Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

One-pot Synthesis of Meso-structured Pd-CeO_x Catalyst for Efficient Low-temperature CO Oxidation under Ambient Condition

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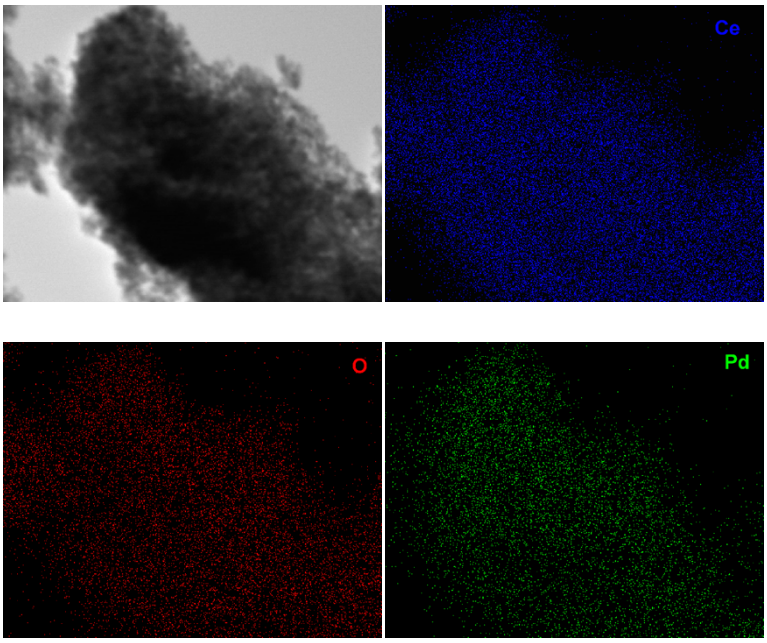

Figure S1. The EDX mapping of 5.9 wt% Pd doped catalyst.

Table S1 The physicochemical properties of the catalysts

Sample	BET surface area (m^2/g)	Average pore diameter (nm)	Pore volume (cm^3/g)
CeO_2	162	6.0	0.28
0.85 wt% Pd-CeO_x	162	6.0	0.28
2.5 wt% Pd-CeO_x	166	5.8	0.24
4.4 wt% Pd-CeO_x	158	5.4	0.21
5.9 wt% Pd-CeO_x	166	5.0	0.22
7.2 wt% Pd-CeO_x	165	5.0	0.23

Table S2 Surface composition of the samples

Sample	Ce		O		Pd	
	Ce^{3+} (%)	Ce^{4+} (%)	Lattice O (%)	Absorbed O (%)	Pd^{2+} (%)	Pd^0 (%)
CeO_2	9.9	16.3	51.6	22.2	-	-
0.85 wt% Pd-CeO_x	9.9	16.2	49.8	23.9	0.2	~0.0
2.5 wt% Pd-CeO_x	9.3	16.6	49.0	24.5	0.4	0.2
4.4 wt% Pd-CeO_x	9.0	15.6	48.5	24.7	0.7	0.5
5.9 wt% Pd-CeO_x	10.1	15.4	47.4	25.7	0.8	0.6
7.2 wt% Pd-CeO_x	8.7	15.8	46.7	27.1	1.0	0.7

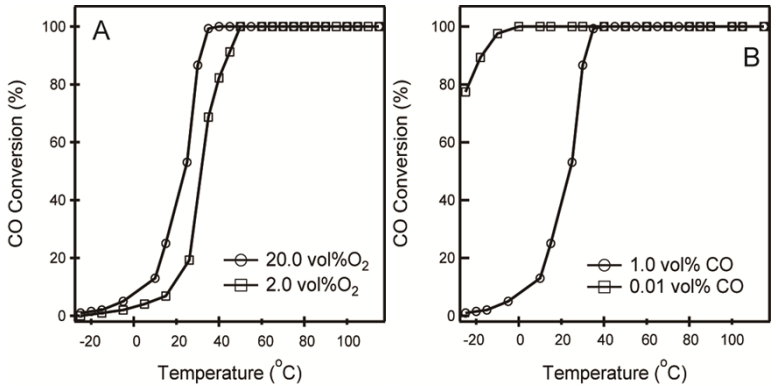

Figure S2. The effect of oxygen (A) and CO (B) concentration on the catalytic activity of 5.9 wt% Pd doped catalyst. (Catalyst: 200 mg; space velocity: 15000 ml h^{-1} g^{-1}. Feed gas: 1.0 vol% CO and desired O_2 banlance with N_2 (A); 20.0 vol% O_2 and desired CO banlance with N_2 (B).)

