

## 1 **Supplementary Information**

2 Supplementary data associated with this article can be found in the online version.

### 3 **Advanced catalytic CO<sub>2</sub> hydrogenation on Ni/ZrO<sub>2</sub> with promoted** 4 **oxygen vacancies formation in photothermal condition at medium-** 5 **low temperatures: experimental and computational studies**

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11 # Equal contribution

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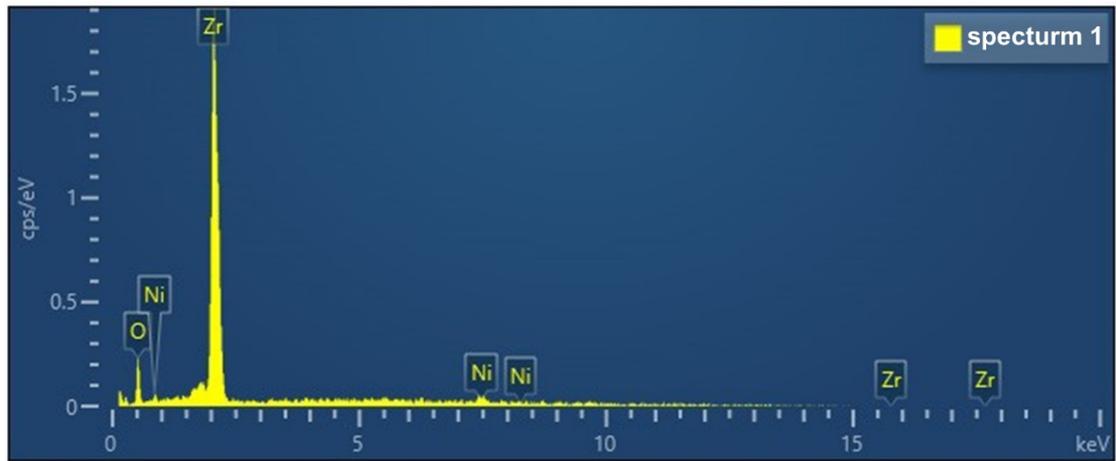


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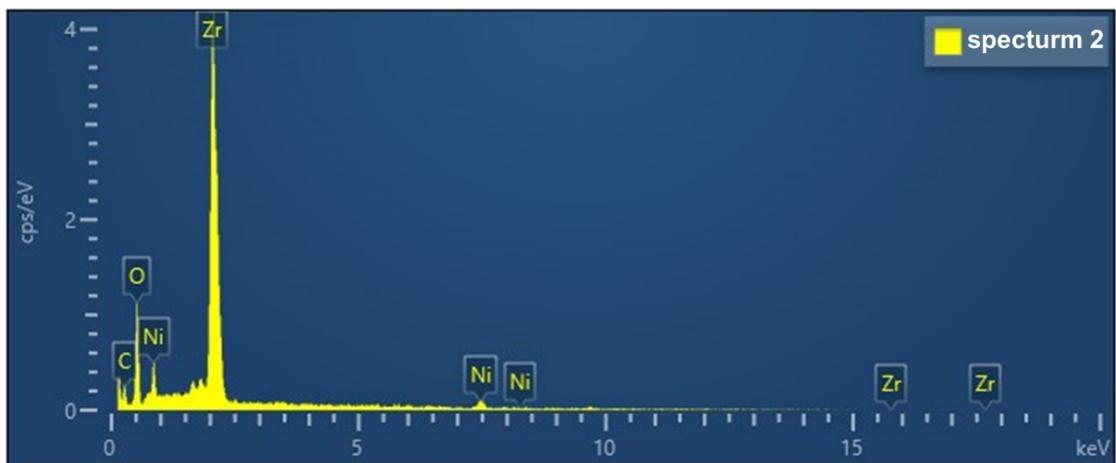
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Figure S1. Digital photos of pristine ZrO<sub>2</sub>, 1wt%, 3wt% and 5wt% Ni/ZrO<sub>2</sub>

