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Synergistic effect of alkali Na and K promoter on Fe-Co-Cu-Al catalysts for CO_2 hydrogenation to light hydrocarbons

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XRD

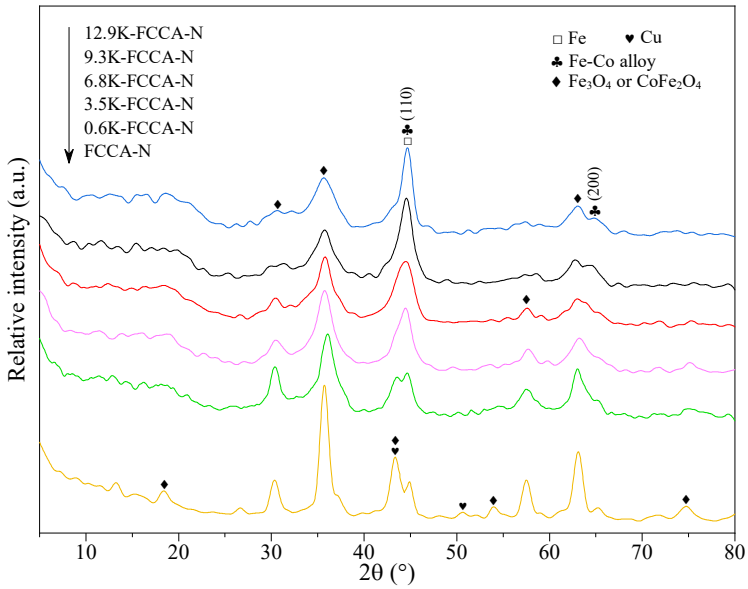

Figure S1. XRD pattern of the reduced FCCA-N modified with different amount of promoter K

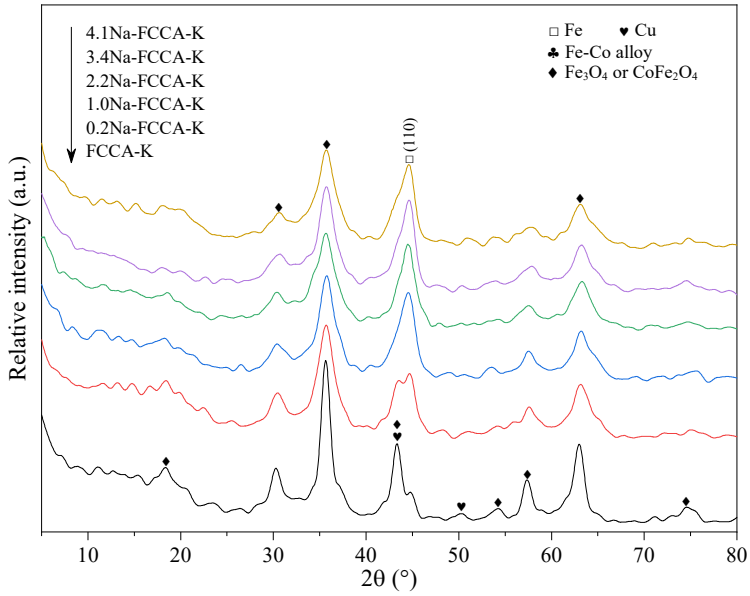

Figure S2. XRD pattern of the reduced FCCA-K modified with different amount of promoter Na

