

## High-performance Ni-Ce<sub>1-x</sub>Zr<sub>x</sub>O<sub>2</sub> nanoparticle for biogas reforming: enhance CO<sub>2</sub> activation and stability

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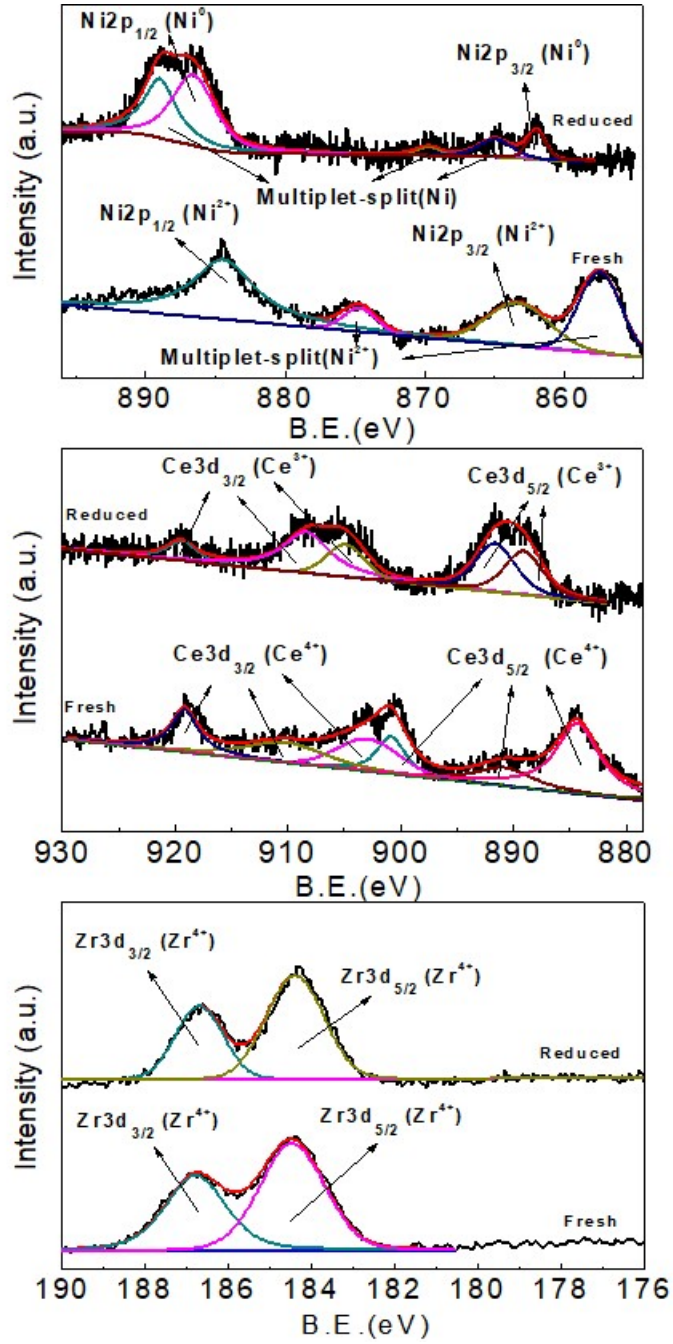
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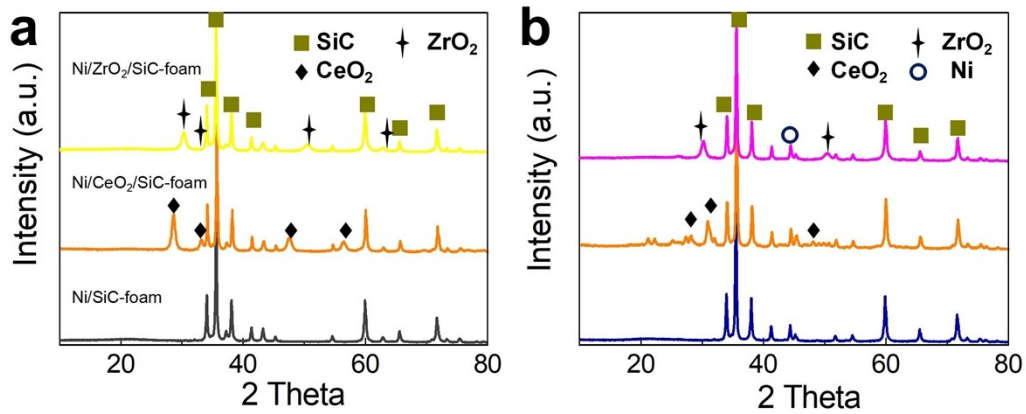
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**Table S1.** Metal amount of Ni-Ce<sub>1-x</sub>Zr<sub>x</sub>O<sub>2</sub>/SiC-foam catalysts.

