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Supporting Information

Phase Transformation of Iron oxide to Carbide and Fe_3C being Active Centers for RWGS Reaction

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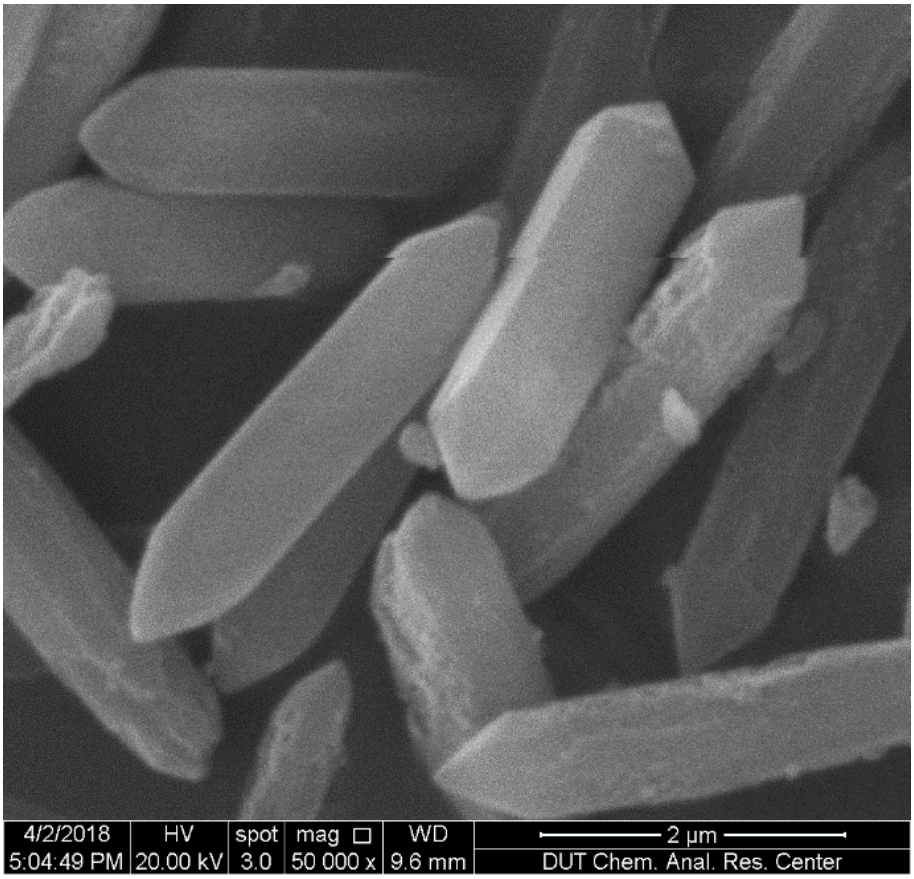

Figure S1 SEM image of as-prepared spindle-like Mil-88A.

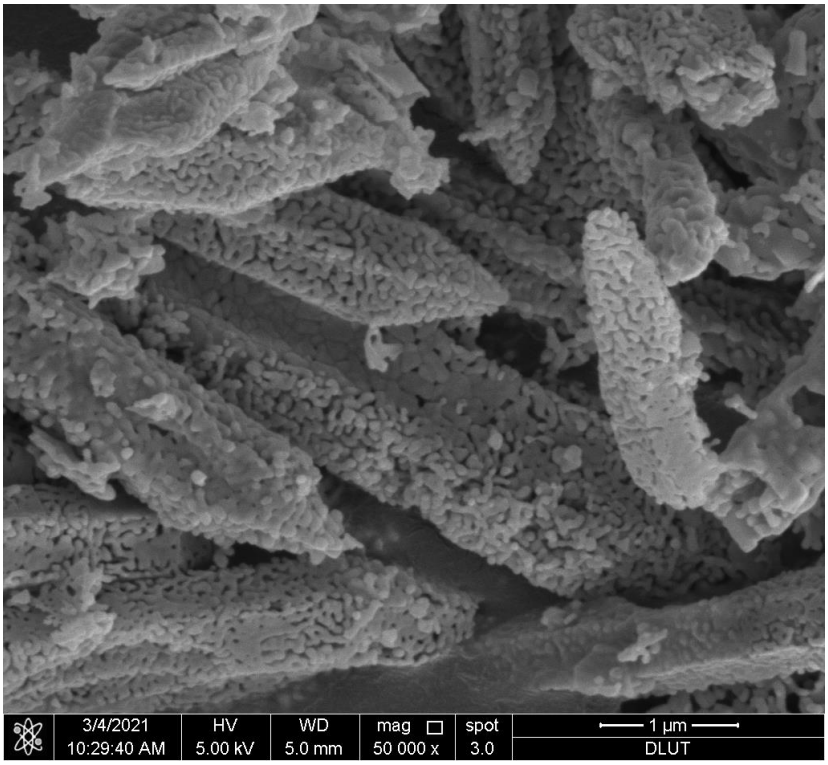

Figure S2 SEM images of Mil-88A derived spindle-like α-Fe_2O_3.