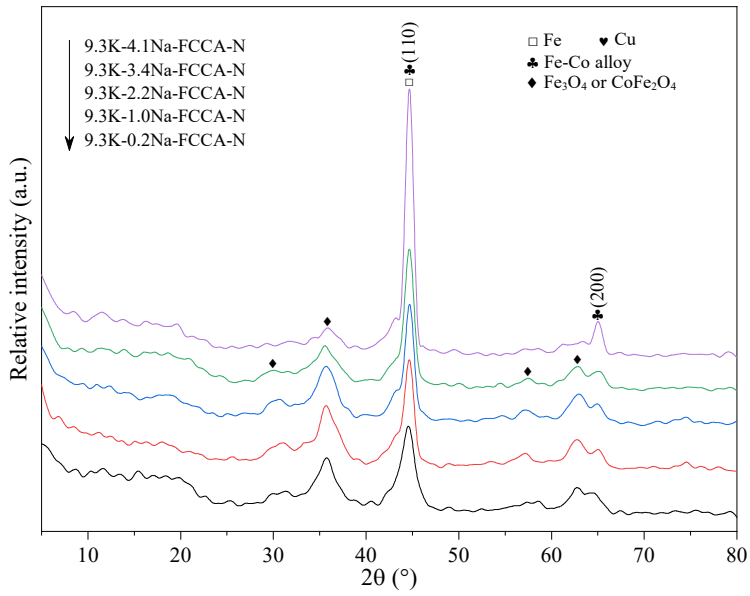

Figure S3. XRD pattern of reduced K-Na-FCCA-N catalysts (K/Fe 9.3mol%) modified by different Na content

H_2-TPR

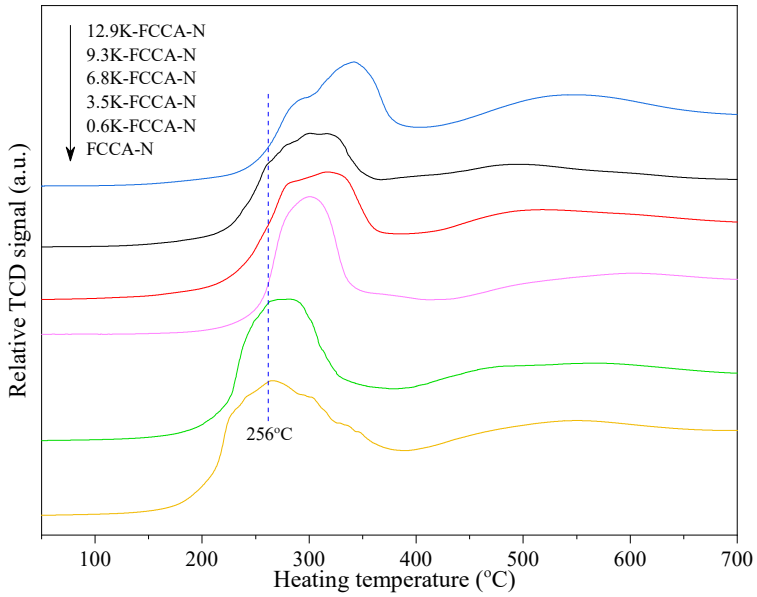

Figure S4. H_2-TPR profiles of FCCA-N catalysts promoted with different amount of K

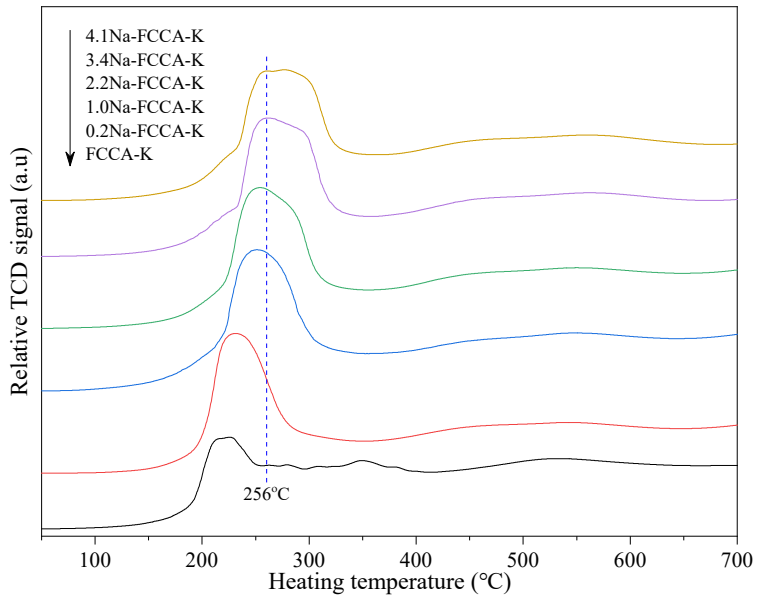

Figure S5. H_2-TPR profiles of FCCA-K catalysts promoted with different amount of Na

