Electronic Supplementary Information for:

# Investigation of oxygen vacancies on Pt, Au modified $CeO_2$ materials for CO oxidation

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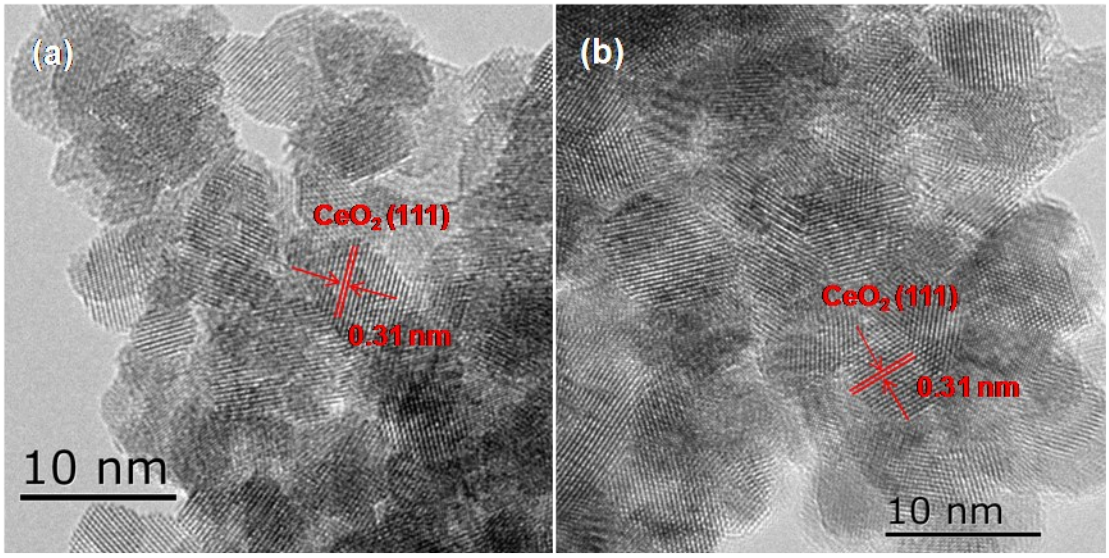


Fig. S1 HRTEM images of Pt-$CeO_2$ (a) and Au-$CeO_2$ (b) samples. These images were obtained on a JEM-2000EM JEOL. Before microscopy examination, the sample was suspended in ethanol with an ultrasonic dispersion for around 10 minutes and then a drop of the solution was put onto a copper grid coated with a thin holey carbon film. As can be seen, no metal particles could be found despite our careful observation. Probably, the Pt or Au particles were highly distributed and too small to be detected on both samples. On the other hand, we can find that the particle size of $CeO_2$ support was around 10 nm, which was in accordance with XRD detects.

