Supplemental information

Improved NO-CO Reactivity of Highly Dispersed Pt particles on CeO_2 Nanorods Catalyst Prepared by Atomic Layer Deposition

Quan Hu [a], Kun Cao [*b], Yun Lang [a], Rong Chen [b], Shengqi Chu [d], Liwei Jia [c], Jun Yue [c] and Bin Shan [*a]

[a] *State Key Laboratory of Material Processing and Die and Mould Technology and School of Materials Science and Technology, Huazhong University of Science and Technology, Wuhan 430074, Hubei, China.*

[b] *State Key Laboratory of Digital Manufacturing Equipment and Technology and School of Mechanical Science and Engineering, Huazhong University of Science and Technology, Wuhan 430074, Hubei, China.*

[c] *Wuxi Weifu International Trade Co., Ltd, Wuxi, Jiangsu, PR China 214031*

[d] *Institute of High Energy Physics, Chinese Academy of Science, Beijing 100049, China*

*Corresponding authors.

E-mail addresses: bshan@mail.hust.edu.cn (Bin Shan); kuncao@hust.edu.cn (Kun Cao).

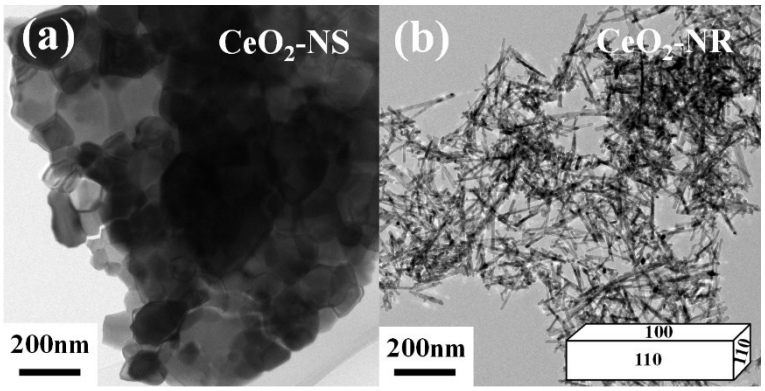

Fig. S1. Low magnification TEM images of (a) CeO_2-NS and (b) CeO_2-NR. The synthesis of CeO_2-NR is according to the hydrothermal method reported in the previous work by our group, and the inserted schematic diagram shows the morphology of CeO_2-NR.

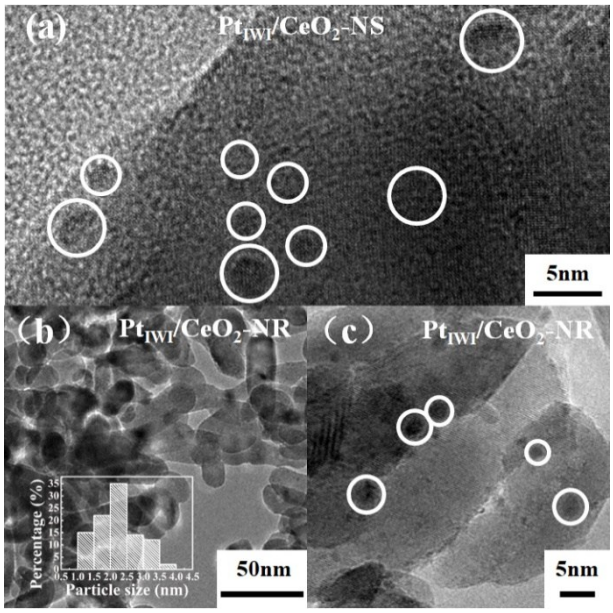

Fig. S2. TEM images of (a) Pt_{IWI}/CeO_2-NS, (b) Pt_{IWI}/CeO_2-NR and HRTEM images of (c) Pt_{IWI}/CeO_2-NS catalysts. Considering that Pt nanoparticles are difficult to be observed, they are marked by these white circles, and the diameters of these circles are determined by the sizes of Pt nanoparticles.

