The Structure, Carbon Deposition and Stability of a $ZrO_X/Ni\text{-}MnO_X/SiO_2$ Catalyst for the CO_2 Reforming of Methane†

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Electronic Supplementary Information (ESI)

Contents

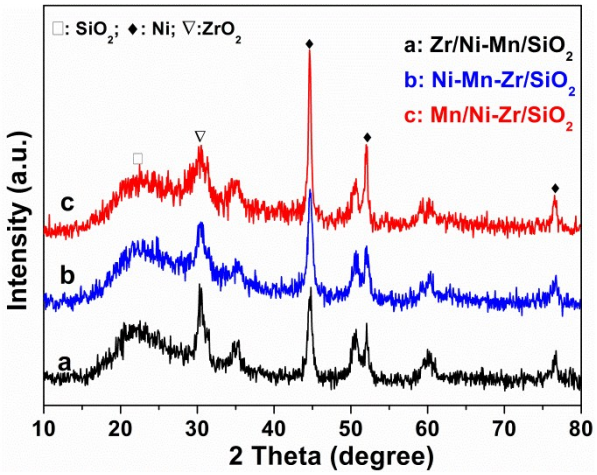

Fig. S1 XRD patterns of Zr and Mn co-promoted catalysts reduced at 800 °C.

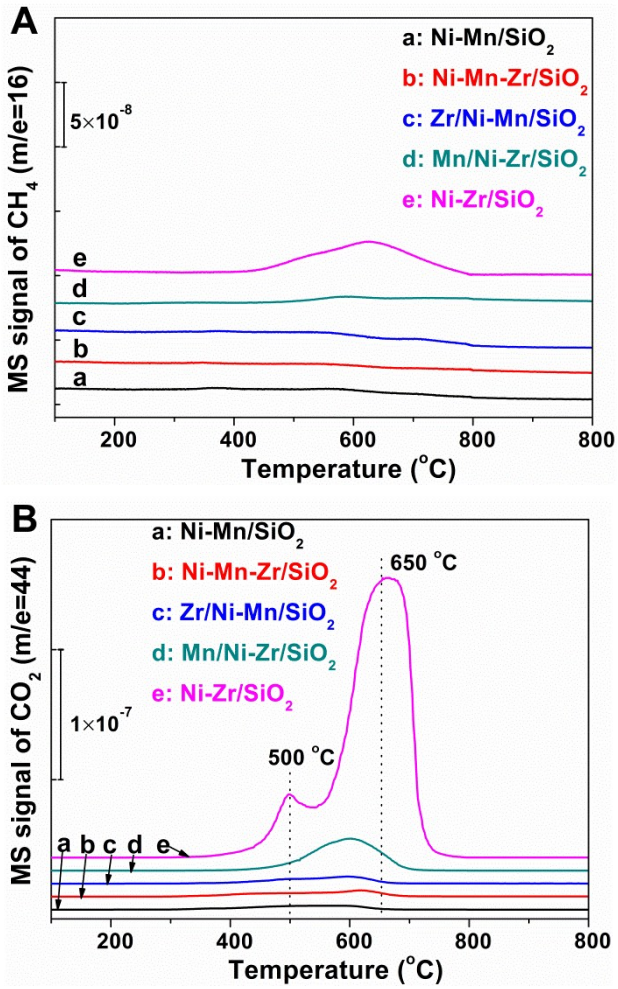

Fig. S2 A) H_2-TPH after CH_4-TPDe and B) the subsequent O_2-TPO on different catalysts.

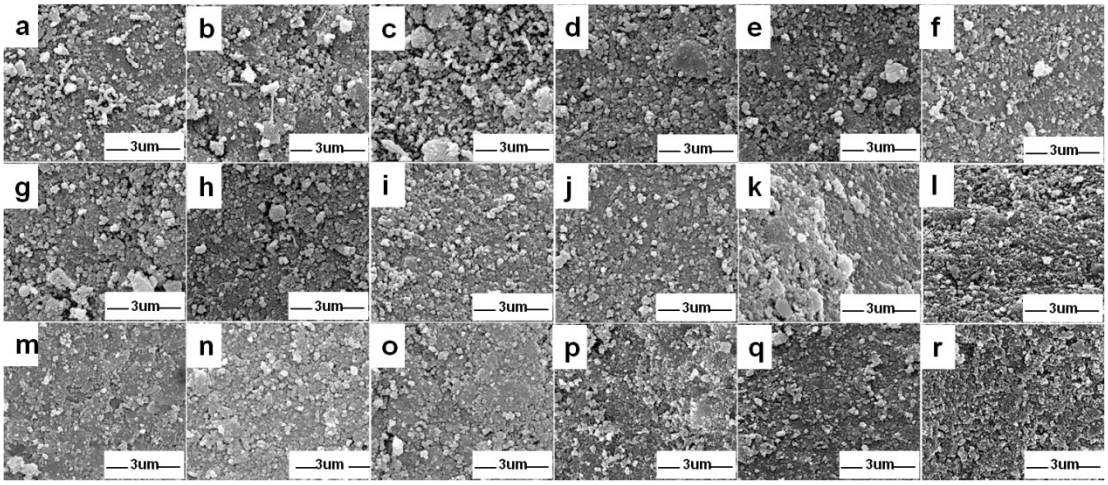

Fig. S3 SEM images of different catalysts. a-e) after CH_4-TPDe, f-j) after CO_2-TPO, k-o) after O_2-TPO and p-r) after 60 h DRM reaction. a),f) and k) Ni-ZrO_X/SiO_2 catalyst; b), g) and l) Ni-MnO_X/SiO_2 catalyst; c), h), l) and p) Ni-MnO_X-ZrO_X/SiO_2 catalyst; d), i), n) and q) MnO_X/Ni-ZrO_X/SiO_2 catalyst; e), g), o) and r) ZrO_X/Ni-MnO_X/SiO_2 catalyst.

Table S1 Elemental analysis results for the fresh Zr and Mn co-promoted catalysts, as determined by XPS.

Sample	Ni %	Zr %	Mn %
Ni-MnO_X-ZrO_X/SiO_2	37.3	43.2	19.5
MnO_X/Ni-ZrO_X/SiO_2	39.4	13.3	47.3
ZrO_X/Ni-MnO_X/SiO_2	46.2	7.6	46.2

Table S2 BET surface area, metal particle size and ICP analysis of the Mn and Zr co-promoted catalysts.

Sample	BET surface area (m^2 g^{-1})	Metal particle size[a] (nm)	Ni Dispersion[b] (%)	Elemental ratio[c] (wt%)		
				Mn	Zr	Ni
Ni-MnO_X-ZrO_X/SiO_2	136	12	0.047	1.1	4.2	8.4
MnO_X/Ni-ZrO_X/SiO_2	100	18	0.065	1.1	4.0	7.8
ZrO_X/Ni-MnO_X/SiO_2	108	12	0.079	1.2	3.9	8.1

[a] Determined from XRD. [b] Ni surface exposure measured from CO chemisorption. [c] Determined from ICP analysis.