

Supporting Information

CO₂ hydrogenation to higher hydrocarbons on K/Fe-Al-O spinel catalysts promoted with Si, Ti, Zr, Hf, Mn and Ce

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Table S1. Performance of carburized K/ Fe-Al-O spinel based catalysts in CO₂ hydrogenation. (T=320°C, (H₂/CO₂)_{in} = 3, P_{total} = 20 bar, WHSV_{CO₂} = 3 h⁻¹)

Catalyst	CO ₂ conversion, (%)	Selectivity, %					
		CO	CH ₄	C ₂ -C ₄	C ₂ -C ₄ olefins/ paraffins ratio	C ₅ +	C ₇ +/C ₅ +
SP	34	16	12	25	7.4	39	0.48
SP-SiO ₂ -5	37	27	23	27	5.3	16	0
SP-SiO ₂ -15	25	59	26	6	1.3	1	0
SP-TiO ₂ -5	45	8	17	34	6.5	32	0.43
SP-TiO ₂ -20	51	10	26	39	2.45	17	0.32
SP-ZrO ₂ -5	50	4	18	37	5.2	32	0.55
SP-ZrO ₂ -20	45	7	12	32	6.2	42	0.63
SP-CeO ₂ -5	35	18	22	35	3.6	18	0.17
SP-MnO-5	36	13	10	25	6.8	45	0.62
SP-HfO ₂ -5	30	19	12	29	5.6	33	0.55
SP-SiO ₂ -15 ^w	18	60	25	5	1.4	3	0
SP-ZrO ₂ -20 ^w	40	8	16	33	7.4	35	0.50
SP ^{np}	33	15	40	30	--	7	0

w-without CTAB

np – not promoted with K

Table S2. Performance of SP and SP-ZrO₂-20 in CO₂ hydrogenation conducted in one and three reactors in series (T=320°C, (H₂/CO₂)_{in} = 3, P_{total} = 20 bar)

Catalyst	Number of reactors	WHSV _{CO₂} , (h ⁻¹)	CO ₂ conversion, (%)	Selectivity, %				
				CO	CH ₄	C ₂ -C ₄	C ₅ +	C ₇ +/C ₅ +
SP	1	3	34	16	12	25	39	0.48
	3	3	57	14	12	26	41	0.70
	3	1	73	8	13	29	42	0.78
SP-ZrO ₂ -20	1	3	45	7	12	32	41	0.63
	3	3	70	6	13	31	42	0.83
	3	1	90	4	12	33	43	0.81