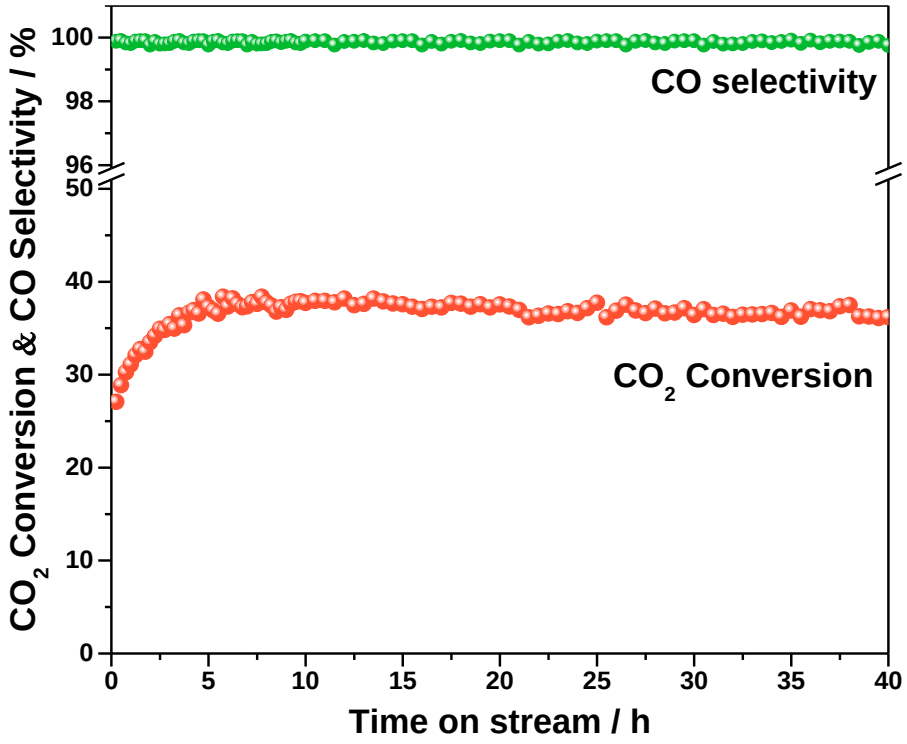

Figure S3 CO_2 conversion and CO selectivity of as-prepared spindle-like iron oxide in RWGS. Reaction conditions: 600 °C, ambient pressure, CO_2/H_2 (v/v)=1/2, WHSV=300,000 mL/g/h.

