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# Highly Efficient Formaldehyde Elimination over Meso-structured M/$CeO_2$ (M = Pd, Pt, Au and Ag) Catalyst under Ambient Condition

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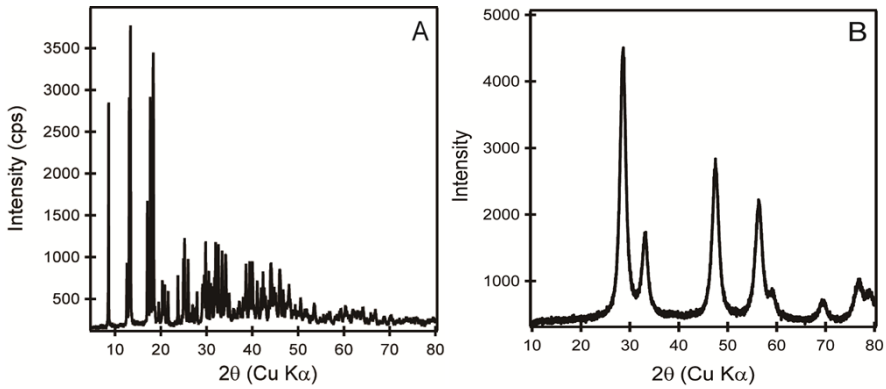


Fig. S1 The XRD patterns of $Ce_2(C_2O_4)_3 \cdot 2H_2O$ precursor (A) and $CeO_2$ support (B).

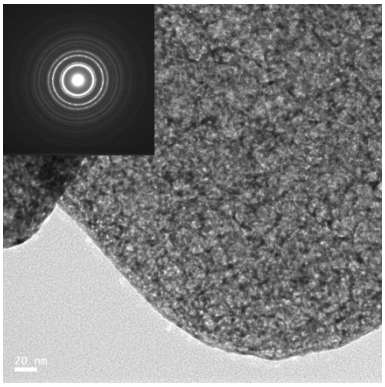

Fig. S2 The TEM image of $CeO_2$ support.

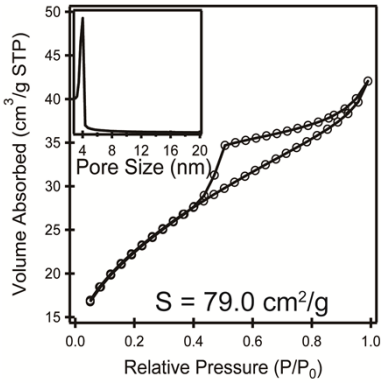


Fig. S3 $N_2$ adsorption-desorption isotherm of the $CeO_2$ support.

**Table S1** Surface composition of the samples

| Sample | Ce | | O | | Noble metal | |
|---|---|---|---|---|---|---|
| | $Ce^{3+}$ (%) | $Ce^{4+}$ (%) | Lattice O (%) | Absorbed O (%) | Ion (%) | Metal (%) |
| $CeO_2$ | 10.5 | 20.7 | 56.4 | 12.4 | - | - |
| 0.78 wt% $Pd/CeO_2$ | 12.1 | 18.1 | 53.1 | 16.5 | < 0.1 | 0.2 |
| 1.00 wt% $Pt/CeO_2$ | 12.1 | 17.8 | 52.7 | 16.9 | < 0.1 | 0.5 |
| 0.92 wt% $Au/CeO_2$ | 11.6 | 17.9 | 55.7 | 14.5 | < 0.1 | 0.3 |
| 0.98 wt% $Ag/CeO_2$ | 10.5 | 19.2 | 55.5 | 13.9 | ~ 0 | 0.9 |

**Table S2** Comparison of the catalyst performance over different noble-metal supported catalysts for formaldehyde oxidation reported previously

| Catalyst | Noble metal loading (wt%) | HCHO concentration (ppm) | Space velocity ($h^{-1}$) | Temperature of 100% HCHO conversion ($^oC$) | TOFat 100% conversion temperature ($10^{-3}$ $S^{-1}$) | Note |
|---|---|---|---|---|---|---|
| $Pd/CeO_2$ | 0.78 | 600 | 120,000 | 22 | 2.84 | This work |
| $Pd/TiO_2$ | 1.0 | 10 | 120,000 | ~25 | 0.398 | Ref. 16 |
| $Pt/CeO_2$ | 1.0 | 600 | 120,000 | < 20 | 4.03 | This work |
| $Pt/TiO_2$ | 1.0 | 100 | 50,000 | < 20 | ／ | Ref. 5 |
| $Au/CeO_2$ | 0.92 | 600 | 120,000 | 28 | 4.34 | This work |
| $Au/CeO_2$ | 0.56 | 600 | 66,000 | 75 | ／ | Ref. 7 |
| $Au/CeO_2$ | 1.0 | 80 | 134,000 | 25 | 1.78 | Ref. 8 |
| $Ag/CeO_2$ | 0.98 | 600 | 120,000 | 100 | 1.80 | This work |
| $Ag/CeO_2$ | ~2.0 | 810 | 84,000 | 110 | 5.00 | Ref. 9 |