Supporting Information

Catalytic activity for CO oxidation of Cu-CeO$_2$ composite nanocubes synthesized by a hydrothermal method

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Figure S1 SEM image of 30Cu-CeO₂ composite nanoparticles.

SEM image revealed that there were various sizes of particles in the 30Cu-CeO₂ nanoparticles. Most particles are irregular morphology and the large particles were composed of small crystallites.
Figure S2: The high-resolution XPS spectra of Ce3d obtained on Cu-CeO$_2$ composite nanoparticles with the different Cu contents: (a) CeO$_2$, (b) 10Cu-CeO$_2$, (c) 30Cu-CeO$_2$, and (d) 40Cu-CeO$_2$, respectively.

The main features are composed of six peaks corresponding to the three pairs of spin–orbit doublets. Due to its highly non-stoichiometric nature, both valences (3+ and 4+) are present in CeO$_2$. The main peaks of Ce$^{4+}$ 3d$_{5/2}$ and Ce$^{4+}$ 3d$_{3/2}$ are shown at binding energies of $\sim$915.7 and $\sim$897.0 eV, respectively. Those of Ce$^{3+}$ 3d$_{3/2}$ and Ce$^{3+}$ 3d$_{5/2}$ are located at $\sim$899.8 and $\sim$881.7 eV. Two additional satellite lines SU1 and SU2, which means ‘shake-up’, are shown at $\sim$906.2 eV on the Ce$^{3+}$ 3d$_{3/2}$ and at $\sim$887.1 eV on the Ce$^{3+}$ 3d$_{5/2}$, respectively.
Figure S3 XPS region spectra of O1s obtained on Cu-CeO$_2$ composite nanoparticles with the different Cu contents: (a) CeO$_2$, (b) 10Cu-CeO$_2$, (c) 30Cu-CeO$_2$, and (d) 40Cu-CeO$_2$, respectively.

All the spectra show a peak at about 529.4 eV, which is assigned to oxygen ions (O$_{\text{lattice}}$) in CeO$_2$. Two evident shoulders at higher binding energies at ~531.7 and ~533 eV are present and attributable to oxygen vacancies and hydroxyl groups, respectively.
Figure S4 The high-resolution XPS spectrum of superposed Cu2p for 30Cu-CeO2 composite nanoparticles.

The XPS spectra for Cu were simple and easily fitted to Cu0 species, indicating little oxidation of the Cu nanoparticles.
**Figure S5**  Time-on-stream CO conversion on Cu-CeO₂ composite nanoparticles (CeO₂ nanoparticles at 260 °C, 5Cu-CeO₂ composite at 340 °C, 30Cu-CeO₂ composite at 180 °C, and 40Cu-CeO₂ composite at 200 °C, respectively).
Table S1 The phase compositions of Cu-CeO$_2$ composite nanoparticles from XRD patterns.

<table>
<thead>
<tr>
<th>Phase composition (Cu/CeO$_2$)</th>
<th>Cu-CeO$_2$ composite nanoparticles</th>
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<tbody>
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<td></td>
<td>0%Cu</td>
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<tr>
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<tr>
<td>CeO$_2$</td>
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<tr>
<td>CuO</td>
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