

Supplementary Materials

Promotional Effect of Manganese on Selective Catalytic Reduction of NO by CO in the Presence of Excess O₂ over M@La-Fe/AC (M=Mn, Ce) Catalyst

Fatemeh Gholami ^{1,*}, Zahra Gholami ^{2,*}, Martin Tomas ¹, Veronika Vavrunkova ¹, Somayeh Mirzaei ³, Mohammadtaghi Vakili ⁴

¹ New Technologies - Research Centre, University of West Bohemia, 30100 Plzeň, Czech Republic; gholami@ntc.zcu.cz (F.G); mtomas@ntc.zcu.cz (M.T); vavrunko@ntc.zcu.cz (V.V)

² Unipetrol Centre of Research and Education, a.s, Areál Chempark 2838, Záluží 1, 436 70 Litvínov, Czech Republic; Zahra.gholami@unicre.cz

³ Department of Chemical Engineering, National Yulin University of Science and Technology, Yulin 64002, Taiwan; Smirzaei@yuntech.edu.tw

⁴ Green intelligence Environmental School, Yangtze Normal University, Chongqing, 408100, China; 20181099@yznu.cn

* Correspondence: gholami@ntc.zcu.cz; Tel.: +420-377-634-816 (F.G.); Zahra.gholami@unicre.cz; Tel.: +420-471-122-239 (Z.G)

Table S1: Raman Spectroscopy analysis for the prepare catalysts.

Catalyst	Peak	Type	Anlytc Area	% Area	Int Area	% Area	Centroid	Moment2	ID/IG
AC	1	Pearson VII Area	2779.381	19.881	2581.802	27.313	1207.503	63957.95	0.94
	2	Pearson VII Area	3106.909	22.224	2952.487	31.234	1339.602	9424.44	
	3	Pearson VII Area	788.433	5.639	788.433	8.341	1520.896	4882.73	
	4	Pearson VII Area	7305.359	52.255	3129.964	33.112	1561.808	56913.76	
		Total	13980.082	100	9452.686	100			
Fe/AC	1	Pearson VII Area	2953.784	29.571	2895.503	29.950	1206.747	46036.54	0.98
	2	Pearson VII Area	2962.856	29.662	2962.852	30.646	1339.137	3692.473	
	3	Pearson VII Area	790.2931	7.9118	790.2931	8.1744	1483.527	3240.429	
	4	Pearson VII Area	3281.83	32.855	3019.229	31.230	1587.837	28481.25	
		Total	9988.763	100	9667.877	100			
La1-Fe3/AC	1	Pearson VII Area	3508.534	30.385	3255.971	29.579	1219.367	66544.1	1.42
	2	Pearson VII Area	4093.787	35.454	4084.277	37.103	1340.3	10111.91	
	3	Pearson VII Area	783.1589	6.7825	783.1589	7.115	1511.452	3642.698	
	4	Pearson VII Area	3161.283	27.378	2884.451	26.203	1588.734	26530.22	
		Total	11546.76	100	11007.86	100			
La1-Fe1/AC	1	Pearson VII Area	2971.799	21.625	2700.201	20.452	1189.984	61832.91	1.51
	2	Pearson VII Area	5904.353	42.964	5887.724	44.595	1342.79	13599.19	
	3	Pearson VII Area	713.7812	5.1940	713.7812	5.4064	1510.424	2359.628	
	4	Pearson VII Area	4152.555	30.217	3900.878	29.546	1587.653	22172	
		Total	13742.49	100	13202.58	100			
La3-Fe1/AC	1	Pearson VII Area	4256.253	37.571	3769.316	34.936	1231.698	89520.16	1.63
	2	Pearson VII Area	4058.083	35.821	4051.323	37.549	1339.543	9465.529	
	3	Pearson VII Area	491.6467	4.340	491.6467	4.5568	1506.645	1941.908	
	4	Pearson VII Area	2522.671	22.268	2477.046	22.959	1595.923	12979.26	
		Total	11328.65	100	10789.33	100			

Table S1: Raman Spectroscopy analysis for the prepare catalysts (Continued).