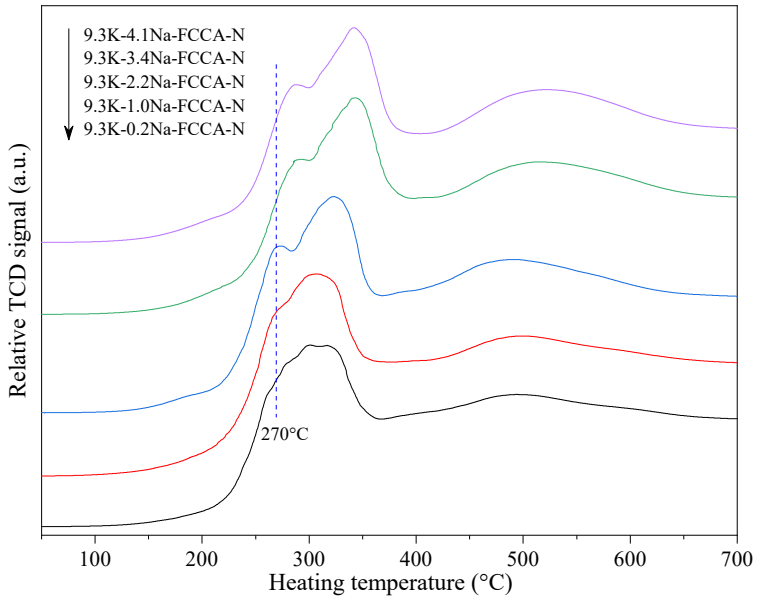

Figure S6. H_2-TPR profiles of K-Na-FCCA-N catalysts (K/Fe 9.3mol%) promoted with different amount of Na

H_2-TPD

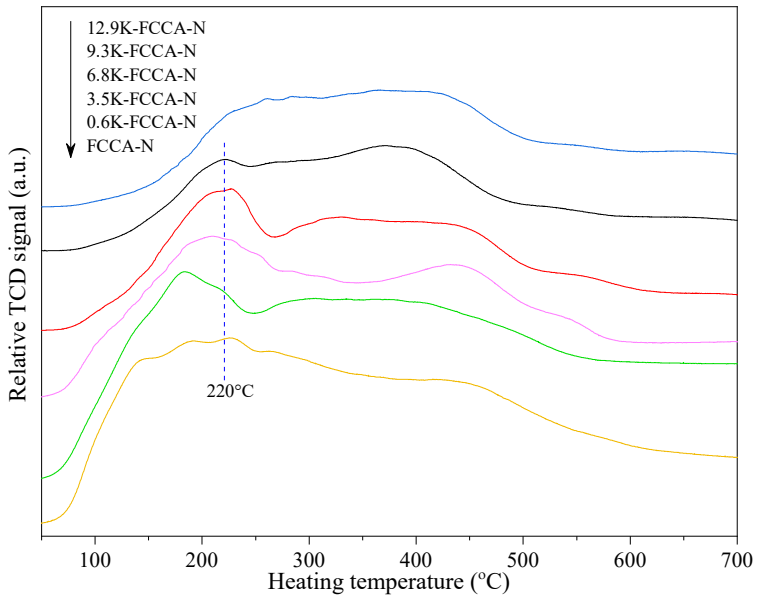

Figure S7. H_2-TPD profiles of FCCA-N catalysts promoted with different amount of K