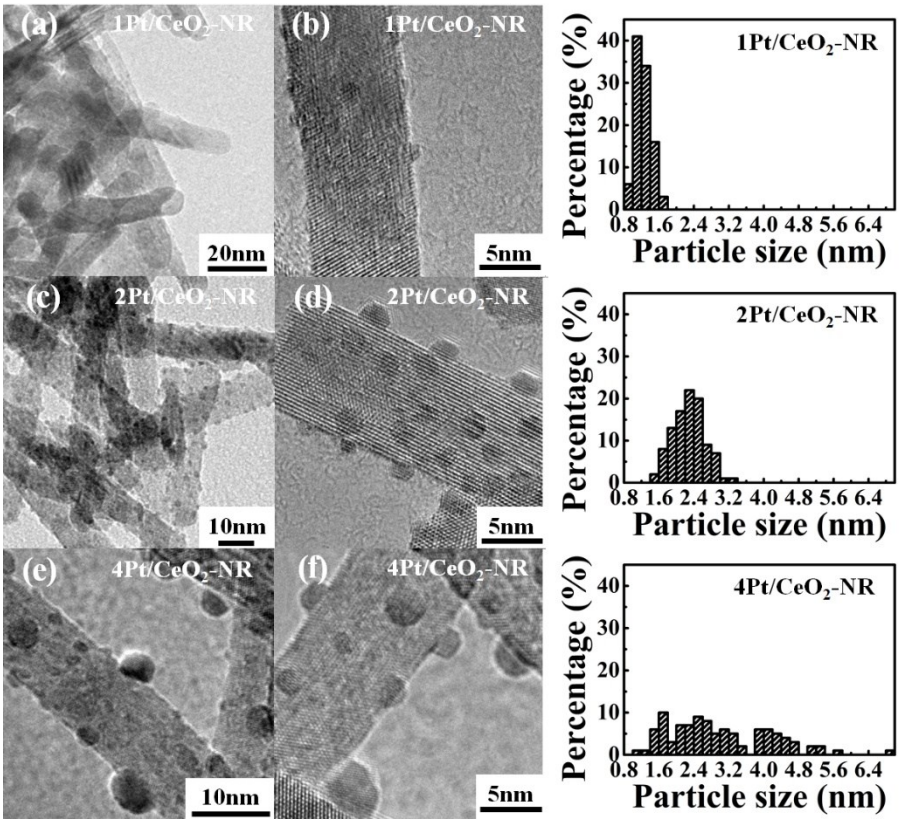

Fig. S3 TEM and HRTEM images of 1Pt/CeO_2-NR, 2Pt/CeO_2-NR and 4Pt/CeO_2-NR

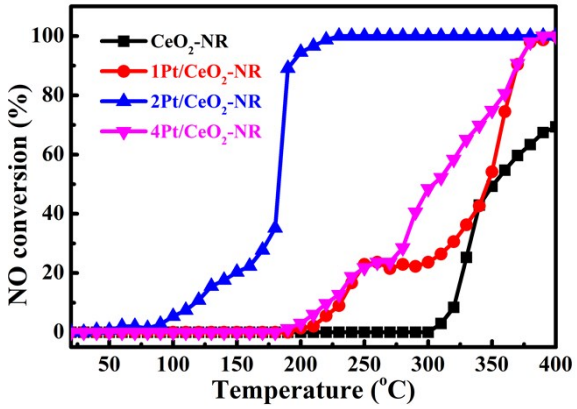

Fig. S4 The conversion curves of NO reduction as a function of temperature.

To study the size effect of Pt nanoparticles to this reaction, CeO_2-NR was deposited by 1, 2 and 4 ALD cycles of Pt and the prepared catalysts denote 1Pt/CeO_2-NR, 2Pt/CeO_2-NR and 4Pt/CeO_2-NR, respectively. Through the particle size statistics, we found that the average sizes of Pt nanoparticles increase with the increase of ALD cycles (Fig. S3). Pt loading increases monotonically with the varying of ALD cycles from 1 to 4, which is revealed by ICP-OES, however, the catalytic activity shows a trend of initial increasing and then decreasing. Based on this, it clear that the size effect

of Pt nanoparticles can't be ignored for the NO-CO reaction. (Fig. S4)

Table S1. The detailed binding energies and integrated areas of Ce 3d peaks of the samples.

		Pt/CeO_2-NS		Pt/CeO_2-NR	
		position	Area	position	Area
Ce^{4+}	u'''	916.3	6032.142	916.3	15329.040
	u''	907.2	2282.043	907.2	8552.216
	u	900.6	4815.774	900.4	14050.440
	v'''	898.0	9048.213	897.8	22993.560
	v''	888.4	3423.064	888.4	12828.320
	v	882.1	7223.662	882.0	21075.660
Ce^{3+}	u'	902.4	1078.571	902.4	6616.318
	u^0	898.1	454.561	898.0	889.972
	v'	884.4	1617.857	884.4	9924.477
	v^0	881.0	681.842	881.0	1334.958

The molar percentage of Ce^{3+} is calculated by using

$$x = \frac{A_{u'} + A_{u^0} + A_{v'} + A_{v^0}}{(A_{u'''} + A_{u''} + A_u + A_{v'''} + A_{v''} + A_v) + (A_{u'} + A_{u^0} + A_{v'} + A_{v^0})}$$

Where A_i is the integrated area of peak "i" shown in Table S1.