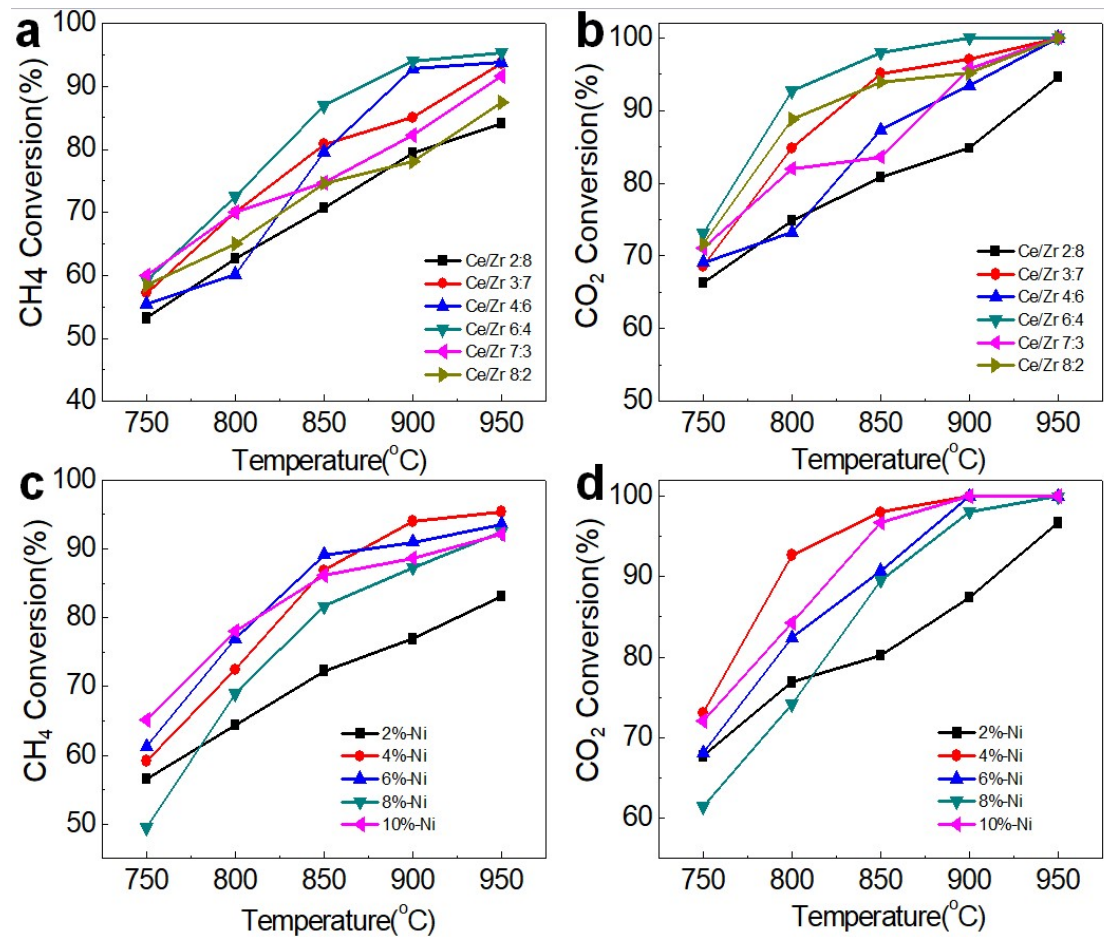
Catalyst	Loading (wt%)					
	Nominal			Actual		
	Ni	Ce	Zr	Ni	Ce	Zr
4wt%Ni/10wt%Ce <sub>0.6</sub> Zr <sub>0.4</sub> O <sub>2</sub> /SiC-foam	3.1	5.5	2.3	3.0	3.9	0.8



**Fig. S1.** XPS spectra of (a) Ni and (b) Ce (c) Zr elements for fresh and reduced Ni/Ce<sub>1-x</sub>Zr<sub>0x</sub>O<sub>2</sub>/SiC-F.