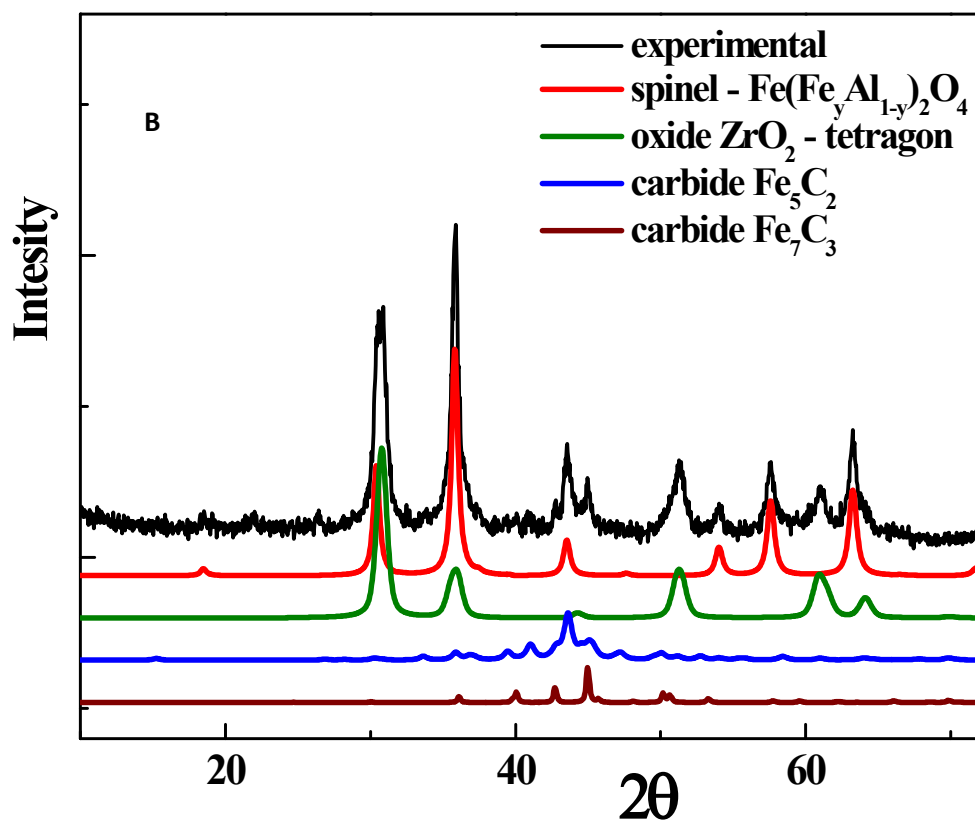
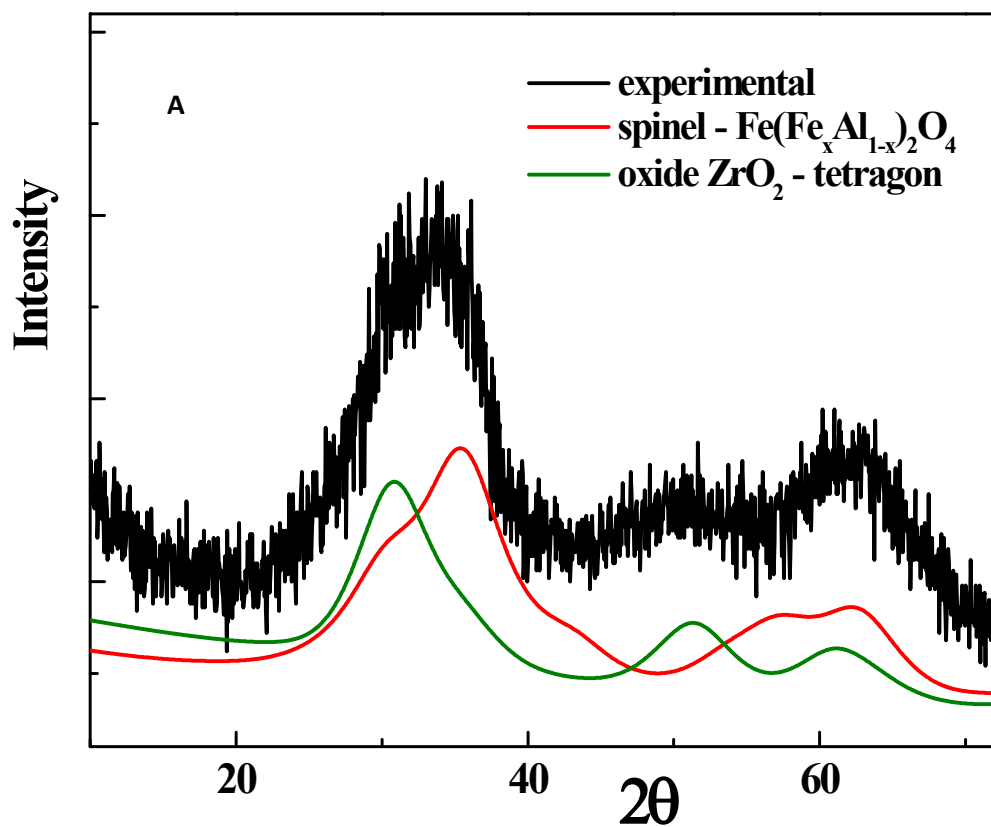


Figure S1. XRD patterns of catalyst SP-ZrO₂-20: experimental envelop and deconvolution of components diffractograms using Rietveld software: A – as synthesized; B- after activation and testing.