Fig. S5. EXAFS oscillations for Pt foil (a) and PtO_2 (b) acquired at room temperature, the Re[χ(q)] function data (c and d, respectively) and the magnitude of the Fourier transforms (e and f, respectively) are also presented. The fitting curves in (e) and (f) correspond to the best of the first average coordination shell.

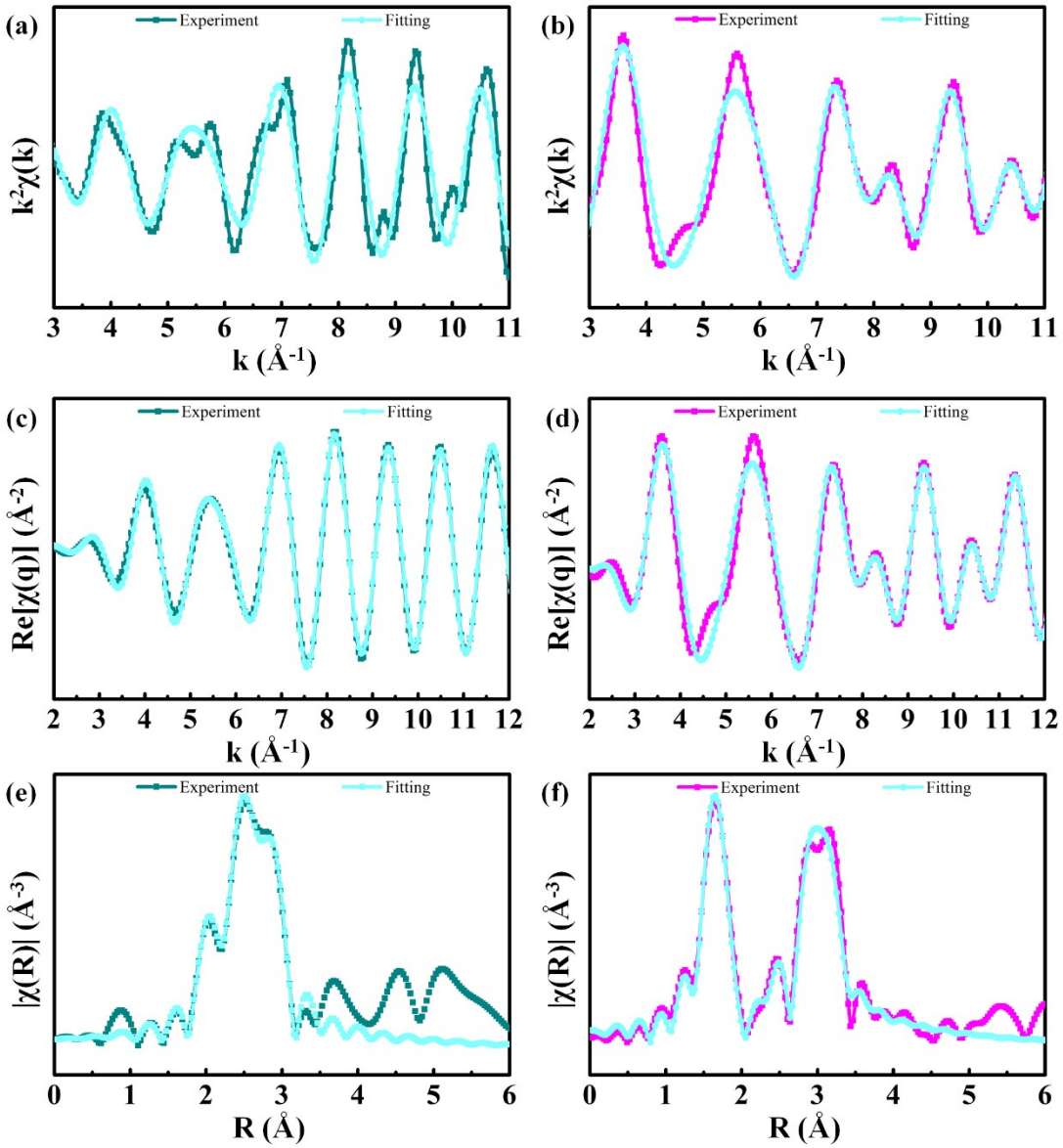

Fig. S6. EXAFS oscillations for Pt/CeO_2-NS (a) and Pt/CeO_2-NR (b) acquired at room temperature, the Re[χ(q)] function data (c and d, respectively) and the magnitude of the Fourier transforms (e and f, respectively) are also presented. The fitting curves in (e) and (f) correspond to the best of the first average coordination shell.

