Supplementary Material (ESI) for *Nanoscale*

Supporting Information

Sol-Gel Nanocasting Synthesis of Patterned Hierarchical $LaFeO_3$ Fibers with Enhanced Catalytic CO Oxidation Activity

Pengna Li,[a] **Xianluo Hu,***[b] **Lei Zhang,**[c] **Hongxing Dai ***[c] **and Lizhi Zhang***[a]

[a] *Key Laboratory of Pesticide & Chemical Biology of Ministry of Education, College of Chemistry, Central China Normal University, Wuhan 430079, P. R. China. Fa/Tel: +86-27-6786 7535; E-mail: zhanglz@mail.ccnu.edu.cn*

[b] *State Key Laboratory of Material Processing and Die & Mould Technology, College of Materials Science and Engineering, Huazhong University of Science and Technology, Wuhan 430074, P. R. China. E-mail: huxl@mail.hust.edu.cnxlhu07@gmail.com*

[c] *Laboratory of Catalysis Chemistry and Nanoscience, Department of Chemistry and Chemical Engineering, College of Environmental and Energy Engineering, Beijing University of Technology, Beijing 100124, P. R. China. E-mail: hxdai@bjut.edu.cn*

1. Experimental Sections

Lanthanum nitrate ($La(NO_3)_3 \cdot 6H_2O$), ferric nitrate ($Fe(NO_3)_3 \cdot 9H_2O$), citric acid ($C_6H_8O_7 \cdot H_2O$) and ammonia ($NH_3 \cdot H_2O$, 25~28 wt%) were of analytical grade and used as received without further purification. The $LaFeO_3$ perovskite precursors were prepared by the citrate-based sol–gel method. In a typical procedure, 0.002 mol of $La(NO_3)_3 \cdot 6H_2O$ and 0.002 mol of $Fe(NO_3)_3 \cdot 9H_2O$ were first dissolved in 15 mL of deionized water. Then, 0.004 mol of citric acid was added to the above solution. The molar amount of citric acid was equal to the total molar amount of metal nitrates in the solution. Ammonia was slowly added to adjust the pH value of the solution in the range of 6~7 to stabilize the nitrate–citrate solution. After continuously stirring for about 20 min, the mixture turned into a transparent and homogeneous yellow sol.

For the nanocasting, cotton template was immersed into the above sol and kept overnight, followed by drying at room temperature. The template was then burned out by calcination in air at 650 ^{o}C for 2 h to obtain the final product.

For comparison, the citrate-based sol–gel synthesized $LaFeO_3$ perovskite precursor sol was directly dried and calcined at 650 ^{o}C for 2 h to obtain its nanoparticle counterpart without using the cotton template.

2. Characterization.

X-ray powder diffraction (XRD) patterns were obtained using a Rigaku D/MAX-RB diffractometer with monochromatized Cu Kα radiation ($\lambda = 0.15418$ nm). Scanning electron microscopy (SEM, JSM-5600) was used to characterize the morphology and particle sizes. Transmission electron microscopic (TEM) images were recorded on a JSM-2010 (JEOL, 200 kV) electron microscopy instrument. The samples for TEM observations were prepared by dispersing the powders in ethanol; the dispersion was then dropped on carbon copper grids. Nitrogen adsorption-desorption isotherms were collected on a Micromeritics Tristar-3000 surface area and porosity analyzer at −196 °C after the sample had been degassed in the flow of N_2 at 200 °C for 5 h. The Brunauer-Emmett-Teller (BET) surface area was calculated from the linear part of the BET plot ($P/P_0 = 0.1–0.25$). X-ray photoelectron spectroscopic (XPS) spectra were recorded on a PHI 5600 multi-technique system with a monochromatic Al Kα source (Physical Electronics) operated at 150 W (15 kV, 10 mA). All of the binding energies were calibrated by using the contaminant carbon (C 1s = 284.8 eV) as a reference.

3. Catalytic activity measurements.

A continuous flow fixed-bed quartz microreactor (i. d. = 4 mm) was employed for the determination of catalyst activity at atmospheric pressure for the complete oxidation of CO. The CO oxidation with O_2 was tested in a flow system in the range of 160−460 °C using 0.02 g of the catalyst (40−60 mesh) diluted with 0.18 g of quartz sand (40−60 mesh). The composition of the reactants was CO, O_2 and balance helium with the volumetric ratio of 0.5:5.0:24.5. The total flow rate was 30 mL min^{-1} with a space velocity of 90 000 mL g^{-1} h^{-1}. Reactants and products were analyzed on-line by a gas chromatograph (GC-14C, Shimadzu) equipped with a thermal conductivity detector (TCD), using a 5A molecular sieve packing column (3 m in length). The activity data were taken after 20 min of the reaction in each run.