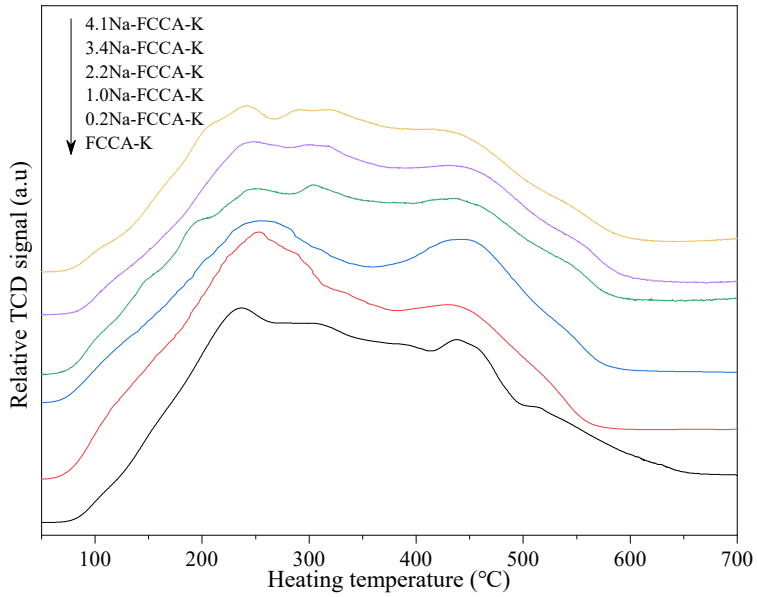

Figure S8. H_2-TPD profiles of FCCA-K catalysts promoted with different amount of Na

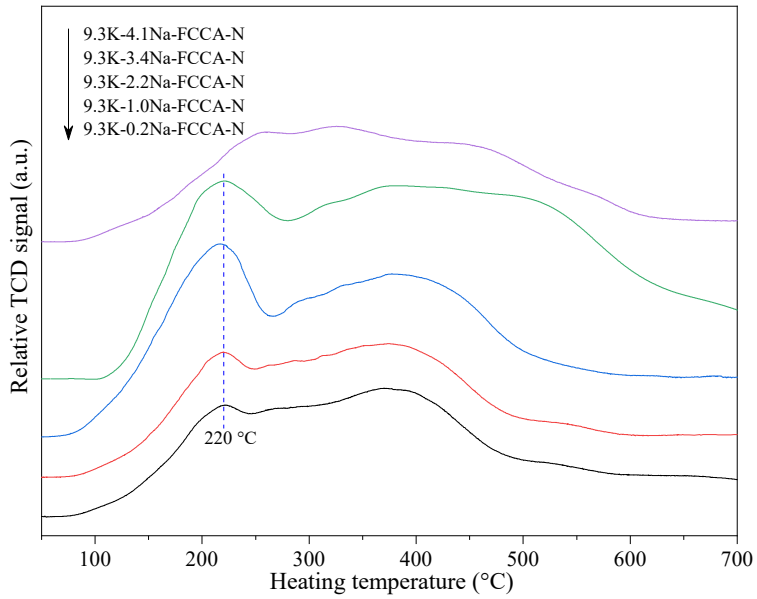

Figure S9. H_2-TPD profiles of K-Na-FCCA-N catalysts (K/Fe 9.3mol%) promoted with different amount of Na