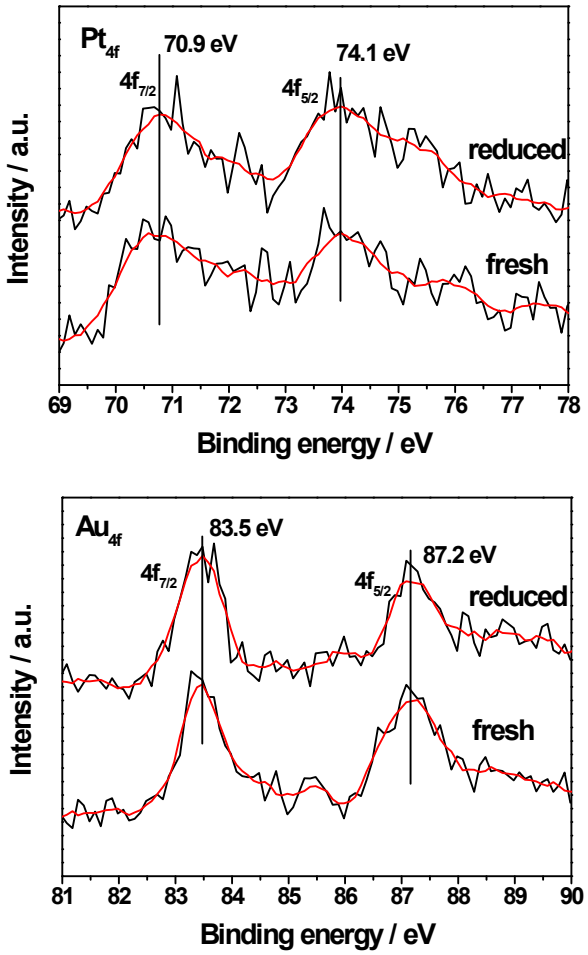


Fig. S2 $Pt_{(4f)}$ and $Au_{(4f)}$ XPS spectra of fresh and reduced Pt-$CeO_2$ and Au-$CeO_2$ samples. X-ray photoelectron spectra (XPS) were determined on a VGESCALAB 210 apparatus to obtain the surface compositions and the binding energies of the catalysts. Mg Ka radiation at an energy scale calibrated versus adventitious carbon ($C_{1s}$ peak at 284.5 eV) was used. The sample was fresh or reduced at 400 $^{o}$C for 2 h before the characterization. As can be seen, before or after $H_2$ reduction treatment, the binding energies of Pt or Au were not changed and exhibited a state of metallic species ($Pt_{4f7/2}$: 70.9 eV, $Au_{4f7/2}$: 83.5 eV).

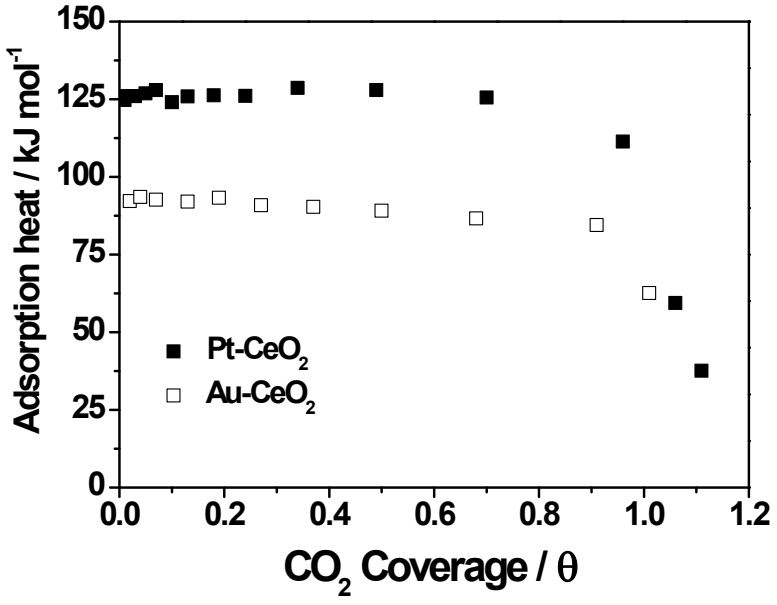


Fig. S3 $CO_2$ adsorption heat with the coverage on Pt-$CeO_2$ and Au-$CeO_2$ materials. This experiment was carried out with a BT 2.15 heat-fluxcalorimeter[1]. Prior to the measurement, the sample was reduced with pure $H_2$ at 400 $^oC$ for 2 h and then outgassed for 0.5 h under high vacuum. The microcalorimetric data were collected by sequentially introducing small doses (1~10 μmol) of $CO_2$ onto the sample until it became saturated. The using of $CO_2$ as probe gas was due to its formation of carbonates on $CeO_2$ materials,[2] thus the differential heat can indicate the adsorption strength of carbonates on these two samples.

**References:**

1. L. Li, X. Wang, X. Zhao, M. Zheng, R. Cheng, L. Zhou and T. Zhang, *Thermochim. Acta,* 2005,**434**,119.
2. C. Binet, M. Daturi and J. Lavalley, *Catal. Today,* 1999,**50**, 207.