To study the effect of oxygen and CO concentration on catalytic activity, experiments were performed using varied feed gases consisting of 1.0 vol% CO, 20.0 vol% O_2 in N_2 and 0.01 vol% CO, 20.0 vol% O_2 in N_2, respectively. The sample (5.9 wt% Pd-CeO_x) still shows significantly high

catalytic activity. The complete conversion temperature (T_{100}) is 50 °C when the oxygen concentration decreased from 20.0 vol% to 2.0 vol% (1.0 vol% CO, Figure S2A). Besides, when the CO concentration was decreased from 1.0 vol% to 0.01 vol% (100 ppm), the CO can be completely converted to CO_2 at lower temperature of 0 °C (Figure S2B).

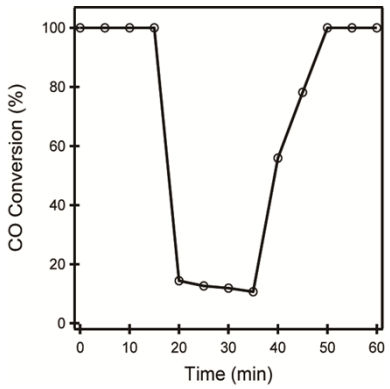

Figure S3. The effect of O_2 on the low temeprature CO oxidation over 5.9 wt% Pd-CeO_x catalyst at 35°C.

(1.0 vol% CO and3.0vol% water, space velocity: 15,000 ml g^{-1} h^{-1})

When O_2 was wiped off from the feed gas, the CO conversion can be ignored (~ 10 %) at 40 °C. Further introduce the O_2, the CO conversion recovered quickly (Figure S3). Thus, the water-gas shift reaction could be excluded.

Table S3 The activation energy of the catalysts

Sample	**Ea (kJ/mol)**	**R^2**
CeO_2	72.0	0.991
0.85wt% Pd-CeO_x	57.3	0.993
2.5wt% Pd-CeO_x	50.3	0.993
4.4wt% Pd-CeO_x	48.5	0.994
5.9wt% Pd-CeO_x	41.0	0.993
7.2wt% Pd-CeO_x	45.4	0.997
5.9 wt% Pd-CeO_x (moisture condition)	40.3	0.998

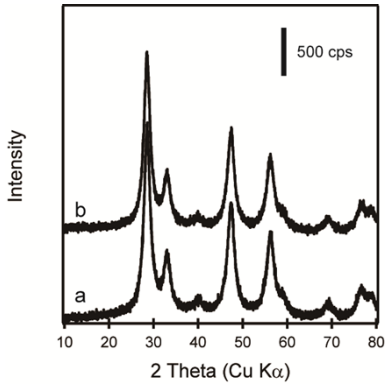

Figure S4. The XRD patterns of 5.9 wt% Pd-CeO_x catalyst after reaction under dry (a) and moisture (b) condition.

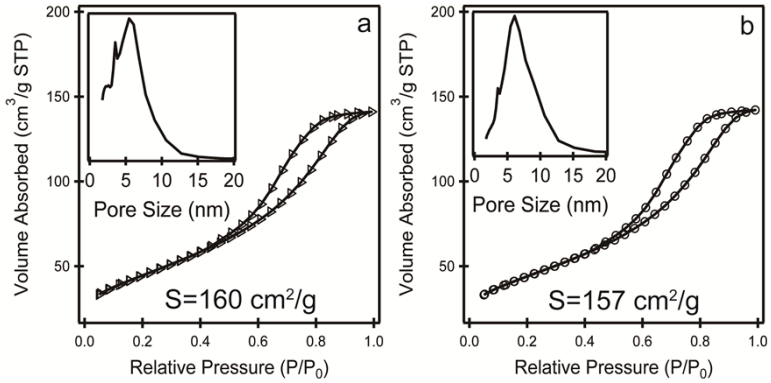

Figure S5. The N_2 adsorption-desorption isotherms of 5.9 wt% Pd-CeO_x catalyst after reaction under dry (a) and moisture (b) condition.

