Supporting information

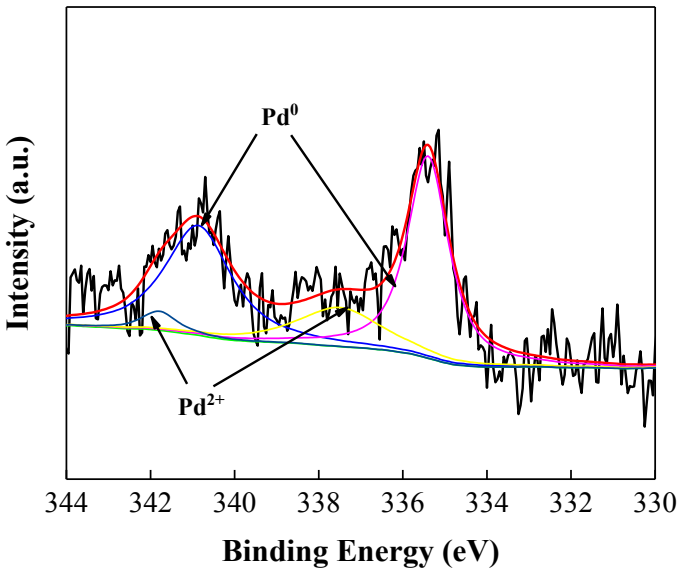

Fig. S1 XPS plots of Pd NPs in Pd@mSiO$_2$ NPs after hydrogen reduction

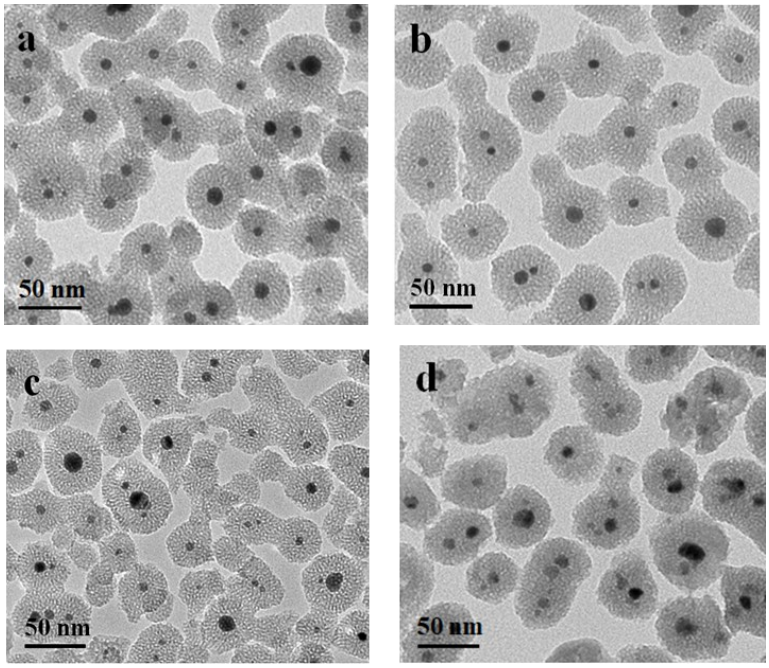

Fig.S2 TEM image of Pd@mSiO$_2$ calcined at different temperatures: (a) 500 °C, (b) 600 °C, (c) 700 °C, (d) 800 °C.