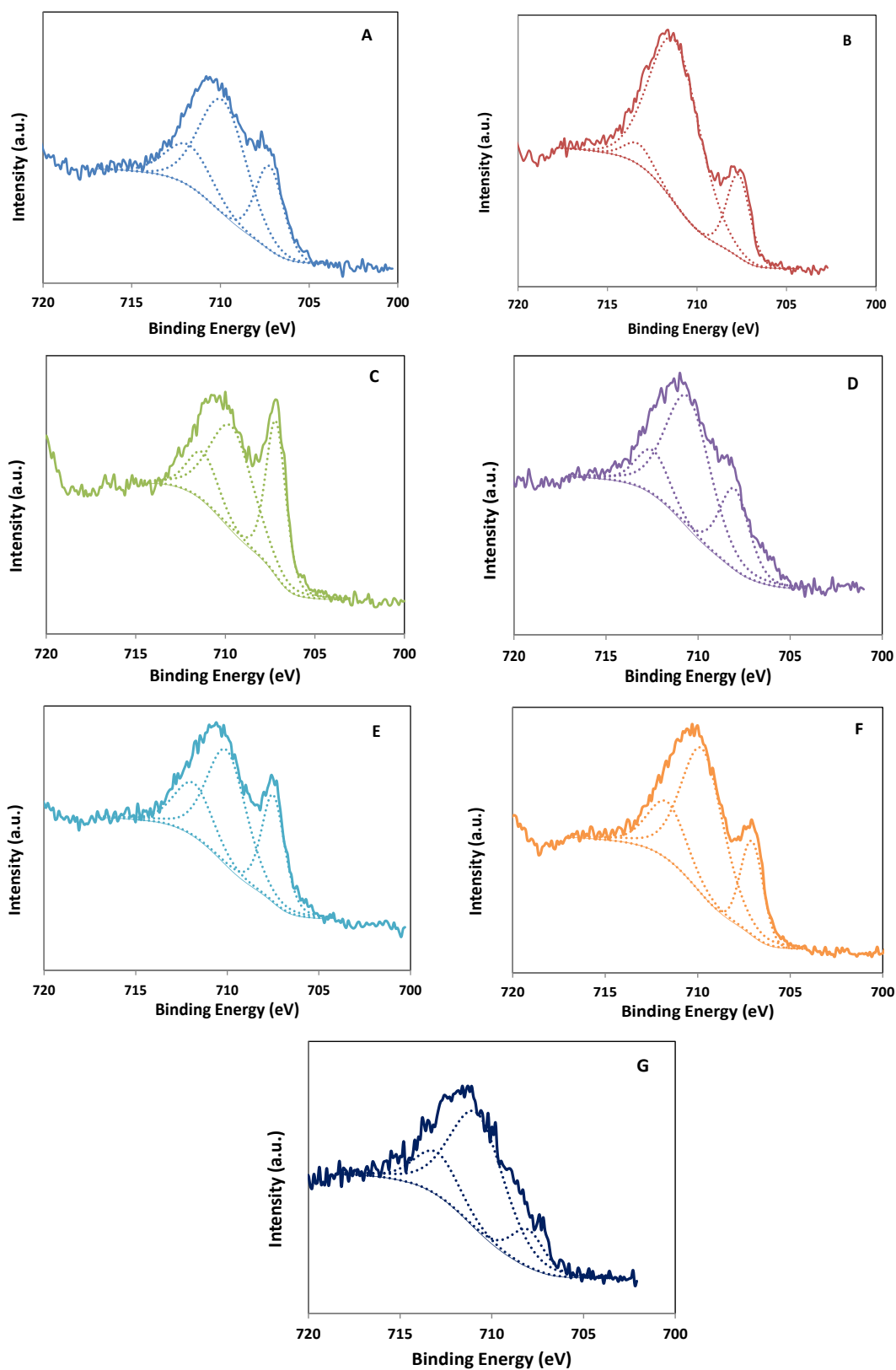


Figure S2. XPS Fe $2p_{3/2}$ profiles recorded with tested SP-based materials: A – SP; B – SP-SiO₂-15; C - SP-TiO₂-20; D – SP-ZrO₂-20; E – SP-CeO₂-5; F– SP-MnO-5; G– SP-HfO₂-5.