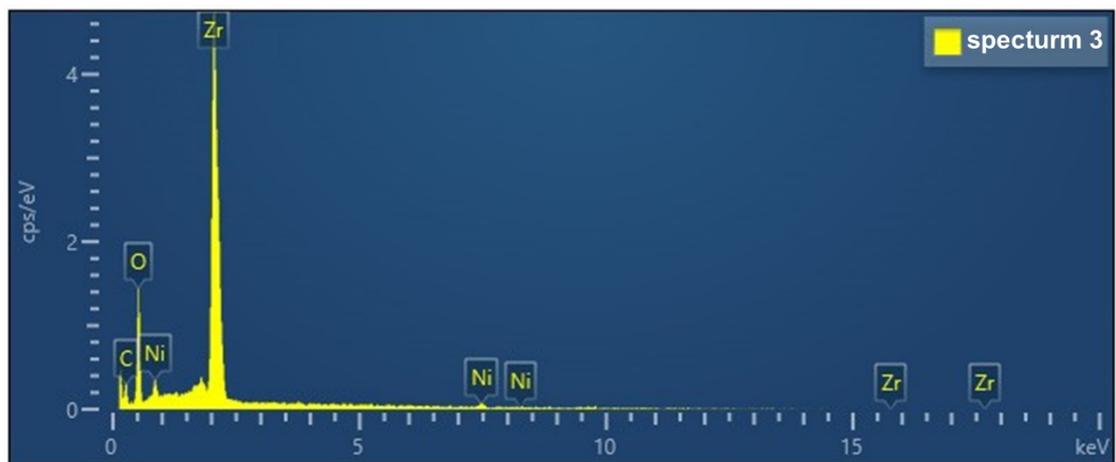
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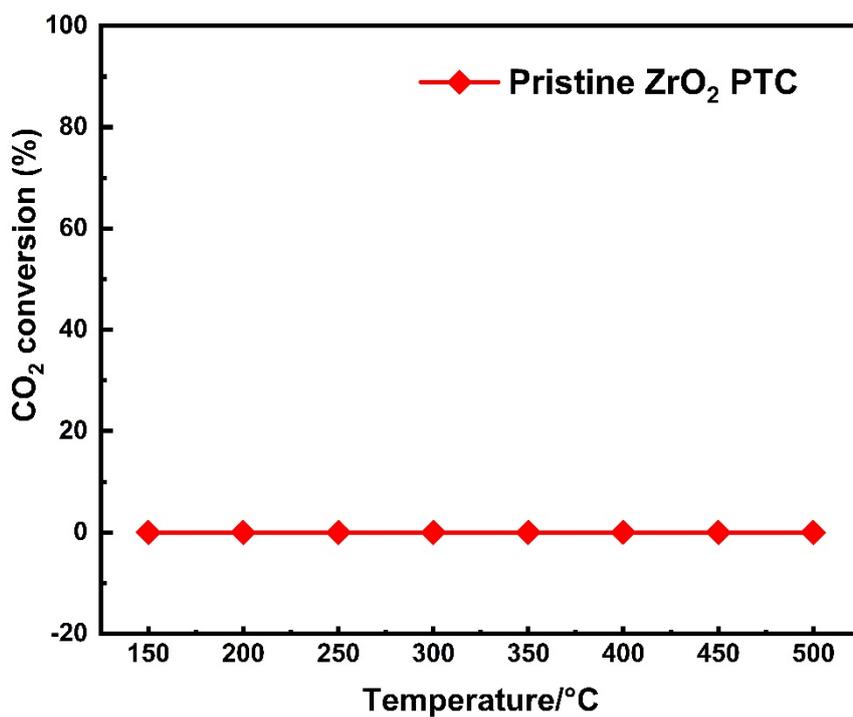
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Figure S2. EDX component analysis after TC (spectrum 1)