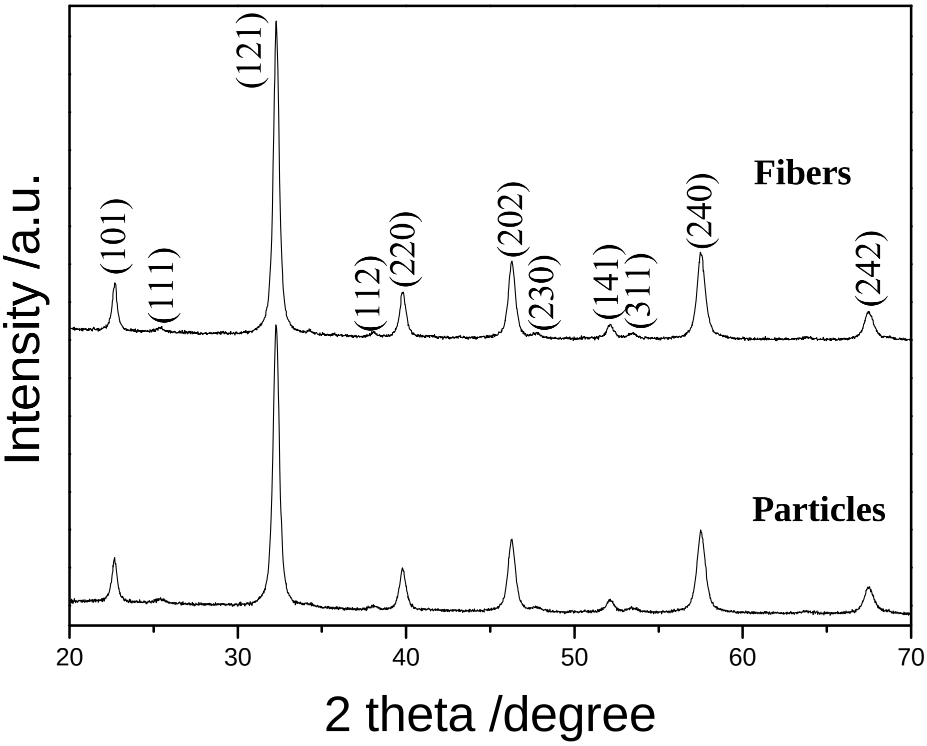


Fig. S1. XRD patterns of the $LaFeO_3$ fibers and particles.

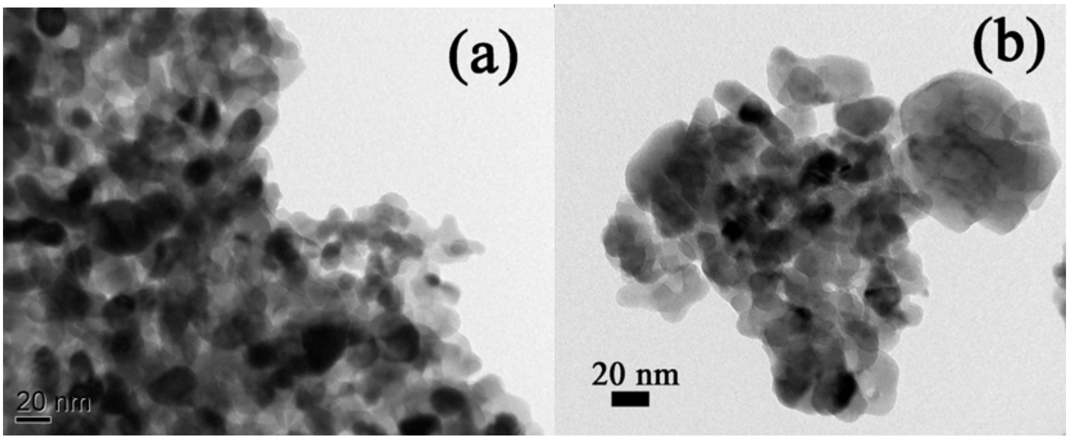


Fig. S2. TEM images of (a) $LaFeO_3$ fibers and (b) $LaFeO_3$ particles obtained after calcination at 650 ^{o}C.

