Supporting Information for

Glutamine-assisted synthesis of Cu-doped CeO_2 nanowires with an improved low-temperature CO oxidation activity

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Experimental details

Materials Synthesis

Cu-doped CeO_2 nanowires were prepared by a facile hydrothermal method. In a typical procedure, solid urea (0.03 mol) was directly added to a mixed solution of $CuSO_4 \cdot 5H_2O$ (9.1mmol) , $Ce(NO_3)_2 \cdot 3H_2O$ (0.91mmol) and glutamine (GLN, 0.01 mol) in distilled water (50 ml). The mixture was vigorously stirred for 15 min and then sealed into a Teflon-lined autoclave. The autoclave was heated to 140 ℃ and maintained for 12 h, and then cooled to room temperature naturally. The resulting precipitate was separated by centrifugation, washed with distilled water several times, and dried at 60 ℃ for 12 h. The obtained samples were further calcined in air at 400 ℃ for 2 h. For comparison, the samples of pure CeO_2 with glutamine and Cu-doped CeO_2 composite without glutamine were also prepared under the same experimental condition. Besides the sample of pure CeO_2 with glutamine, Cu-doped CeO_2 composite without glutamine was also prepared under the same experimental condition to make sure the role of Cu^{2+} ions in the formation of nanowires. In addition, the effect of reaction time on the morphologies of glutamine-assisted Cu-doped CeO_2 was investigated.

Materials Characterizations

The crystal phases of the calcined samples were characterized using X-ray powder diffraction (XRD, Rigaku. D/Max Φ) with a graphite monochromatic Cu Kα radiation (λ=0.15418 nm) at a scanning rate of 4°/min. Inductively coupled plasma-atomic spectroscopy (ICP-AES) analysis was performed on a Profile Spec ICP-AES spectrometer (ICP-900（N+M） USA Thermo Jarrell-Ash Corp). X-ray photoelectron spectroscopy (XPS) measurement was performed on a Kratos Axis Ultra DLD spectrometer employing a mono-chromated Al-Kα X-ray source (hγ = 1486.6 eV). The Ar+ bombardment on the CeCu0.20 nanowires sample was performed with an ion current of ～100 mA rastered over an area of 2 × 2 mm2. The ion beam had an energy of 3.8 keV and made an angle of 60° with the sample surface. Using the atomic sensitivity factors and Shirley mode for subtraction of the spectral background, Cu/Ce relative atom ratio was automatically achieved by the Vision Processing 2.2.8, where the shakeup contribution to the intensity of the main peak has been also taken into account. The size and morphology of the calcined samples were examined by scanning electron microscopy (SEM, HITACHI S-4800) and transmission electron microscopy (TEM, JEM-2100F). The Brunauer-Emmett-teller (BET) surface area of calcined Cu-doped CeO_2 nanowire sample was tested by Quantachrome NOVA 2000e sorption analyzer.

Catalytic tests

The catalytic activities of Cu-doped CeO_2 nanowires were carried out with 0.2 g in a quartz tube reactor under atmospheric pressure flow of 33.4 mL • min^{-1}, with a 1 % CO and fresh air balanced composition from air generator. The reactor outlet stream

was monitored for CO and CO_2 concentration by on-line GC 900A. In order to check the stability of the system, a second run of Cu-doped CeO_2 nanowires for CO oxidation was also carried out under the same condition.

Supplementary Figures

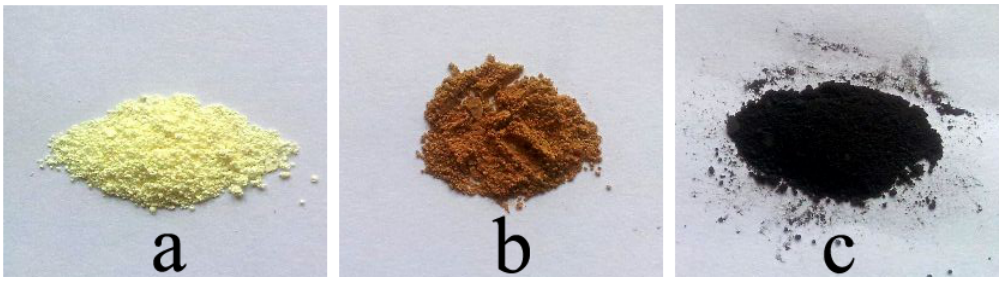

Fig. S1 Photos of calcined samples as powders.
(a) pure CeO_2 ; (b) $CuCe_{0.20}$; (c) $CeCu_{0.41}$

Table 1

Relative atomic content of Cu and Ce of $CeCu_{0.20}$ nanowires from XPS depth profiling at different etching times

Etching time /min / Atomic content /%	**0**	**2**	**6**	**11**
Cu	19.99	21.87	20.11	19.54
Ce	80.01	78.13	79.89	80.46