CO_2-TPD

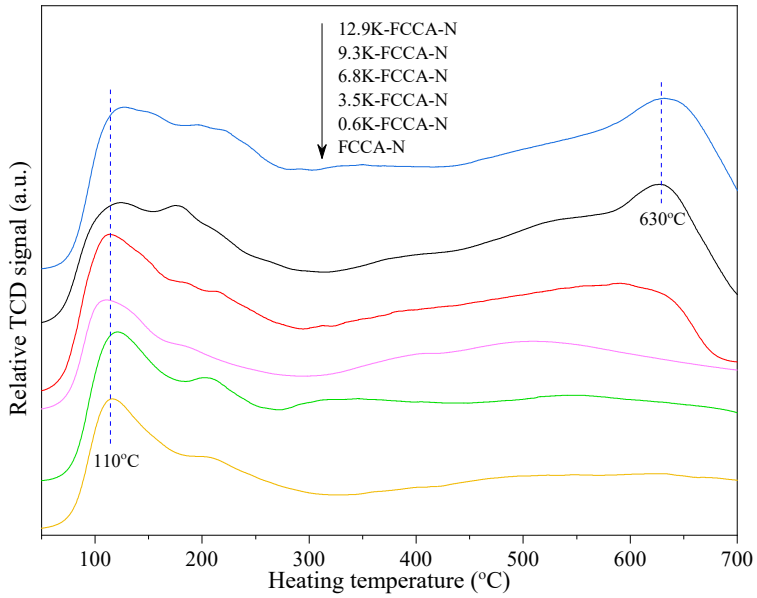

Figure S10. CO_2-TPD profiles of FCCA-N catalysts promoted with different amount of K

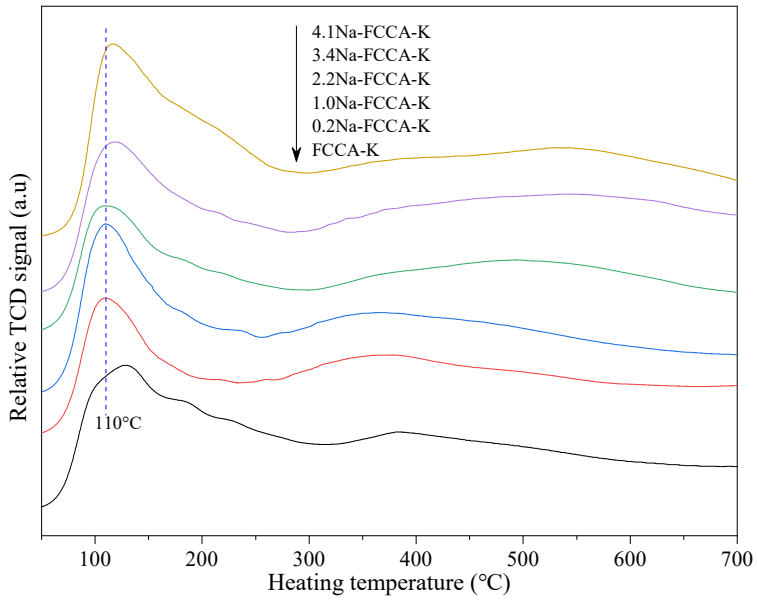

Figure S11. CO_2-TPD profiles of FCCA-K catalysts promoted with different amount of Na