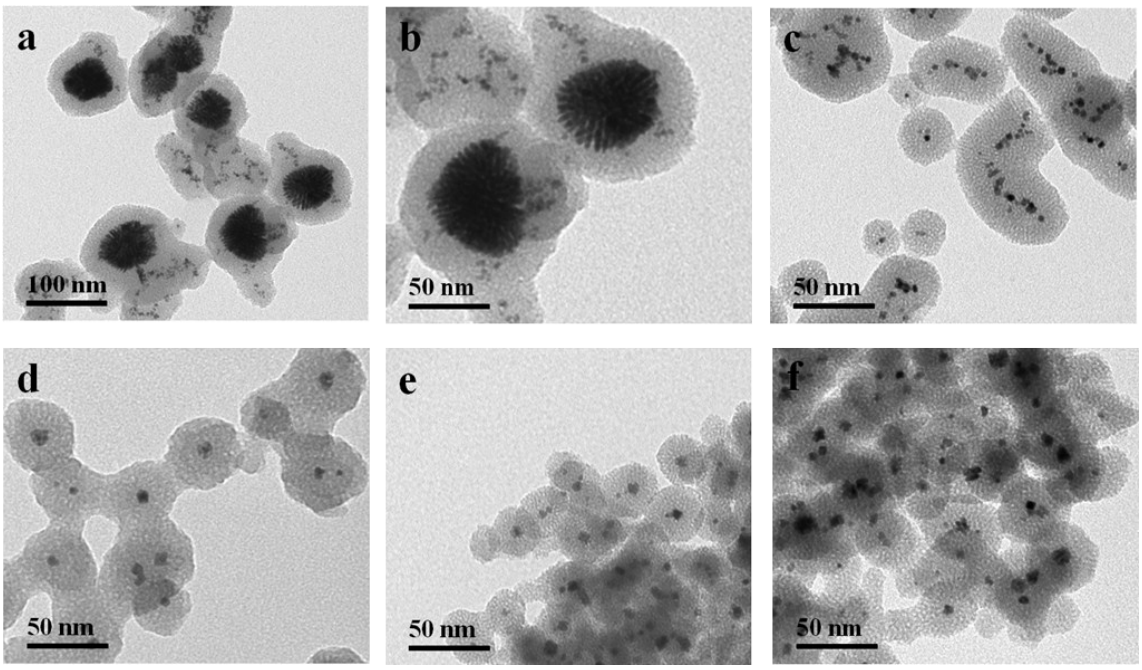

Fig.S3 TEM image of the influence of different CTAB concentrations on Pd@SiO_2 core-shell structure:

(a) 2.7 mM, (b) 2.7 mM. (c) 4.39 mM, (d) 6.59 mM, (e) 8.78 mM (f) 10.98 mM.

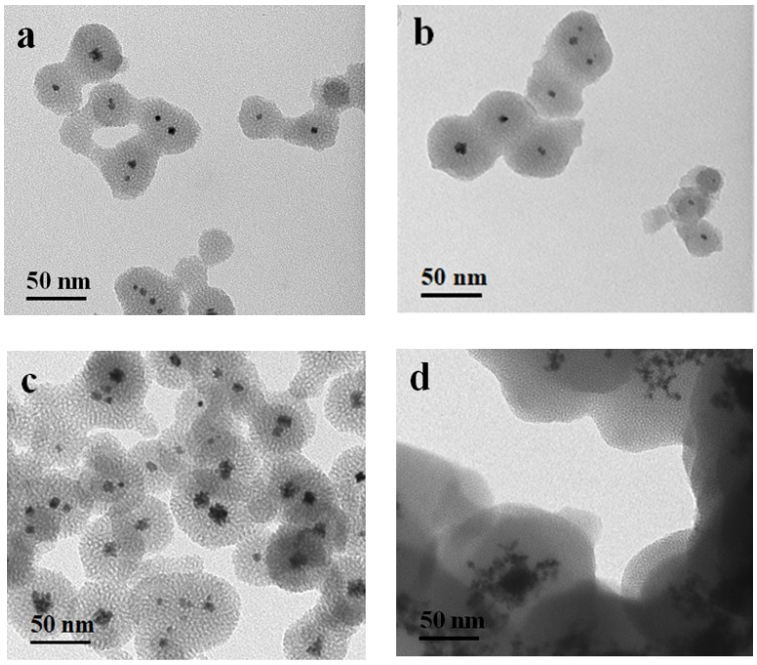

Fig.S4 TEM image of the influence of pH on Pd@SiO_2 core-shell structure: (a) 1.0 mL, (b) 1.4 mL, (c)

1.8 mL, (d) 2.2 mL.

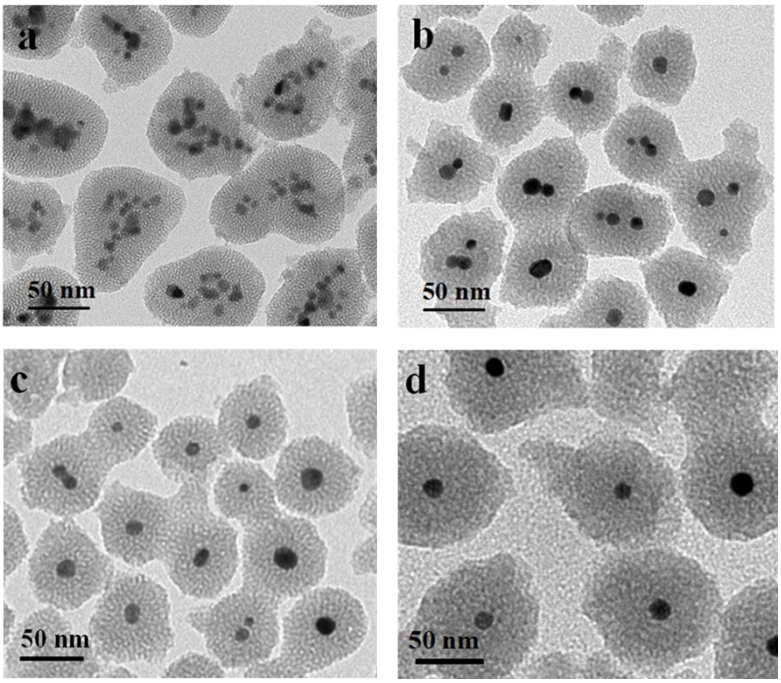

Fig.S5 The TEM images of as-synthesized Pd@mSiO$_2$ obtained under different Pd:TEOS ratios conditions：(a) 1:5, (b) 1:8, (c) 1:10, (d) 1:12.