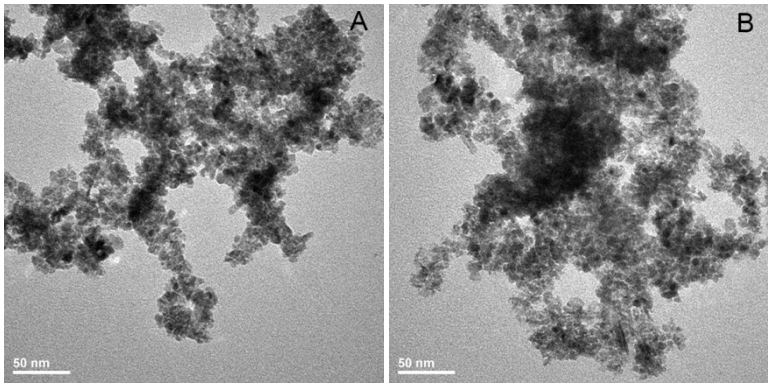

Figure S6. The TEM images of 5.9 wt% Pd-CeO_x catalyst after reaction under dry (A) and moisture (B) condition.

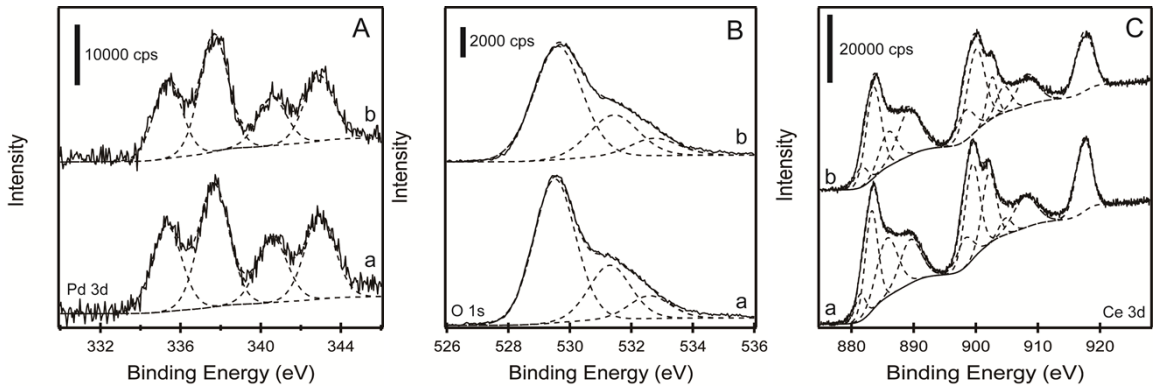

Figure S7. XPS spectra of Pd 3d (A), O 1s (B) and Ce 3d (C) of 5.9 wt% Pd-CeO_x catalyst after reaction under dry (a) and moisture (b) condition.

Table S4 Surface composition of the 5.9 wt% Pd-CeO_x catalyst after reaction under different condition

Sample	Ce		O		Pd	
	Ce^{3+} (%)	Ce^{4+} (%)	Lattice O (%)	Absorbed O (%)	Pd^{0} (%)	Pd^{2+} (%)
5.9 wt% Pd-CeO_x after reaction under dry condition	8.9	15.4	48.2	26.1	0.6	0.8
5.9 wt% Pd-CeO_x after reaction under moisture condition	8.4	15.8	48.3	26.1	0.6	0.8

Table S5 The physicochemical properties of the 5.9 wt% Pd-CeO_x catalyst after reaction under different condition

Sample	**BET surface area (m^2/g)**	**Average pore diameter (nm)**	**Pore volume (cm^3/g)**
5.9 wt% Pd-CeO_x after reaction under dry condition	160	5.4	0.22
5.9 wt% Pd-CeO_x after reaction under moisture condition	157	6.0	0.22