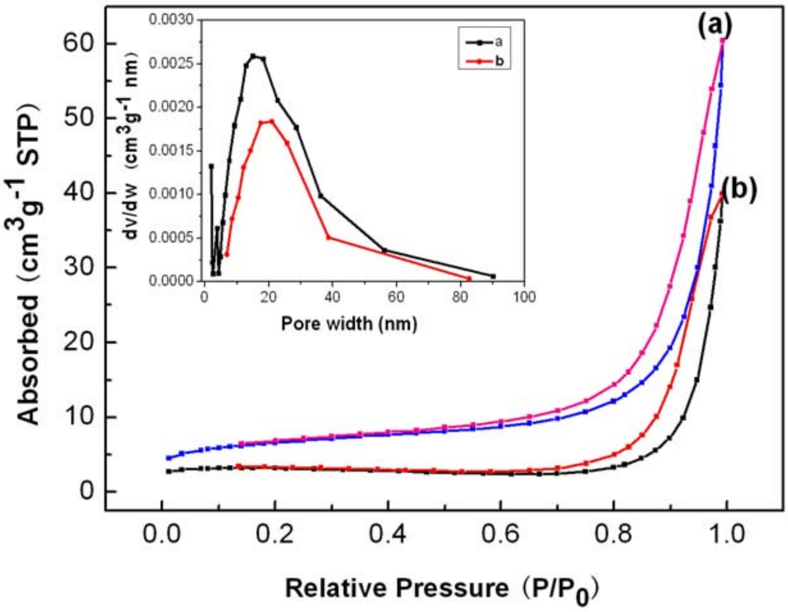
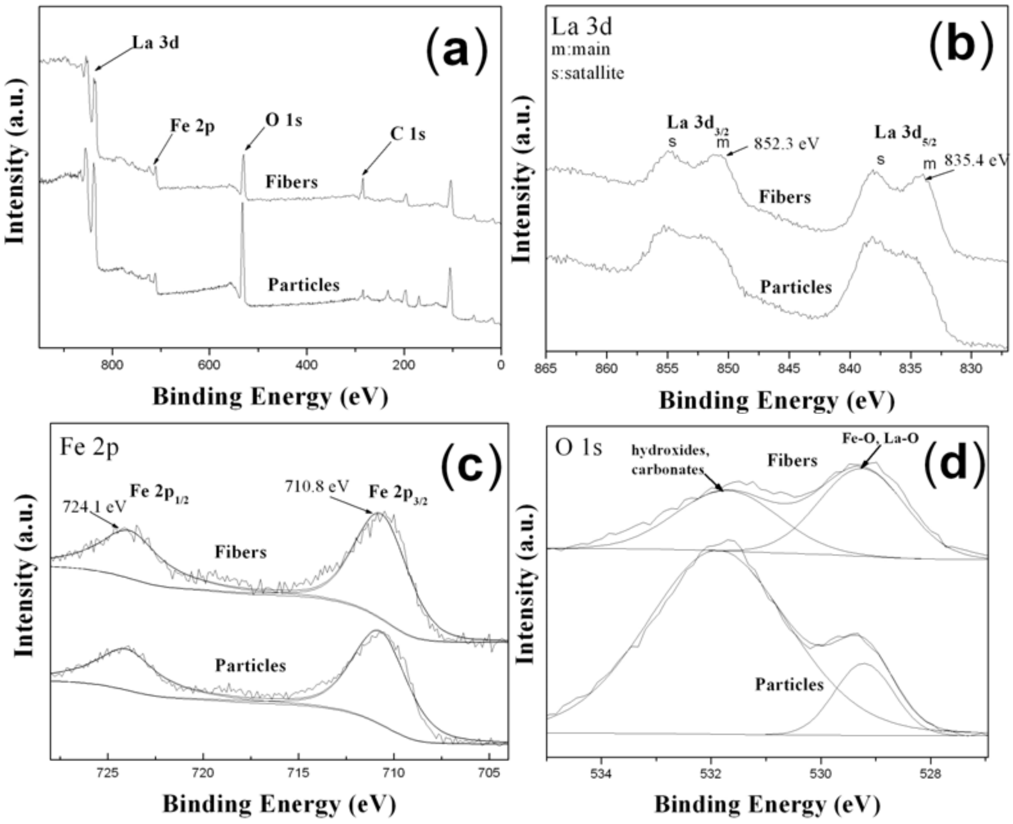


Fig. S3. N_2 adsorption-desorption isotherms and pore size distributions (inset) of $LaFeO_3$ fibers (a) and particles (b).



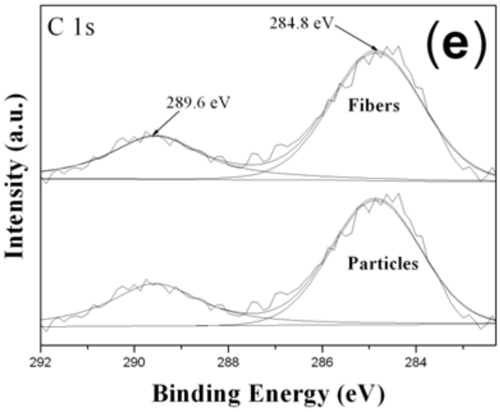


Fig. S4. XPS spectra of the $LaFeO_3$ fibers and $LaFeO_3$ particles obtained after calcination at 650 ºC, survey of the sample (a), La 3d (b), Fe 2p (c), O 1s (d) and C 1s (e).

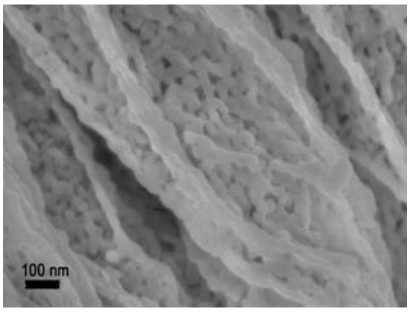


Fig. S5 High-resolution SEM image of the $LaFeO_3$ fibers.