2D Petal-Like PdAg Nanosheets Promote Efficient Electrocatalytic Oxidation of Ethanol and Methanol

Yuhua Xu[a, b], Jie Li[a], Mengyu Hu [a], Zhengying Wu*[, c], Yukou Du *[, a]

[a]*College of Chemistry, Chemical Engineering and Materials Science, Soochow University, Suzhou 215123, China*

[b]*The school of science, Xi'an Jiaotong-liverpool University, Suzhou 215028, China*

[c]*Jiangsu Key Laboratory for Environment Functional Materials, School of Materials Science and Engineering, Suzhou University of Science and Technology, Suzhou 215009, China*

* *Corresponding author: E-mail: zywu@mail.usts.edu.cn* (Z. Wu)*; duyk@suda.edu.cn* (Y. Du)

Experimental section

Preparations of PdAg NSs and Pd NSs. In a synthesis of $PdAg_{1.5}$ NSs, Na_2PdCl_4 (7.3 mg), $Mo(CO)_6$ (20 mg), hexadecyl trimethyl ammonium chloride (41mg), $AgNO_3$ (1.5 mg), polyvinyl pyrrolidone (40 mg), 2.5 mL benzyl alcohol and 500 μL acetylacetone were added into a glass bottle (volume: 35 mL). After ultrasonication for about 50 minutes, the mixture was then heated to 100 °C and maintained for 3 h in an oil bath. The synthesis of Pd NSs was similar to that of $PdAg_{1.5}$ NSs, except without the addition of $AgNO_3$. The synthesis of $PdAg_{0.5}$ and $PdAg_1$ NSs was similar to that of $PdAg_{1.5}$ NSs, except the addition of 0.5 mg and 1 mg $AgNO_3$.

Electrochemical tests. The electrochemical measurements of all catalysts were performed at a three-electrode system. a saturated calomel electrode (SCE), a glassy carbon electrode (GCE) (diameter: 5 mm, area: 0.196 cm^2), and a Pt wire were used as the reference, working, and counter electrodes, respectively. The ECSAs were determined by the reduction peak of PdO in cycle voltammetry curves with 50 mV s^{-1} in 1 M KOH. EOR and MOR performance tests were performed in 1 M KOH + 1 M

ethanol at 50 mV s^{-1} and 1 M KOH + 1 M methanol, respectively.

Characterizations

Transmission electron microscopy (TEM) was conducted on a HITACHI HT7700 transmission electron microscope at an accelerating voltage of 120 kV. High-resolution TEM (HRTEM) and HAADF-STEM images were implemented on an Tolos F200X G2 field emission transmission electron microscope operated at 200 kV. An X'Pert-Pro MPD diffractometer (PANalytical, Netherlands) was used to collect the X-ray diffraction (XRD) patterns. X-ray photoelectron spectroscopy (XPS) was used to investigate the surface composition the products on Thermo Scientific, ESCALAB 250 XI.

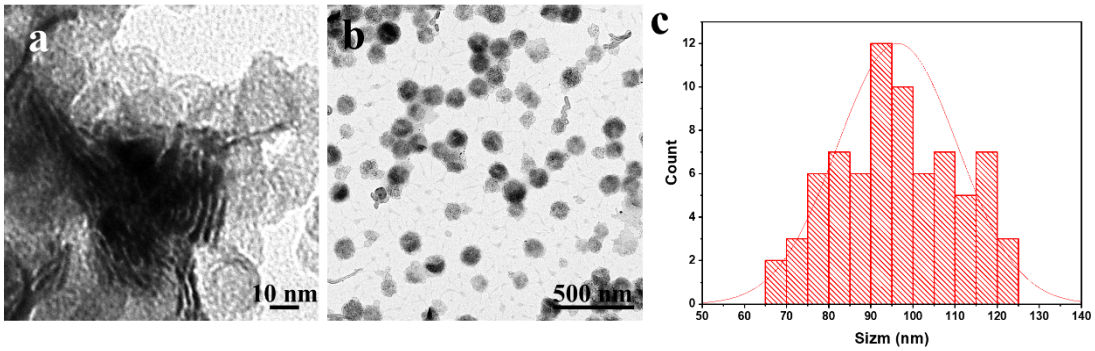

Fig. S1 (a) TEM of erect nanosheets, (b, c) TEM image and corresponding histogram of diameter distribution of $PdAg_{1.5}$ NSs.