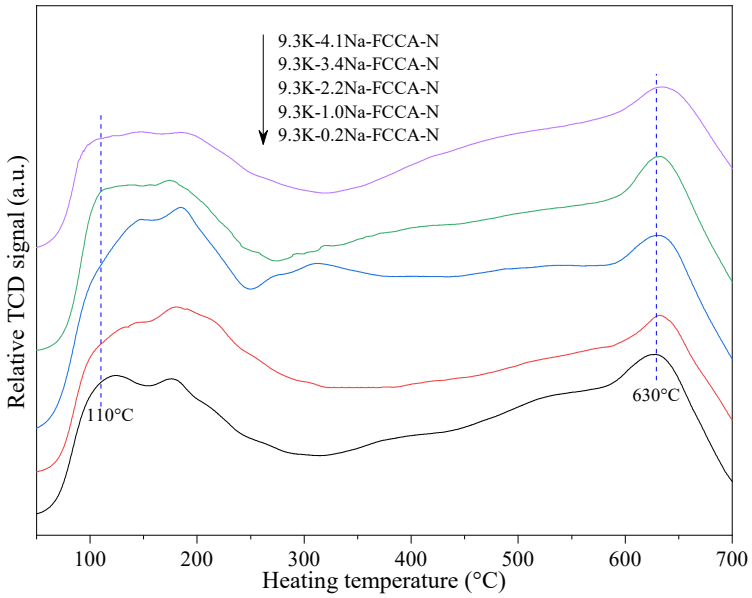

Figure S12. CO_2-TPD profiles of K-Na-FCCA-N catalysts (K/Fe 9.3mol%) promoted with different amount of Na

Table S1. Textural and catalytic properties of K-promoted FCCA-N in CO_2 hydrogenation

K/Fe ratio in catalyst (mol%)	N_2 adsorption-desorption			CO_2 conv. (mol%)	Distribution of products (mol%)				
	S_{BET} ($m^2 \cdot g^{-1}$)	V_{BJH} ($mL \cdot g^{-1}$)	d_{pore} (nm)		CO	CH_4	C_2^+	Olefin C_2-C_4	Paraffin C_2-C_4
0	134.1	0.42	4.1	35.02	2.56	26.13	71.31	20.98	44.50
0.6	117.6	0.36	4.0	41.42	2.20	25.04	72.76	20.73	43.37
3.5	107.6	0.35	4.2	43.48	3.00	24.19	72.81	21.43	38.03
6.8	113.8	0.33	3.8	44.48	3.63	22.45	73.92	24.38	31.31
9.3	105.4	0.36	4.2	46.22	2.89	17.00	80.11	25.51	33.67
12.9	102.9	0.31	4.0	46.36	2.30	13.64	84.06	23.97	42.35

Table S2. Textural and catalytic properties of Na-promoted FCCA-K in CO_2 hydrogenation

Na/Fe ratio in catalyst (mol%)	N_2 adsorption-desorption			CO_2 conv. (mol%)	Distribution of products (mol%)				
	S_{BET} ($m^2 \cdot g^{-1}$)	V_{BJH} ($mL \cdot g^{-1}$)	d_{pore} (nm)		CO	CH_4	C_2^+	Olefin C_2-C_4	Paraffin C_2-C_4
0	102.9	0.32	4.0	36.7	2.68	32.15	65.17	16.29	33.33
0.2	149.6	0.32	3.0	46.69	3.07	21.31	75.62	26.26	33.66
1.0	154.8	0.31	2.9	47.66	3.48	14.86	81.66	30.92	34.94
2.2	144.5	0.33	3.1	46.79	5.62	12.39	81.99	31.32	34.67
3.4	135.9	0.34	3.2	47.52	4.77	10.22	85.01	28.35	40.00
4.1	131.0	0.31	3.1	44.77	4.85	11.33	83.82	30.10	36.58

Table S3. Textural property and catalytic performance of Na-promoted K-FCCA-N catalysts (K/Fe 9.3mol%) in CO_2 hydrogenation

Na/Fe ratio in catalyst (mol%)	N_2 adsorption-desorption			CO_2 conv. (mol%)	Distribution of products (mol%)				
	S_{BET} ($m^2 \cdot g^{-1}$)	V_{BJH} ($mL \cdot g^{-1}$)	d_{pore} (nm)		CO	CH_4	C_2^+	Olefin C_2-C_4	Paraffin C_2-C_4
0.2	119.8	0.33	3.6	46.22	2.89	17.00	80.11	25.51	33.67
1.0	114.2	0.28	3.3	51.59	2.16	10.33	87.51	29.90	40.27
2.2	110.5	0.27	3.3	51.05	2.31	7.82	89.87	31.54	40.38
3.4	110.3	0.28	3.4	52.87	2.29	8.01	89.70	32.14	39.98
4.1	101.3	0.27	3.4	53.01	2.08	8.31	89.61	31.90	41.44