Catalyst	Peak	Type	Anlytc Area	% Area	Int Area	% Area	Centroid	Moment2	ID/IG
Ce@La3-Fe1/AC	1	Pearson VII Area	3815.344	33.662	3430.601	31.693	1229.823	83825.99	1.70
	2	Pearson VII Area	4306.357	37.994	4287.668	39.611	1340.877	13045.34	
	3	Pearson VII Area	580.0303	5.118	580.8632	5.366	1518.617	3171.881	
	4	Pearson VII Area	2632.591	23.227	2525.176	23.329	1594.621	19548.19	
		Total	11334.32	100	10824.31	100			
Mn@La3-Fe1/AC	1	Pearson VII Area	2783.448	31.350	2591.19	30.314	1221.058	79469.88	2.03
	2	Pearson VII Area	3836.009	43.205	3747.52	43.842	1340.898	22230.91	
	3	Pearson VII Area	367.1067	4.1347	367.1067	4.295	1520.166	2066.301	
	4	Pearson VII Area	1892.048	21.310	1842.009	21.549	1595.95	14625.76	
		Total	8878.611	100	8547.826	100			

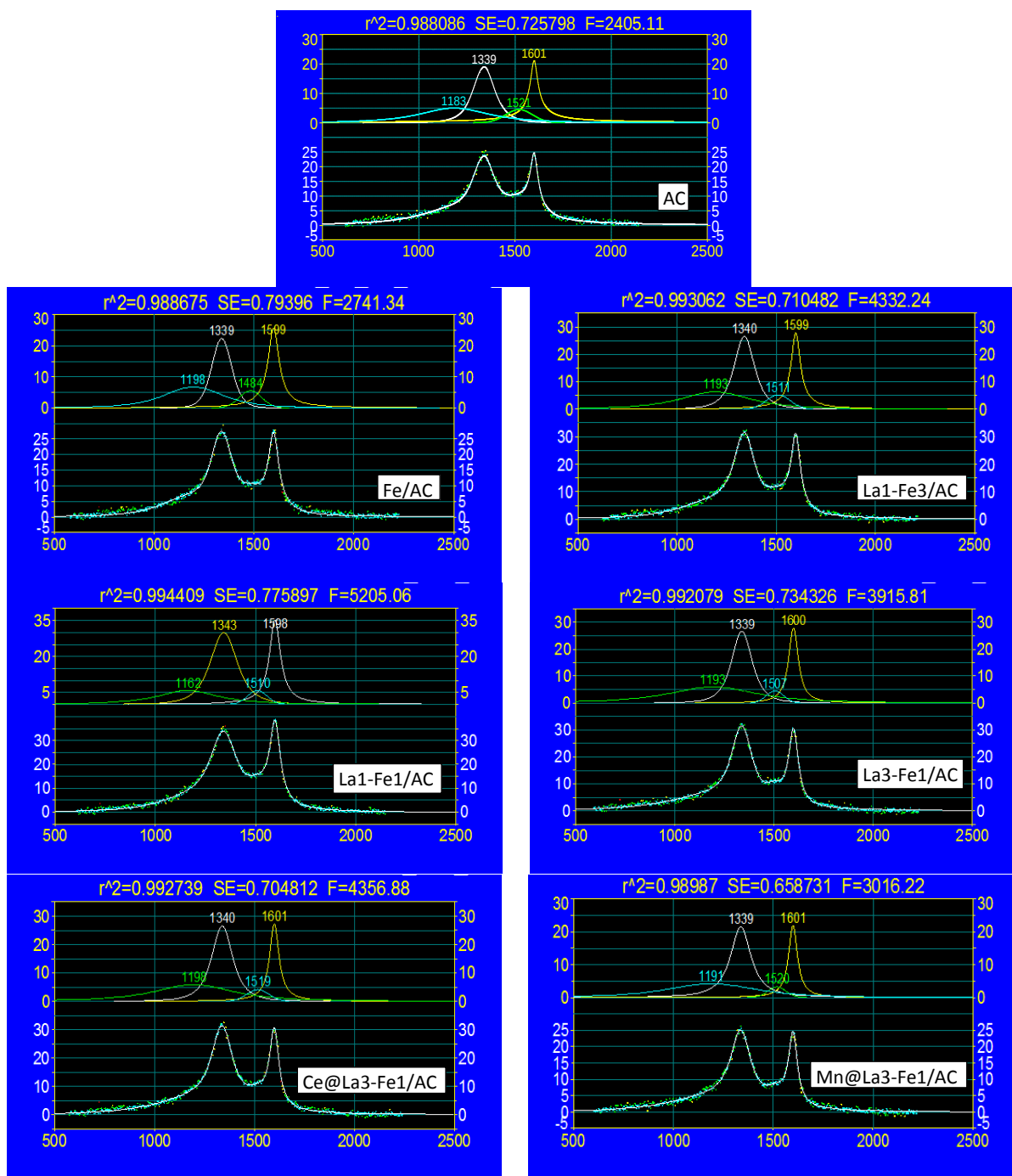


Figure S1. Raman spectroscopy of the prepared catalysts.