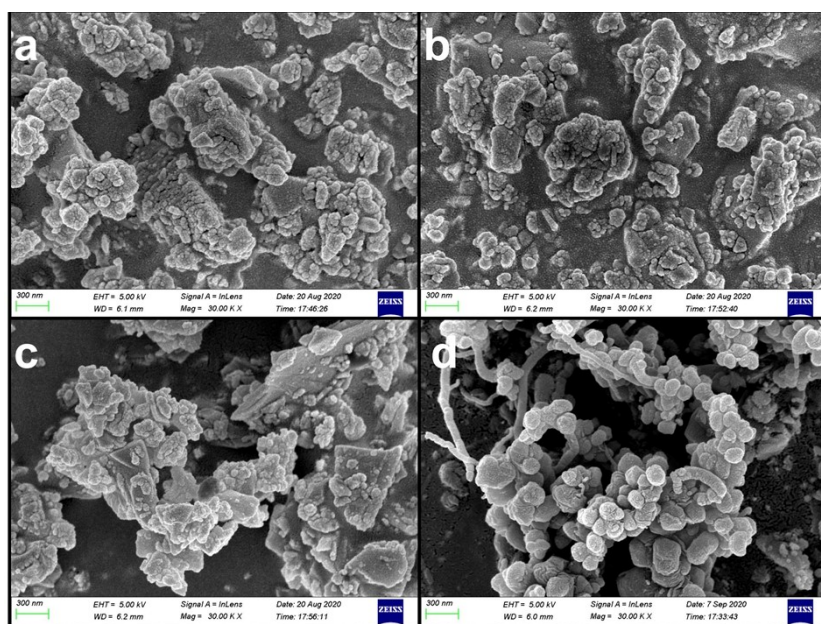


**Fig. S2.** XRD patterns of (a) fresh and (b) reduced Ni/CeO<sub>2</sub>/SiC-foam, Ni/ZrO<sub>2</sub>/SiC-foam and Ni/SiC-foam.

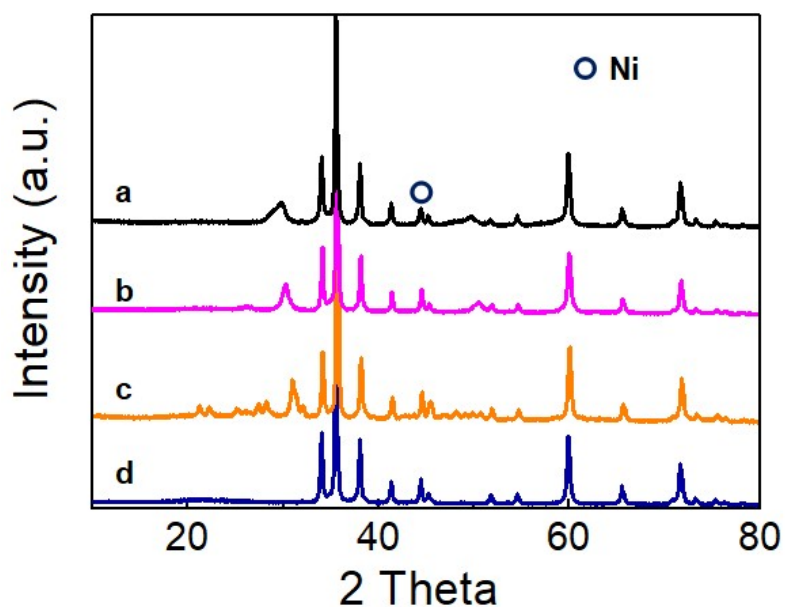


**Fig. S3.** (a-b) CH<sub>4</sub> and CO<sub>2</sub> conversions rates on Ni/Ce<sub>1-x</sub>Zr<sub>x</sub>O<sub>2</sub>/SiC-foam with different Ce/Zr molar ratio. (c-d) CH<sub>4</sub> and CO<sub>2</sub> conversions on Ni/Ce<sub>0.6</sub>Zr<sub>0.4</sub>O<sub>2</sub>/SiC-foam with different Ni loadings. Reaction condition: CH<sub>4</sub>/CO<sub>2</sub> molar ratio of 1/1,

GHSV of 24000 mL g<sup>-1</sup> h<sup>-1</sup>, atmospheric pressure.



**Fig. S4.** SEM images of (a) Ni/Ce<sub>0.6</sub>Zr<sub>0.4</sub>O<sub>2</sub>/SiC-foam, (b) Ni/CeO<sub>2</sub>/SiC-foam, (c) Ni/ZrO<sub>2</sub>/SiC-foam and (d) Ni/SiC-foam after catalytic activity evaluation.



**Fig. S5.** XRD patterns of (a) Ni/Ce<sub>0.6</sub>Zr<sub>0.4</sub>O<sub>2</sub>/SiC-foam, (b) Ni/ZrO<sub>2</sub>/SiC-foam, (c) Ni/CeO<sub>2</sub>/SiC-foam and (d) Ni/SiC-foam after catalytic activity evaluation.

**Table S2.** Average particle size of Ni NPs of Ni/Ce<sub>0.6</sub>Zr<sub>0.4</sub>O<sub>2</sub>/SiC-foam, Ni/ZrO<sub>2</sub>/SiC-foam, Ni/CeO<sub>2</sub>/SiC-foam and Ni/SiC-foam after catalytic activity evaluation.

Catalyst	Ni size <sup>b</sup> (nm)
Ni/Ce <sub>0.6</sub> Zr <sub>0.4</sub> O <sub>2</sub> /SiC-foam	11
Ni/CeO <sub>2</sub> /SiC-foam	23
Ni/ZrO <sub>2</sub> /SiC-foam	24
Ni/SiC-foam	32