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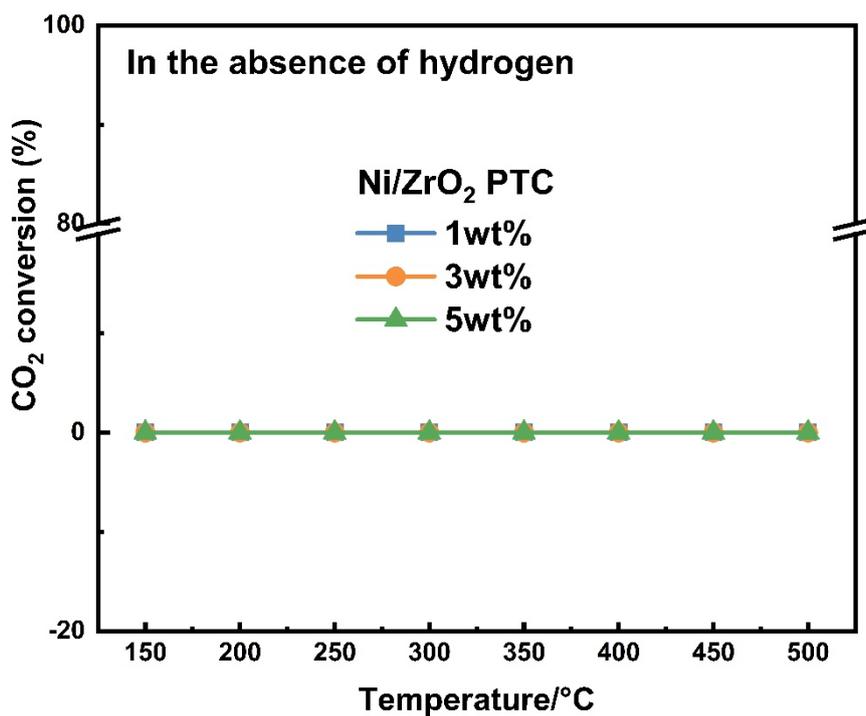
or PTC (spectrum 2 and 3) reaction

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23 Figure S3. The catalytic conversion rate of pure ZrO<sub>2</sub> used in photothermal CO<sub>2</sub> hydrogenation

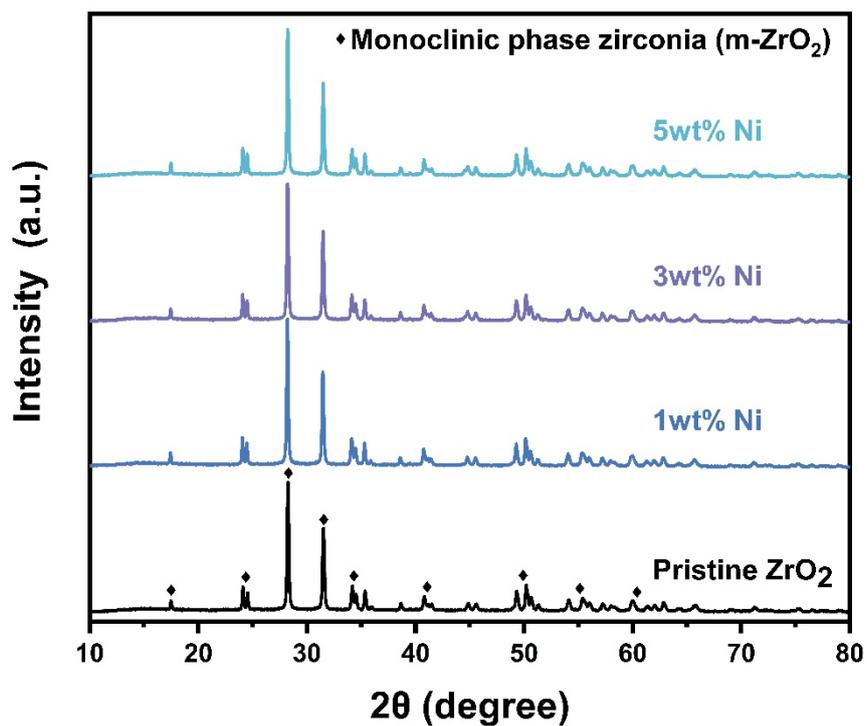


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25 Figure S4. Photothermal CO<sub>2</sub> conversion rate of 1wt%, 3wt% and 5wt% Ni/ZrO<sub>2</sub>