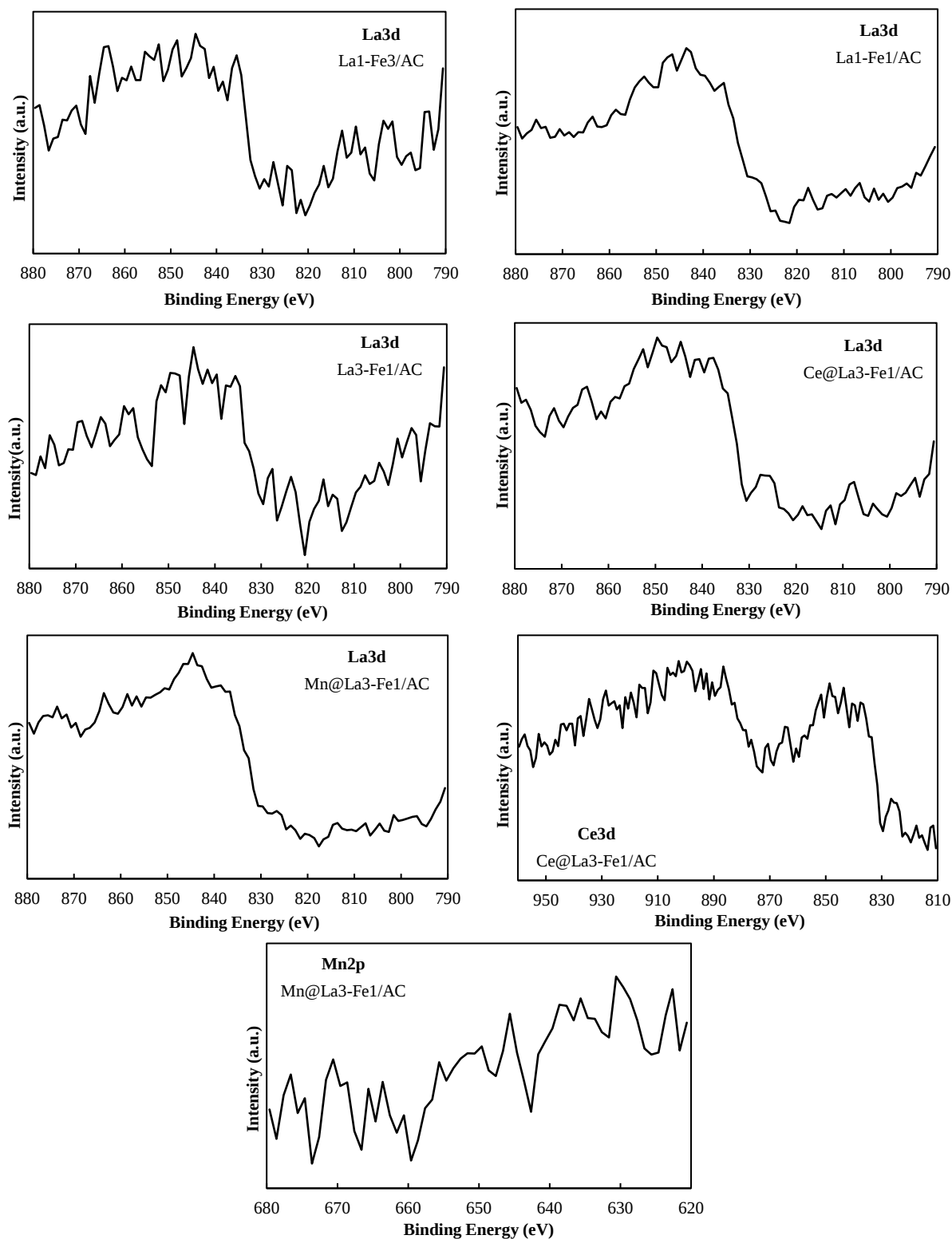


Figure S2. XPS spectrum of La3d, Ce3d and Mn2p of the La-Fe/AC catalysts.

Table S2. Details for the peak deconvolution XPS spectrum of the prepared catalysts.