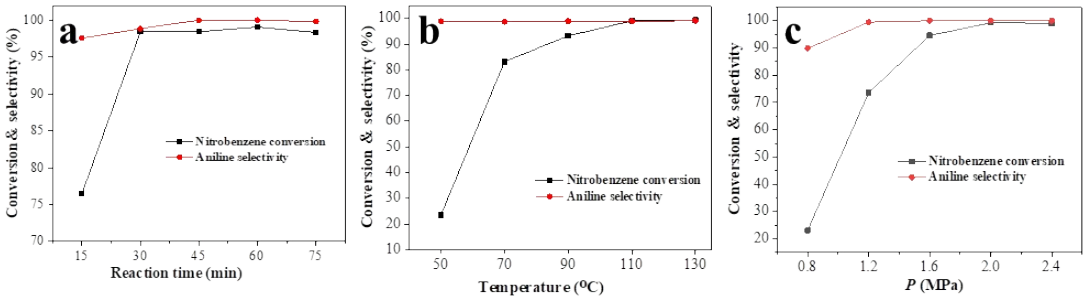

Fig.S6 Using Pd @ mSiO$_2$ with a shell thickness of 17 nm and CTAB as a structure-directing agent as catalyst to investigate the optimal reaction conditions; reaction time: 30 min, H_2 pressure: 2.0 MPa and reaction temperature: 110 °C.

Catalysts	Surfactant	BET surface area (m^2/g)	Pore size (nm)	Pore volume (cm^3/g)	ICP (wt %)	ICP (after five cycles) (wt %)
Pd@mSiO_2	C_{16}TAB	640.13	2.39	0.85	6.24	5.97
Pd/SiO_2	-	13.27	-	-	2.53	0.89
Pd/MCM-41	-	900	3.7	-	2.79	1.35

Table.S1 mesoporous silica shell parameters and metal contents of the different types of catalysts synthesized

Shell Thickness (nm)	BET surface area (m^2/g)	Pore size (nm)	Pore volume (cm^3/g)	ICP (wt %)
17 nm	640.13	2.39	0.85	6.24
28 nm	435.92	2.38	0.62	4.03

Table.S2 mesoporous silica shell parameters and metal contents of the catalyst samples.

Catalysts	Surfactant	BET surface area (m^2/g)	Pore size (nm)	Pore volume (cm^3/g)	ICP (wt %)	ICP (after five cycles) (wt %)
Pd@$m_{14}SiO_2$	TTAB	525.38	1.97	0.49	5.78	5.42
Pd@$m_{16}SiO_2$	CTAB	640.13	2.39	0.85	6.24	5.97
Pd@$m_{18}SiO_2$	STAB	713.08	2.73	1.14	6.13	5.82

Table.S3 mesoporous silica shell parameters and metal contents of the different core-shell catalysis synthesized.

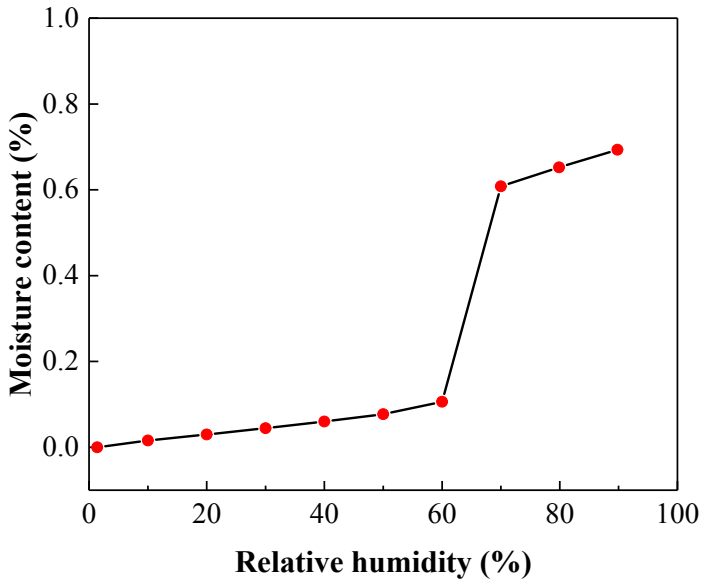

Fig. S7 Water vapor isotherm adsorption curve of Pd@mSiO$_2$ NPs (298K)

Fig S7 shows the adsorption isotherms measured at room temperature. It can be clearly observed that the sample can absorb 69% of its own weight of water, and this excellent water absorption capacity is related to the porosity and strong hydrophilicity of the silicon shell of the Pd@mSiO$_2$ NPs.