

**Table 1 S**  $L_9(3^4)$  Factors and levels of the orthogonal tests

Level Factor	Temperature (A)	Water carbon ratio(B)	Capacity (C)
1	600°C	1.0	0
2	700°C	1.5	2.5%
3	800°C	2.0	5%

**Table 2 S** Orthogonal experimental protocol  $L_9(3^4)$

Test number	Column number			
	1(A)	2(B)	3(C)	4
1	1	1	1	1
2	1	2	3	2
3	1	3	2	3
4	2	1	2	3
5	2	2	1	1
6	2	3	3	2
7	3	1	3	2
8	3	2	2	3
9	3	3	1	1

**Table 3 S** Hydrogen selectivity extreme difference analysis

Test number	Column number				Experimental result
	1(A)	2(B)	3(C)	4	H <sub>2</sub> Selectivity
1	1	1	1	1	85.33
2	1	2	3	2	79.24
3	1	3	2	3	83.01
4	2	1	2	3	78.28

5	2	2	1	1	82.30
6	2	3	3	2	77.02
7	3	1	3	2	78.27
8	3	2	2	3	74.67
9	3	3	1	1	79.32
$K_1$	246.941	241.874	247.573		
$K_2$	235.959	238.842	237.594		
$K_3$	234.521	239.349	232.254		
$k_1$	82.314	80.625	82.524		
$k_2$	78.653	79.614	79.198		
$k_3$	78.174	79.783	77.418		
$R_1$	4.14	1.011	5.106		

**Table 4 S** Hydrogen content extreme difference analysis

Test number	Column number				Experimental result
	1(A)	2(B)	3(C)	4	H <sub>2</sub> Content %
1	1	1	1	1	78.405
2	1	2	3	2	66.616
3	1	3	2	3	67.167
4	2	1	2	3	64.958
5	2	2	1	1	63.065
6	2	3	3	2	74.511
7	3	1	3	2	56.353
8	3	2	2	3	59.882
9	3	3	1	1	62.728
$K_1$	212.188	199.716	212.798		
$K_2$	203.119	189.563	194.302		

$K_3$	178.963	204.406	186.585
$k_1$	70.729	66.572	70.933
$k_2$	67.706	63.188	64.767
$k_3$	59.654	68.135	62.195
$R_1$	11.075	4.947	8.738

**Table 5 S** Model Summary

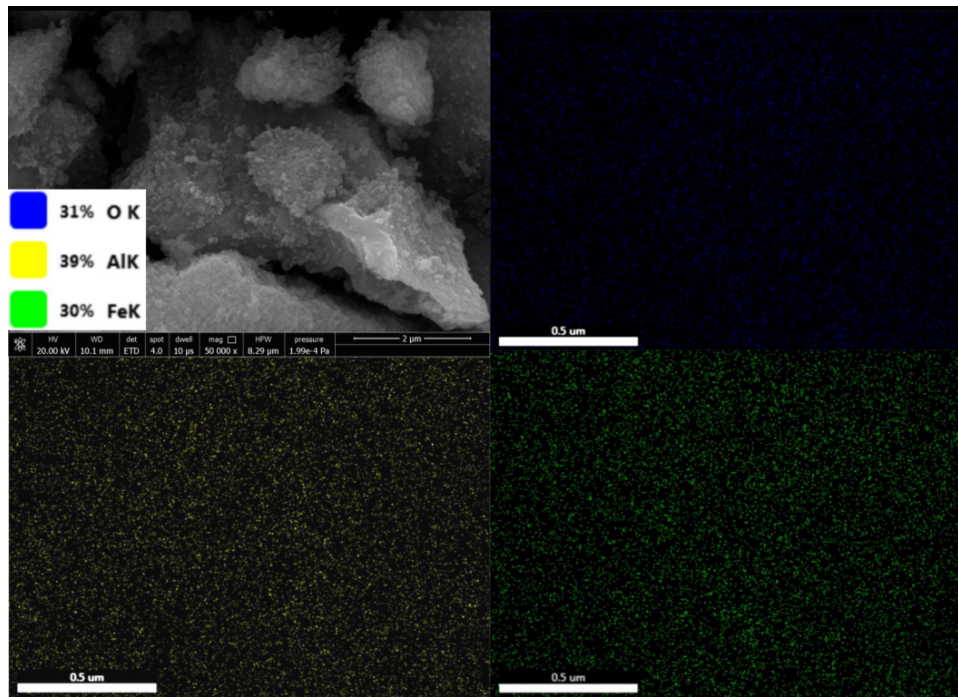
	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Error in the standard estimates
Hydrogen selectivity	0.891	0.795	0.726	1.71864
Hydrogen content	0.910	0.828	0.771	3.29358

**Table 6 S** Variance of hydrogen gas selectivity

	Quadratic sum	Free degree	Mean square	F	Significance
Regression	68.576	2	34.288	11.608	0.009
Residual	17.722	6	2.954		
Total	86.298	8			