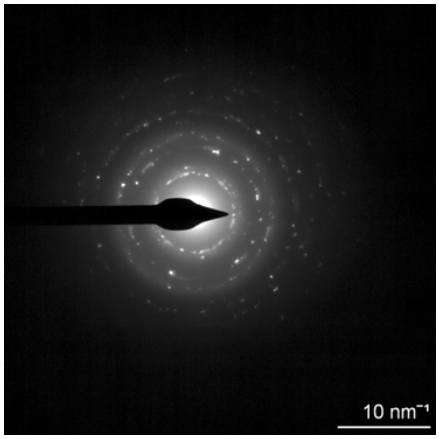

Fig. S2 SAED pattern of PdAg NSs.

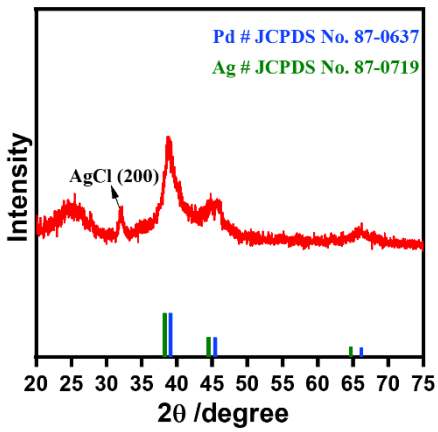

Fig. S3 XRD pattern of $PdAg_{1.5}$ NSs.

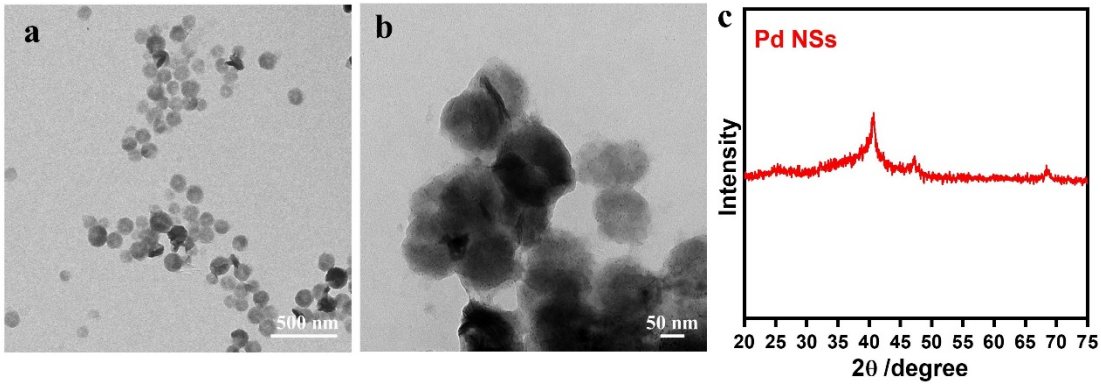

Fig. S4 (a, b) TEM image, (c) XRD pattern of Pd NSs.

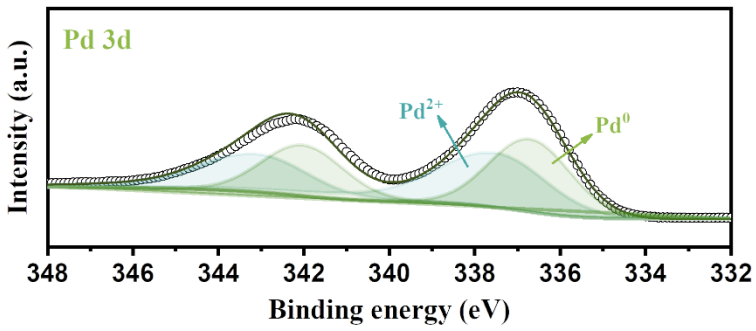

Fig. S5 (f)Pd 3d XPS spectra of Pd NSs.