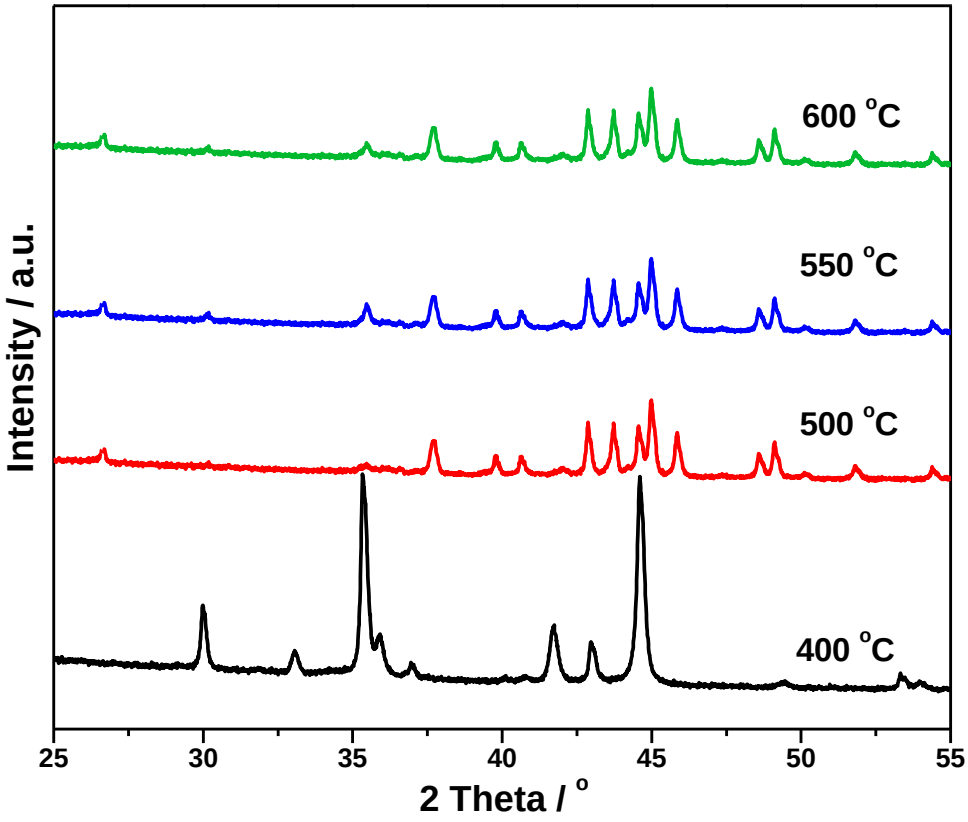

Figure S4 XRD patterns of the spent samples after 15h at 400 °C, 500 °C, 550 °C and 600 °C.

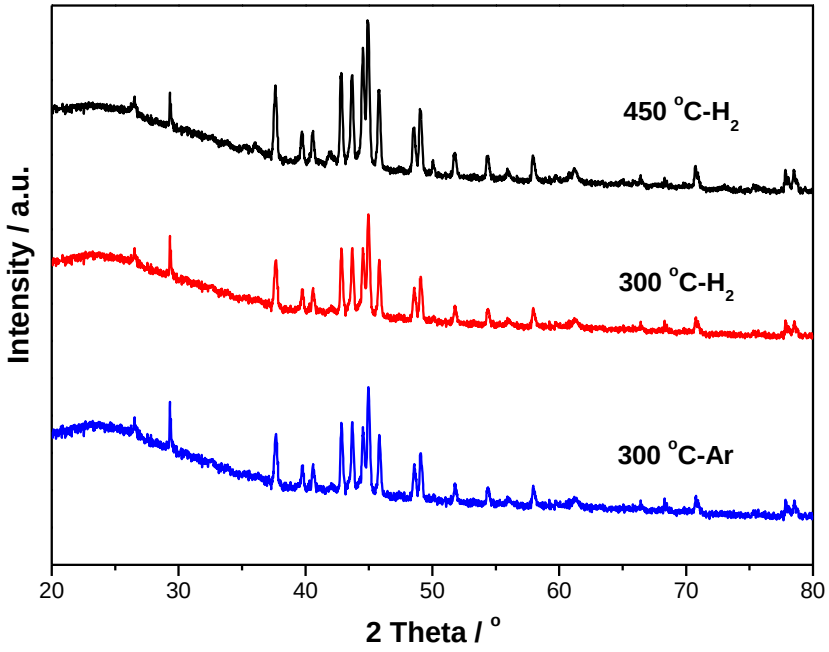

Figure S5 XRD patterns of the spent samples after 15h at 600 °C after different pretreatments. Reaction conditions: 0.1 MPa, CO_2/H_2 (v/v)=1/2, WHSV=300,000 mL/g/h.

Table S1 Comparison of catalytic performance for the in-situ formed Fe_3C and Literature Reported Catalysts

Catalyst	Reaction temp. (°C)	Space volocity (mL/g/h)	CO_2 Conv. (%)	CO Sel. (%)	Producing CO rate (mmol/g/h)	Ref.
In-situ formed Fe_3C	600	300,000	38	ca. 100	1695	Our work
	550	300,000	33	ca. 100	1471	
	500	300,000	28	ca. 100	1249	
Mo_2C@N-C	600	24,000	58	98	152	1
Fe-Ce-Al	600	30,000	55	99	146	2
NiCu-Saponite	500	15,000	53	89	63	3
MnO	850	200,000	50	100	893	4
Mo_2C	550	12,000	60	100	64	5
Cs-Mo_2C	550	12,000	66	100	70	
Fe oxide	600	6,000	35	100	47	6
$CsFe/Al_2O_3$	600	12,000	63	98	66	7
BaZrYZn	600	2,400	37.5	97	19	8
Co-CeO_2	600	600,000	35	98.5	4617	9
Ru/CeO_2	600	120,000	38	ca. 100	1017	10
β-Mo_2C	600	300,000	42.5	99	1878	11

1. Journal of Energy Chemistry 50 (2020) 37–43
2. Applied Catalysis A, General 593 (2020) 117442
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6. Journal of Industrial and Engineering Chemistry 23 (2015) 67–71
7. Catalysts 8 (2018) 608
8. ACS Catalysis. 4 (2014) 3117−3122
9. Catalysis Today 316 (2018) 155–161
10. Journal of CO_2 Utilization 26 (2018) 350–358
11. ACS Catalysis. 7 (2017) 912−918