Fe/AC									
	Name	Start BE	Peak BE	End BE	Height Counts	FWHM eV	Area (P) CPS.eV	Area (N)	At. %
Lattice	O1s Scan A	545.55	530.53	525.65	1591.41	1.99	3426.54	0.02	10.16
Vacancy	O1s Scan B	545.55	531.59	525.65	7332.48	1.36	10786.37	0.05	31.99
Chemisorbed	O1s Scan C	545.55	532.93	525.65	9690.27	1.86	19496.68	0.09	57.85
Fe3-La1/AC									
	Name	Start BE	Peak BE	End BE	Height Counts	FWHM eV	Area (P) CPS.eV	Area (N)	At. %
Lattice	O1s Scan A	545.55	529.77	525.65	2803.87	1.35	4090.13	0.02	13.2
Vacancy	O1s Scan B	545.55	531.48	525.65	7160.43	2.28	17665.63	0.08	57.04
Chemisorbed	O1s Scan C	545.55	533	525.65	4300	1.69	7885.76	0.04	25.47
Scan D	O1s Scan D	545.55	534.84	525.65	722.93	1.69	1325.79	0.01	4.28
Fe1-La1/AC									
	Name	Start BE	Peak BE	End BE	Height Counts	FWHM eV	Area (P) CPS.eV	Area (N)	At. %
Lattice	O1s Scan A	545.55	529.63	525.65	5129.03	1.3	7230.81	0.03	20.08
Vacancy	O1s Scan B	545.55	531.14	525.65	6730.42	2.46	17922.54	0.08	49.79
Chemisorbed	O1s Scan C	545.55	532.92	525.65	4203.96	2.1	9548.53	0.04	26.54
Scan D	O1s Scan D	545.55	535.77	525.65	587.82	2.03	1292.37	0.01	3.59
Fe1-La3/AC									
	Name	Start BE	Peak BE	End BE	Height Counts	FWHM eV	Area (P) CPS.eV	Area (N)	At. %
Lattice	O1s Scan A	545.55	529.52	525.65	1430.23	1.2	1860.4	0.01	5.84
Vacancy	O1s Scan B	545.55	531.37	525.65	6221.77	2.69	18171.28	0.08	57.06
Chemisorbed	O1s Scan C	545.55	532.84	525.65	4787.12	2.28	11810.6	0.05	37.1

Table S2. Details for the peak deconvolution XPS spectrum of the prepared catalysts (Continued).

Ce@Fe1-La3/AC									
	Name	Start BE	Peak BE	End BE	Height Counts	FWHM eV	Area (P) CPS.eV	Area (N)	At. %
Lattice	O1s Scan A	545.55	529.63	525.65	4225.26	1.59	7280.4	0.03	22.88
Vacancy	O1s Scan B	545.55	531.46	525.65	6470.56	2.71	19004.24	0.09	59.75
Chemisorbed	O1s Scan C	545.55	532.96	525.65	2254.68	1.7	4158.35	0.02	13.08
Scan D	O1s Scan D	545.55	535.77	525.65	411.67	3.05	1362.99	0.01	4.29
Mn@Fe1-La3/AC									
	Name	Start BE	Peak BE	End BE	Height Counts	FWHM eV	Area (P) CPS.eV	Area (N)	At. %
Lattice	O1s Scan A	545.55	529.45	525.65	9437.47	1.37	14043.93	0.06	33.05
Vacancy	O1s Scan B	545.55	531.23	525.65	8819.84	2.02	19341.84	0.09	45.54
Chemisorbed	O1s Scan C	545.55	532.88	525.65	4255.19	1.77	8165.15	0.04	19.23
Scan D	O1s Scan D	545.55	535.48	525.65	392.78	2.16	920.86	0	2.17

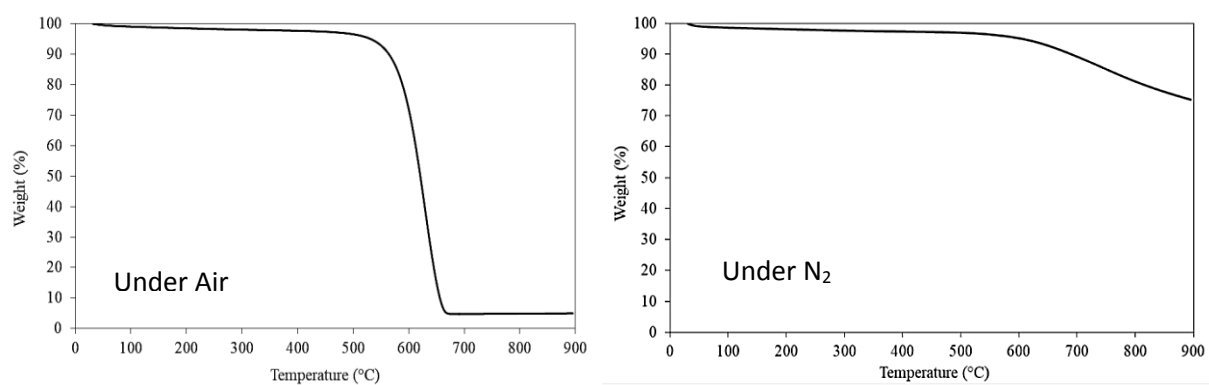


Figure S3. TGA analysis for AC, under air and nitrogen.