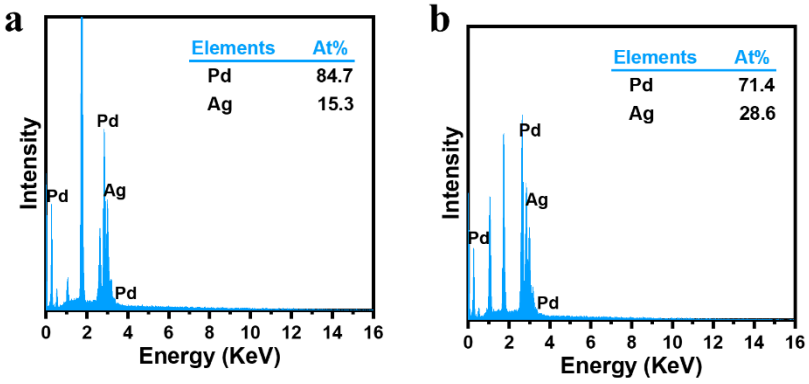

Figure S6. EDS pattern of $PdAg_{1.5}$ NSs intermediate products collected at 5 min (a), 25 min (b).

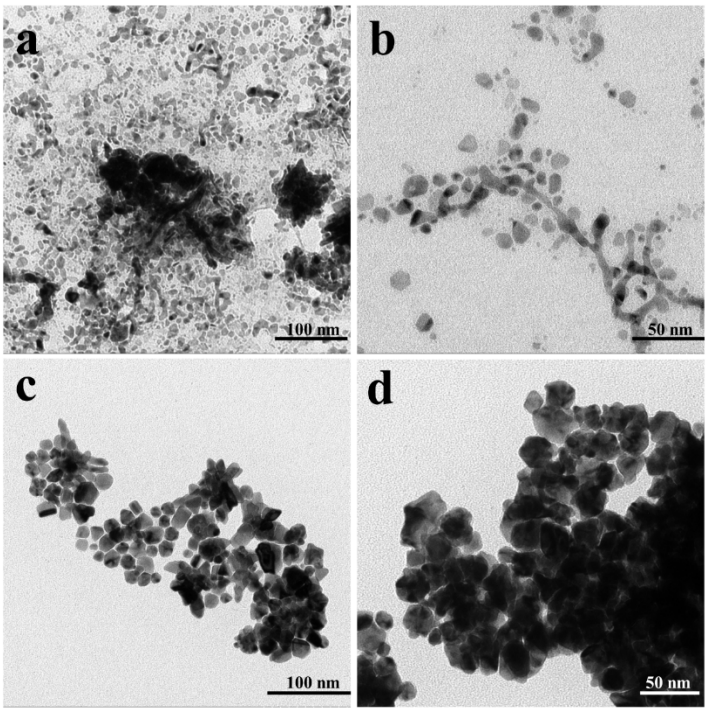

Fig. S7 (a, b) TEM images of the products in the absence of CTAC. (c, d) TEM images of the products in the absence of $Mo(CO)_6$.