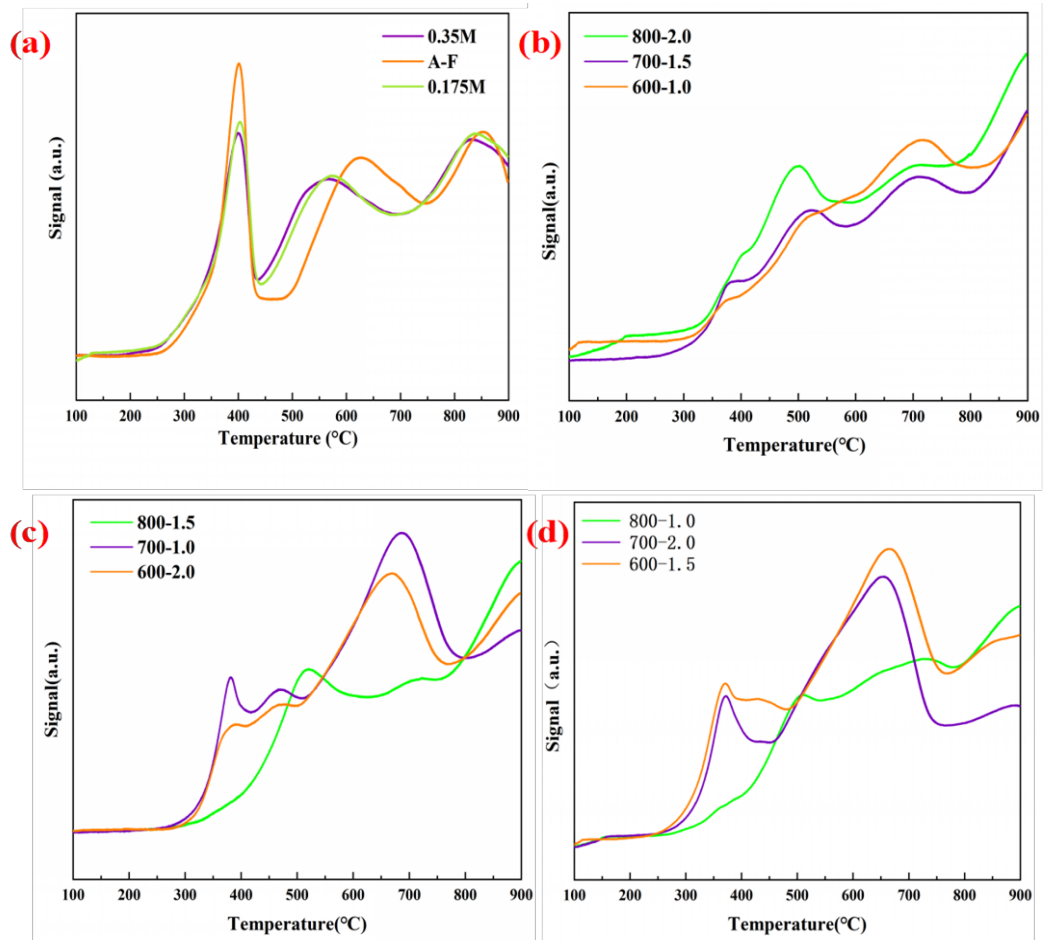
**Table 7 S** Variance of hydrogen content

	Quadratic sum	Free degree	Mean square	F	Significance
Regression	313.866	2	156.933	14.467	0.005
Residual	65.086	6	10.848		
Total	378.952	8			



**Fig. 1 S.** SEM results of prepared Fe-Al OCs

**Fig. 2 S.** EDX micrographs of prepared Fe-Al OCs



**Fig. 3 S.** H<sub>2</sub>-TPR patterns of (a) three fresh OCs; (b)After five cycles of OCs of 0 under different reaction conditions; (c)After five cycles of OCs capacity of 2.5% under different reaction conditions; (d)After five cycles of OCs capacity of 5% under different reaction conditions

**Fig. 4 S.** Orthogonal test effect graph (a) Optimum hydrogen content (b) Optimum hydrogen selectivity

**Fig. 5 S.** Gas content of glycerol reforming with different OCs in five cycles

**Fig. 5 S.** (continued).

Fig. 5 S. (continued).

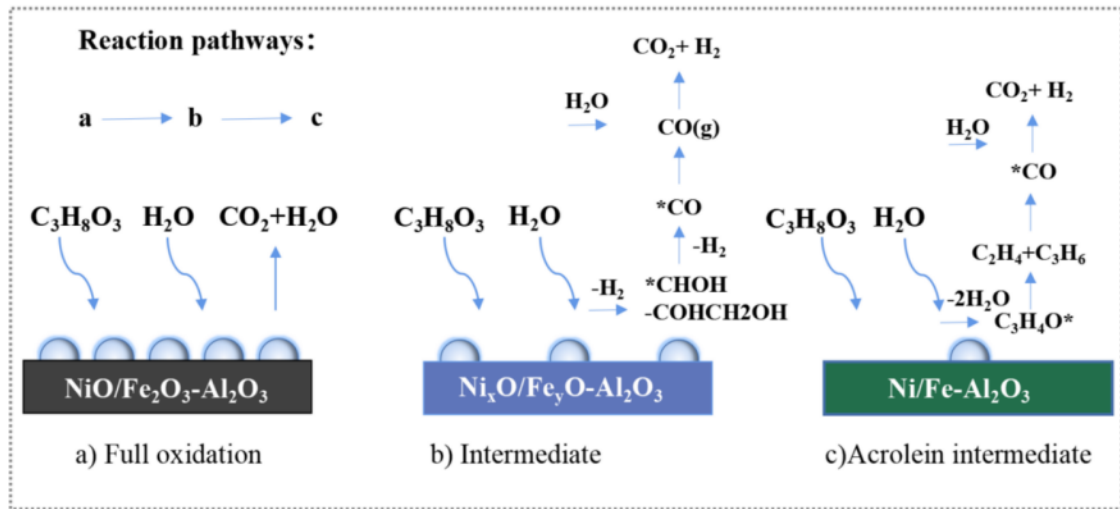


Fig. 6 S. Glycerol reaction pathway