The relationship between chemical state of Pd species and catalytic activity of methane combustion on Pd/CeO$_2$

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Author Contributions

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**Table S1** the peak area for each peak from the H$_2$-TPR results
Fig. S1 Pd 3d XPS spectra of Pd/CeO$_2$ catalysts after stability test
Fig. S2 Pd 3d XPS spectra of Pd/CeO₂ catalysts with low Pd loading
Data details for H$_2$-TPR Calibration by CuO

Fig. S3 H$_2$-TPR profile for 50 mg of CuO (a); the Peak area of H$_2$ consumption by CuO with different mass (b).

H$_2$-TPR measurement of CuO with different mass is carried on and the H$_2$-TPR profile for 50 mg of CuO is shown in Fig S1(a), then Peak area of H$_2$ consumption is integrated and shown in Fig S1(b). The relationship of peak area ($A$) and the mass of CuO ($m_{\text{CuO}}$) follows the equation S1:

\[ A = 0.2631 \times m_{\text{CuO}} \]  [S1]
Table S1 Peak area (A) of each peak from the H₂-TPR results

<table>
<thead>
<tr>
<th>Catalysts</th>
<th>Peak(α)</th>
<th>Peak(β)</th>
<th>Peak(φ)</th>
<th>Peak(γ)</th>
<th>Peak(δ)</th>
<th>Peak(η)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T/°C</td>
<td>A</td>
<td>T/°C</td>
<td>A</td>
<td>T/°C</td>
<td>A</td>
</tr>
<tr>
<td>Pd/CeO₂ (HHA)</td>
<td>-12</td>
<td>0.081</td>
<td>-</td>
<td>-</td>
<td>21</td>
<td>0.886</td>
</tr>
<tr>
<td>Pd/CeO₂ (FA)</td>
<td>-12</td>
<td>0.033</td>
<td>18</td>
<td>0.157</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pd/CeO₂ (IMP)</td>
<td>-11</td>
<td>0.060</td>
<td>31</td>
<td>0.162</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CeO₂ nanorods</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The peak area of each H₂ consumption peak in Fig. 6 is shown in Table S2. The relationship of peak area and the H₂ uptake follows the equation S2:

\[
\text{H₂ uptake} = 956 \times A \quad [\text{S2}]
\]