Supplementary information

Insight into the chemical adsorption properties of CO molecules on supported Au or Cu and hybridized Au-CuO nanoparticles

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Supplementary information

**Figure S1.** Photos displaying the distinctive colors of samples before and after calcination process.

**Figure S2.** TEM images of CuO/AO (a), Au/AO (b), and size distribution of gold nanoparticles in Au/AO (c).
**Figure S3.** XRD patterns of typical samples (left) and zoomed spectra in the range of 33-40° (right).

**Figure S4.** CO-TPD profiles of pure Al₂O₃ powder. The deposition compounds are monitored with m/z intensity of 28 and 44 for CO and CO₂, respectively, at a heating rate of 5 °C min⁻¹ in helium.
Figure S5. H\textsubscript{2}-TPR profiles of the Au/AO, CuO/AO and Au-CuO/AO catalysts. The reduction compounds are monitored by mass spectroscopy with m/z intensity of 18 for H\textsubscript{2}O, at a heating rate of 10 °C·min\textsuperscript{-1} in 5% H\textsubscript{2} balanced with helium.

Figure S6. STEM image and size distribution of Au/AO\textsubscript{-3.2} with smaller AuNPs.
Figure S7. CO conversion over three catalysts in CO oxidation as a function of reaction temperature. Conditions: Gas flow rate of 20 ml·min⁻¹, 50 mg catalyst, 1 vol % CO in air. The error bars were marked based on three continuous reaction cycles from room temperature to 300 °C.

Figure S8. FT-IR spectra of different samples as CO adsorption for 30 min in the range of 2250-1980 cm⁻¹.
**Figure S9.** Operando DRIFT spectra of CuO/AO (a-b) and Au/AO (c-d) samples as CO adsorption for 30 min in the range of 2250-1980 cm$^{-1}$. 
Figure S10. Operando DRIFT spectra of Au/AO-3.2 at 25 °C under: CO adsorption (left) and He purging (right) until the adsorption peaks become stable. Conditions: Gas flow rate of 20 ml·min⁻¹, 2 vol % CO in helium, 30 mg catalyst.

Figure S11. FT-IR spectra of Au-CuO/AO under different temperature at steady state in CO adsorption in the range of 2250-1980 cm⁻¹.
**Figure S12.** CO conversion over Au-CuO/AO as a function of reaction temperature, 2\textsuperscript{nd} reaction cycle of calcined Au-CuO/AO (■), 1\textsuperscript{st} (○) and 2\textsuperscript{nd} (★) reaction cycles after reduction at 300 °C in H\textsubscript{2} for 1 h.

**Table S1** Information of surface metal compositions revealed by XPS analysis.

<table>
<thead>
<tr>
<th>Catalyst</th>
<th>Au/Cu</th>
<th>Au 4f (XPS)</th>
<th>Au\textsuperscript{0}</th>
<th>Au\textsuperscript{+}</th>
<th>BE of Au\textsuperscript{0} (eV)</th>
<th>Cu 2p</th>
<th>Cu\textsuperscript{+}</th>
<th>Cu\textsuperscript{2+}</th>
</tr>
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<tbody>
<tr>
<td>Au/AO</td>
<td>-</td>
<td>-</td>
<td>80.3%</td>
<td>19.7%</td>
<td>83.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cu/AO</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Au-Cu/AO</td>
<td>1:5.2</td>
<td>1:1.6</td>
<td>90.5%</td>
<td>9.5%</td>
<td>83.4</td>
<td>89.0%</td>
<td>11.9%</td>
<td>89.0%</td>
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