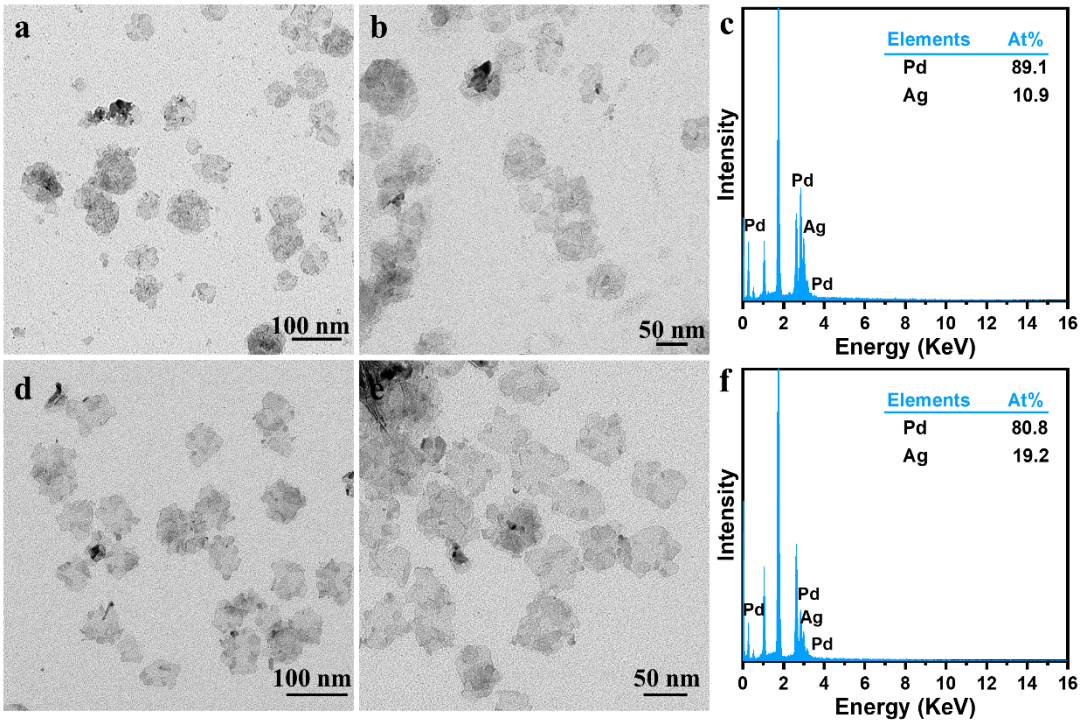

Fig. S8 (a, b, c) TEM images and EDS spectrum of $PdAg_{0.5}$ NSs with the use of 0.5 mg $AgNO_3$. (d, e, f) TEM images and EDS spectrum of $PdAg_1$ NSs with the use of 1 mg $AgNO_3$.

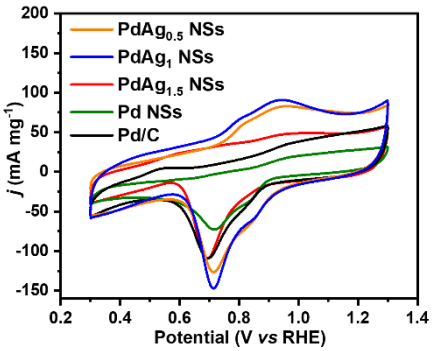

Figure S9. CV curve in 1 M KOH solution.

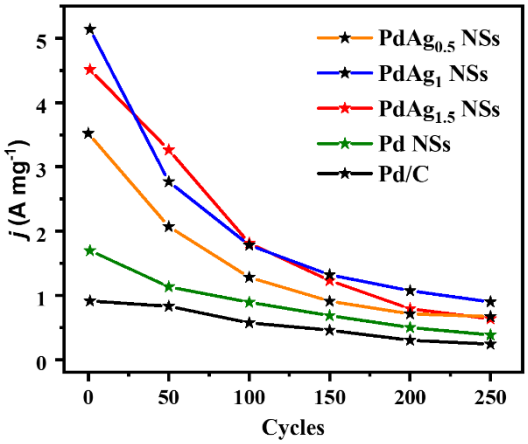

Figure S10. The mass ass activity variation during the consecutive CV tests of $PdAg_{0.5}$ NSs, $PdAg_1$ NSs, $PdAg_{1.5}$ NSs, Pd NSs, and Pd/C catalysts toward EOR.

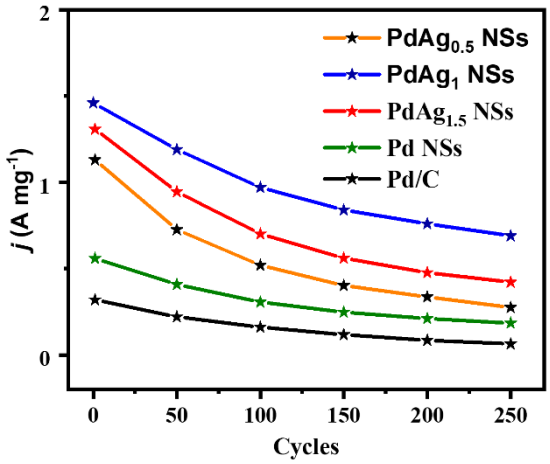

Fig. S11 The mass ass activity variation during the consecutive CV tests of PdAg NSs, Pd NSs, and Pd/C catalysts toward EOR.