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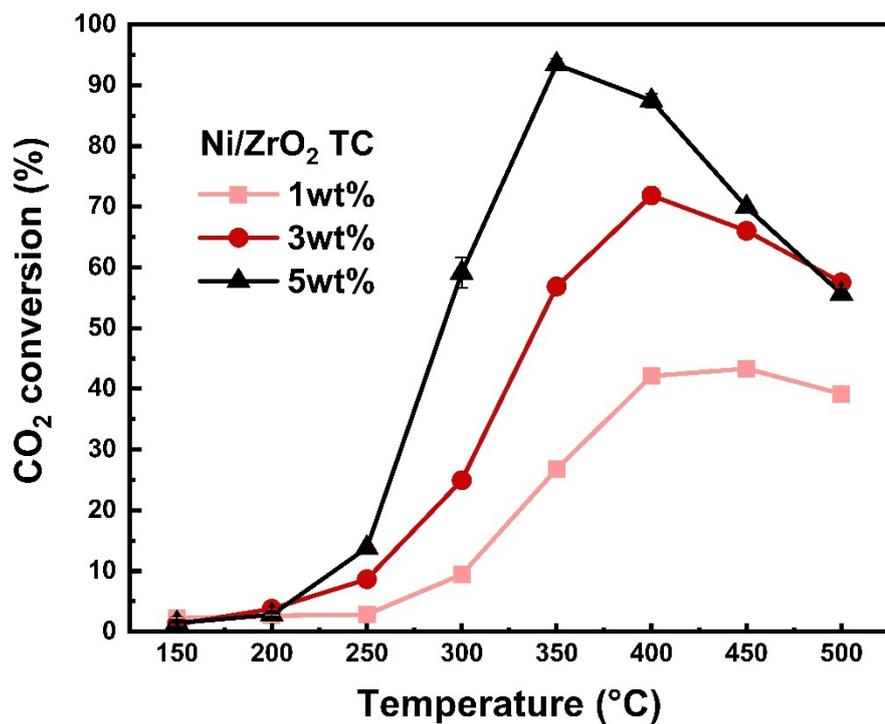
in the absence of hydrogen



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Figure S5. XRD pattern of pristine ZrO<sub>2</sub>, fresh Ni/ZrO<sub>2</sub> with different loading

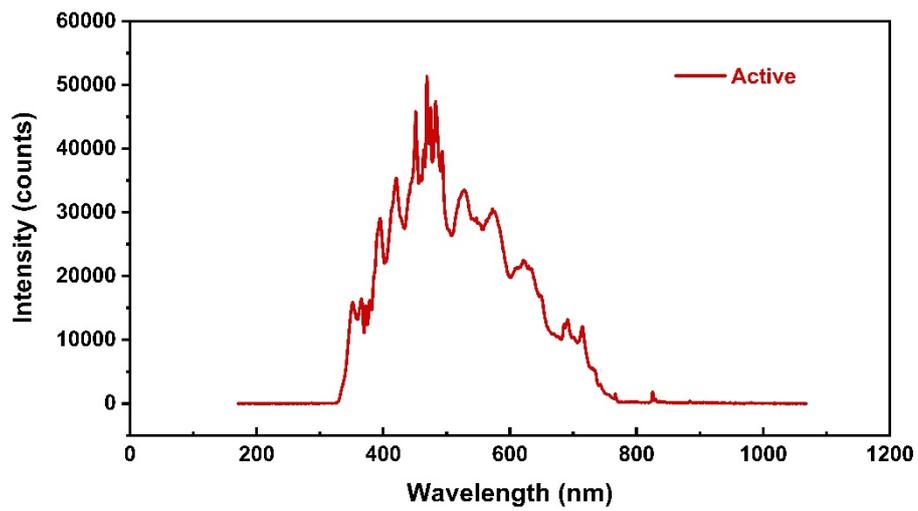


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Figure S6. CO<sub>2</sub> conversion rate in thermally catalytic CO<sub>2</sub> hydrogenation reaction over Ni/ZrO<sub>2</sub> catalysts with different metal loading



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Figure S7. Spectral image of Xe lamp