

## Electronic Supplementary Information

Table S1 The CO-TPD results of fresh catalysts

Catalyst	Peak I		Peak II	
	Temperature (°C)	Desorption amount (μmol/g)	Temperature (°C)	Desorption amount (μmol/g)
Sm0	85.1	29.11	563.0	80.19
Sm0.5	83.8	26.37	591.2	93.18
Sm1	85.3	22.48	617.7	165.62
Sm1.5	86.3	28.62	587.6	102.34
Sm2	85.0	29.45	580.3	98.69

Table S2 The H<sub>2</sub>-TPD results of fresh catalysts

Catalyst	Peak I		Peak II	
	Temperature (°C)	Desorption amount (μmol/g)	Temperature (°C)	Desorption amount (μmol/g)
Sm0	85.7	13.36	257.1	55.50
Sm0.5	88.2	14.28	251.6	48.57
Sm1	88.1	12.45	240.3	30.84
Sm1.5	84.2	15.87	255.4	51.21
Sm2	86.3	17.99	255.8	73.94

Table S3 The CO<sub>2</sub>-TPD results of fresh catalysts

Catalyst	Peak I		Peak II	
	Temperature (°C)	Desorption amount (μmol/g)	Temperature (°C)	Desorption amount (μmol/g)
Sm0	104.0	1034.03	489.9	3583.91
Sm0.5	117.1	1889.97	501.7	3725.74
Sm1	117.5	1807.78	527.6	4959.07
Sm1.5	105.6	1123.11	519.1	4324.98
Sm2	117.7	2019.09	491.2	3487.17

Table S4 The Fe/Mn/Sm surface ratios of catalysts after reduction in XPS.

	Fe (%)	Mn (%)	Sm(%)
Sm0	30.11	1.86	0.00
Sm0.5	28.33	1.89	0.95
Sm1	27.63	1.84	1.51
Sm1.5	27.41	2.27	1.75
Sm2	27.42	2.35	2.07