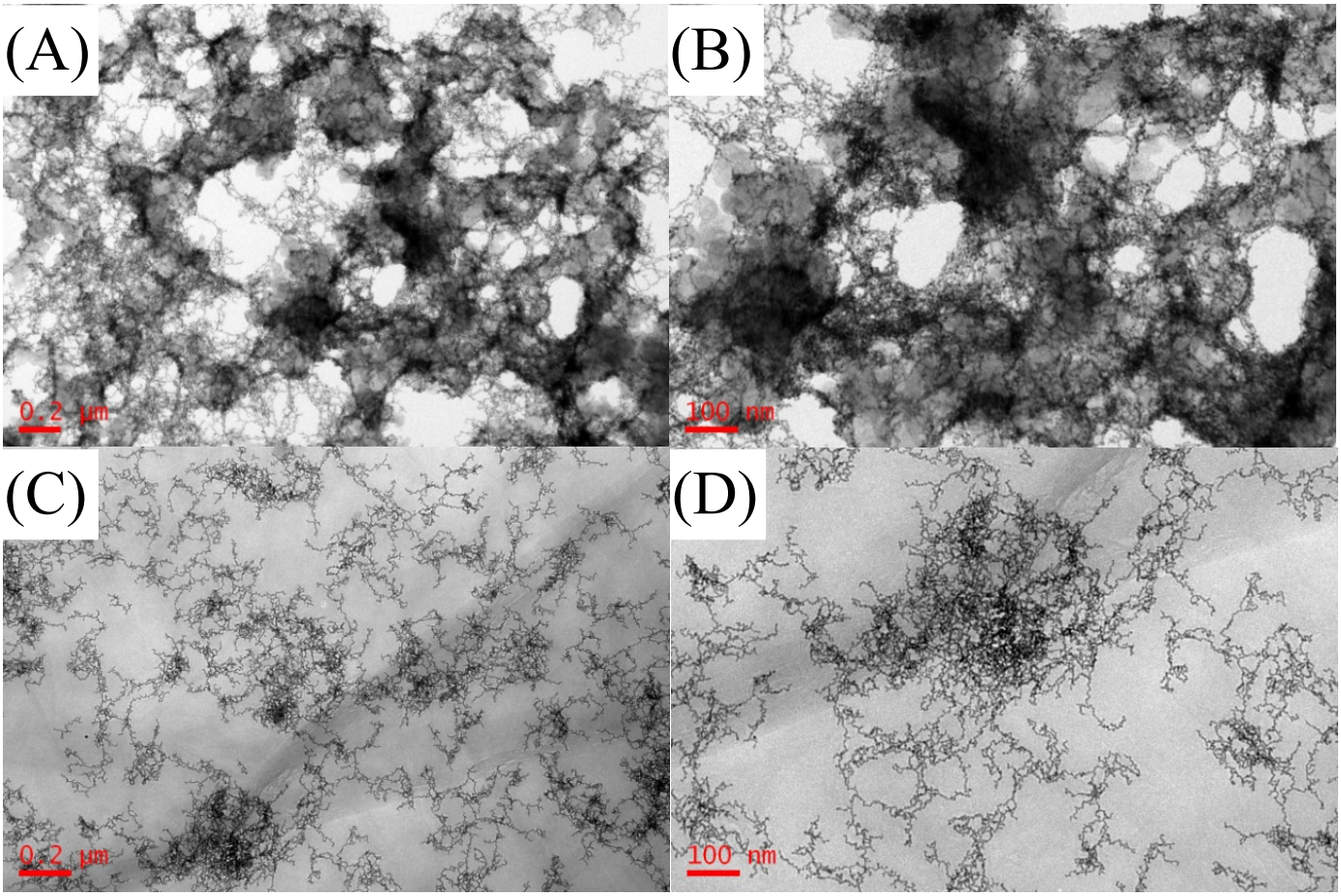

Figure S2 TEM images of $Pt_{55}Pd_{38}Bi_7$/C (A and B) and $Pt_{55}Pd_{38}Bi_7$/RGO (C and D) with different magnifications.

References

[1] Y.-Y. Shen, Y. Sun, L.-N. Zhou, Y.-J. Li, E. S. Yeung, *J. Mater. Chem. A*, 2014, **2**, 2977-2984