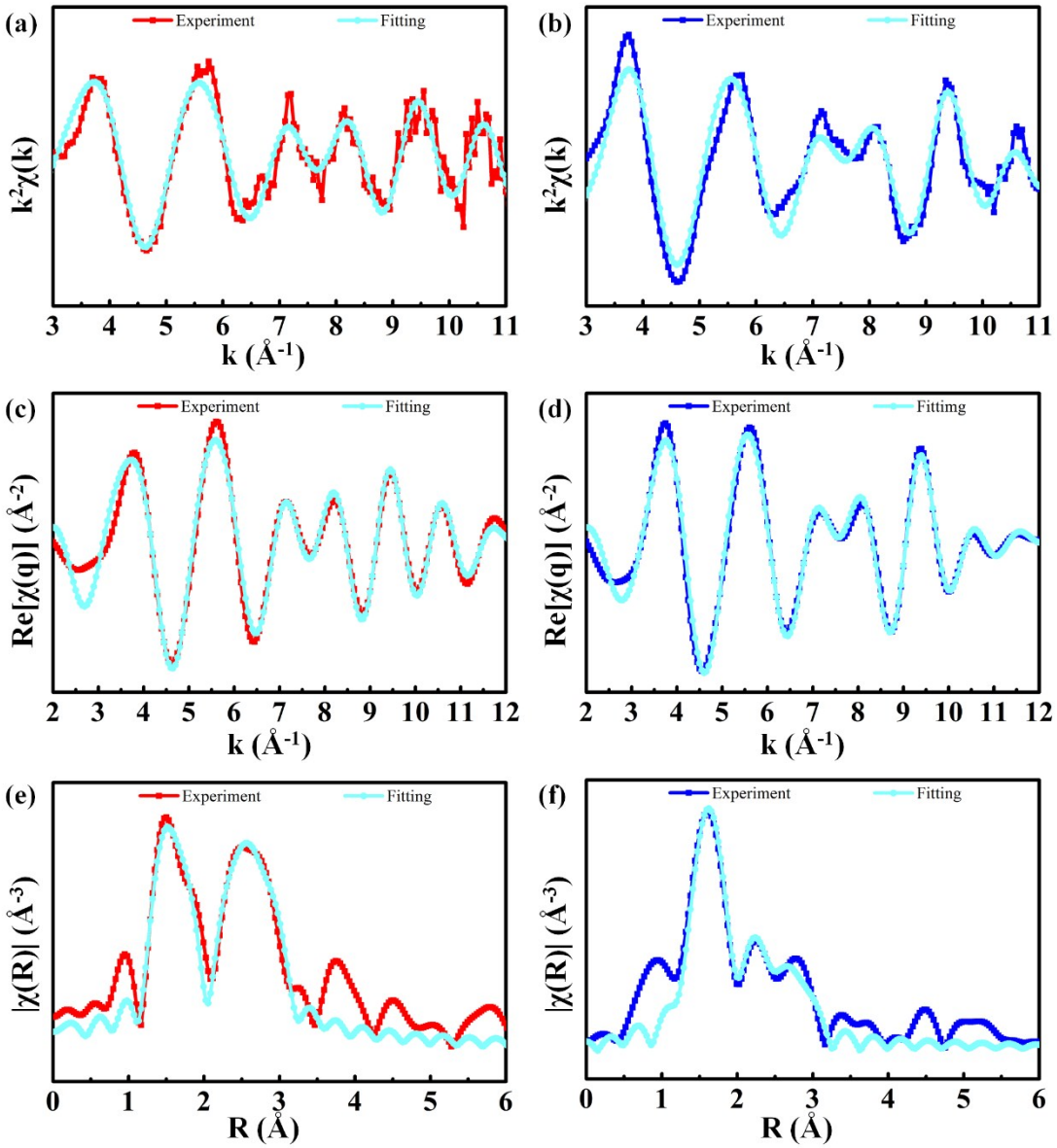

Table S2. Structural information and fitting parameters obtained from Pt LIII-edge EXAFS of samples. The fitting results of Pt foil and PtO_2 references agree well with many previous references.

sample	Shell	N	R(Å)	σ^2 (Å^2)	ΔE_0 (eV)
Pt foil	Pt-Pt	12	2.767±0.0021	0.0047±0.001	8.469±0.5525
PtO_2	Pt-O	6	2.026±0.0064	0.0024±0.004	11.283±1.4395
	Pt-Pt	6	3.108±0.0064	0.0026±0.002	10.216±2.0678
Pt/CeO_2-NS	Pt-Pt	2.27±0.87	2.739±0.0201	0.0029±0.022	8.387±4.5549
	Pt-O	2.38±0.64	1.984±0.0204	0.0065±0.029	6.863±3.2917
Pt/CeO_2-NR	Pt-Pt	2.94±0.87	2.746±0.0156	0.0042±0.017	4.772±3.4526
	Pt-O	2.10±0.32	2.000±0.0093	0.0012±0.013	9.942±1.9359