Supplementary information

Template-free synthesis of uniform single-crystal hollow cerium dioxide nanocubes and catalytic activity

Xiguang Han,[*ab] Liang Li,[a] Chao Wang[a]

[a]*Department of Chemistry, Jiangsu Normal University, Xuzhou, Jiangsu 221116, China.*
[b]*School of Chemistry and Chemical Engineering, Key Laboratory of Green Synthetic Chemistry for Functional Materials, Jiangsu Normal University, Xuzhou, 221116, P. R. China*
E-mail: xghan@jsnu.edu.cn

Experimental Section:

Reagents: Cerium(III) chloride heptahydrate ($CeCl_3$•$7H_2O$), Ammonium Chloride (NH_4Cl), Polyvinylpyrrolidone (PVP, K-30) were purchased from commercial suppliers (Sinopharm Chemical Regent) and used as received without further purification.

Synthesis and characterization of hollow CeO_2 with exposed {001} facets:

In a typical synthesis, $CeCl_3$•$7H_2O$ (0.37 g, 1 mmol), NH_4Cl (0.27 g, 5 mmol) and PVP (0.315 g) were in order added to the mixed solvent of ethanol and distilled water (6 mL, v/v of 1:1) under intense ultrasonic treatment. The resulting solution was transferred into a Teflon-lined stainless-steel autoclave and was kept at 200 ^oC for 12 h. The products were collected by centrifugation at 10000 rpm, and washed several times with deionized water and ethanol.

The composition and phase of the as-prepared products were acquired by the powder X-ray diffraction (XRD) pattern using a Panalytical X-pert diffractometer with CuKα radiation. The morphology and crystal structure of as-prepared products were observed by scanning electron microscopy (SEM, S4800), and high-resolution transmission electron microscopy (HRTEM, FEI Tecnai-F30) with an acceleration voltage of 300 kV. All TEM samples were prepared from depositing a drop of diluted suspensions in ethanol on a carbon film coated copper grid. The surface areas (S) of these CeO_2 particles were measured by the Brunauer-Emmett-Teller (BET) method using nitrogen adsorption and desorption isotherms on a Micrometrics ASAP 2020 system.

Measurement of catalytic CO oxidation: The catalytic activity of CeO_2 catalysts towards CO oxidation was carried out in a continuous flow reactor. The reaction gas, 10 mL/min 5% CO in nitrogen and 40 mL/min air, was fed to catalyst particles. Steady-state catalytic activity was measured at each temperature with the reaction temperature rising from room temperature to 360 °C in step of 20 °C. The effluent gas was analyzed on-line by an on-stream gas chromatograph (FuLi 9790II) equipped with a TDX-01 column.

Experimental Results Section:

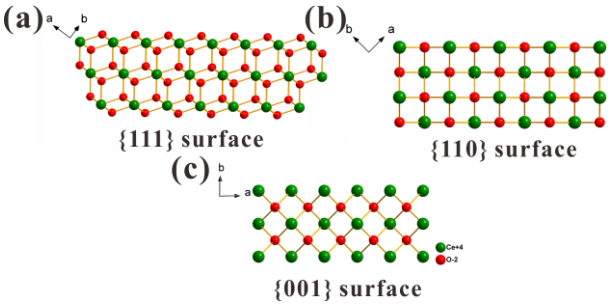

Fig S1 Surface atom arrange of different facets of face-centered cubic CeO_2, (a) {111} surface; (b) {110} surface; (c) {001} surface.

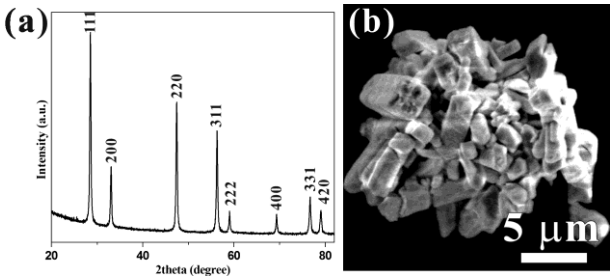

Fig. S2 (a) The XRD of commercial CeO_2 particles, (b) the SEM image of commercial CeO_2 particles.

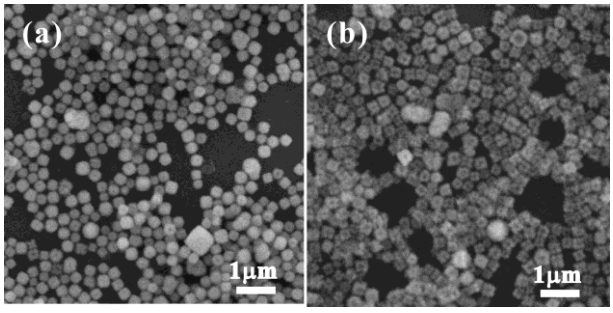

Fig. S3 the SEM images of CeO_2 after CO catalysis, (a) CeO_2 cubes, (b) CeO_2 cubes with pore.