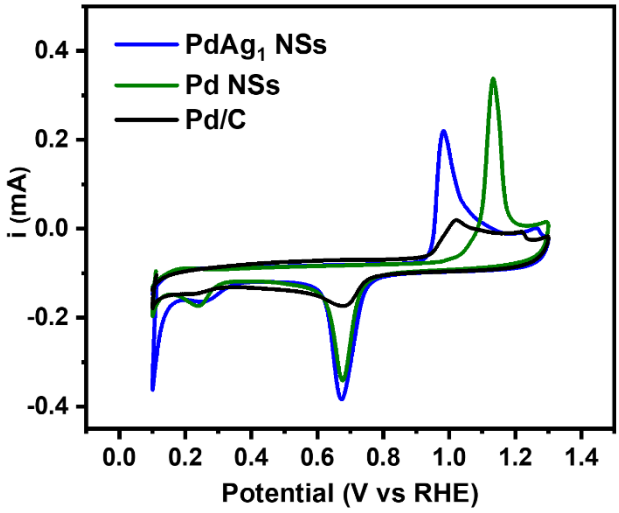

Fig. S12 CO stripping curves of $PdAg_1$ NSs, Pd NSs, and Pd/C in 0.1 M $HClO_4$ electrolyte at room temperature with a scan rate of 20 mV s^{-1}.

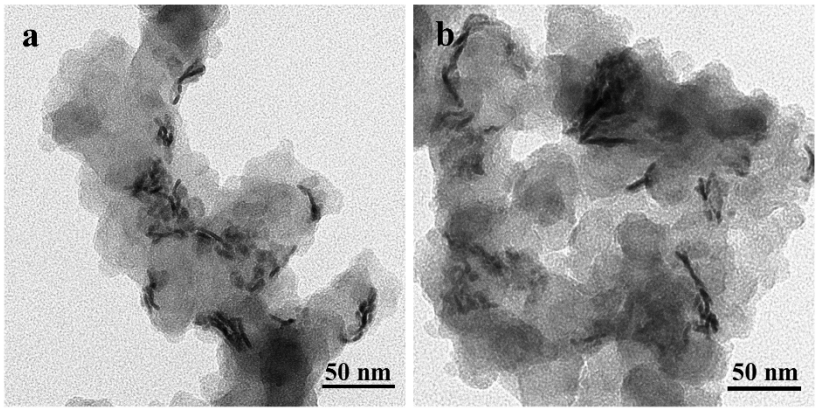

Fig. S13 TEM image of PdAg NSs/C before (a), after (b) electrochemical tests.

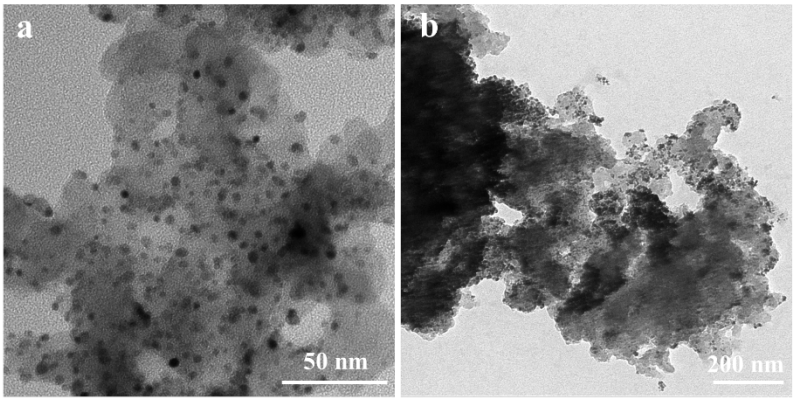

Fig. S14 TEM image of Pd/C before (a), after (b) electrochemical tests.