Supplementary Information

In situ **MnO_x/N-doped carbon aerogels from cellulose as monolithic and highly efficient catalysts for upgrading of bioderived aldehydes**

*Shenghui Zhou [a], Guixian Chen [a], Xiao Feng [a], Ming Wang [a], Tao Song [a], Detao Liu [a], Fachuang Lu [a,b], Haisong Qi [a,b]**

[a] State Key Laboratory of Pulp and Paper Engineering, South China University of Technology, Guangzhou 510640, China.

[b] Guangdong Engineering Research Center for Green Fine Chemicals, Guangzhou 510640, China.

*Corresponding Author

E-mail: qihs@scut.edu.cn

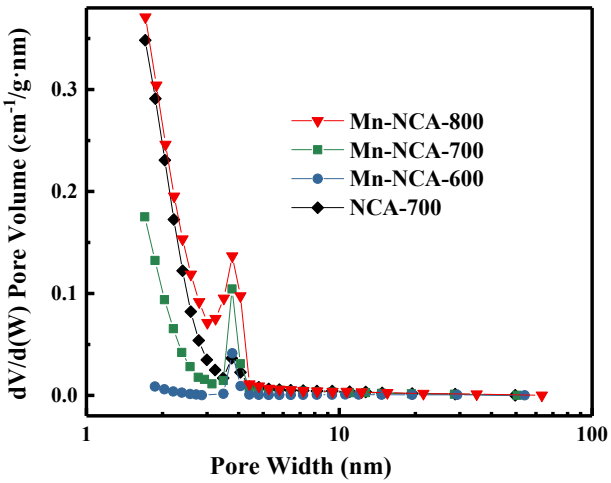

Fig. S1 Pore size distribution of Mn-NCA-T

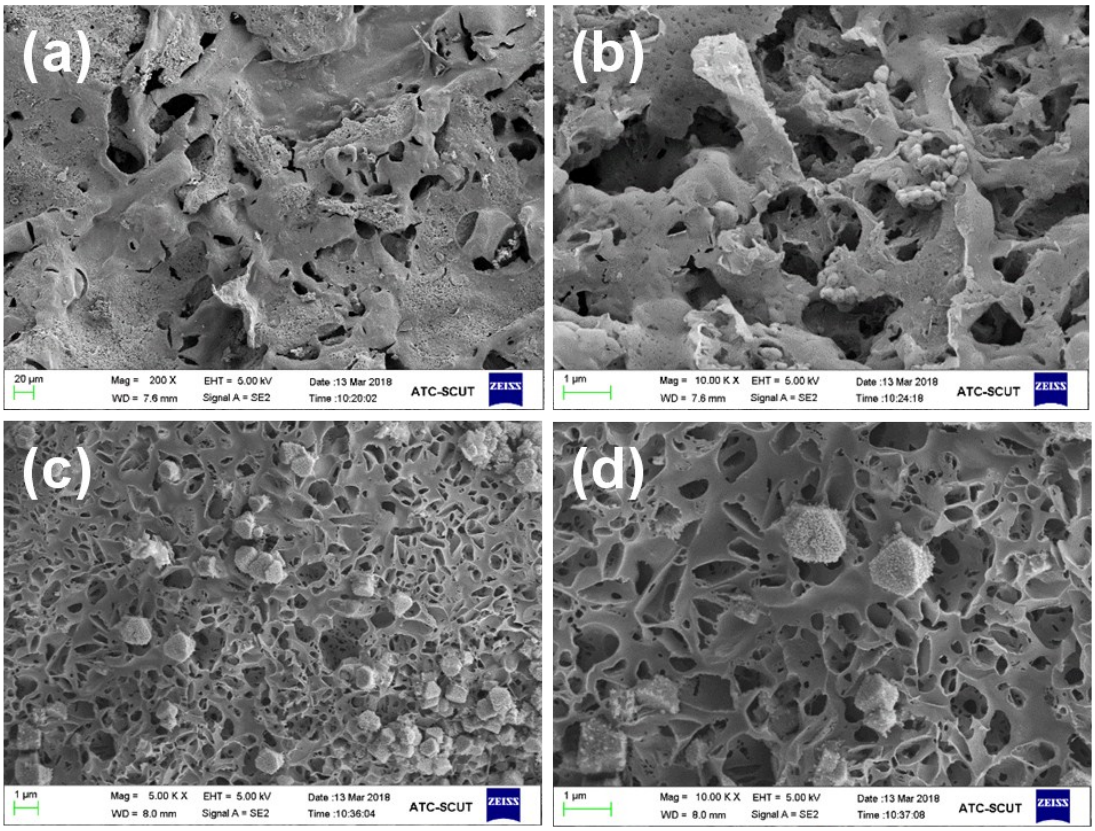

Fig. S2 SEM images of Mn-NCA-600 (a, b) and Mn-NCA-800 (c, d).

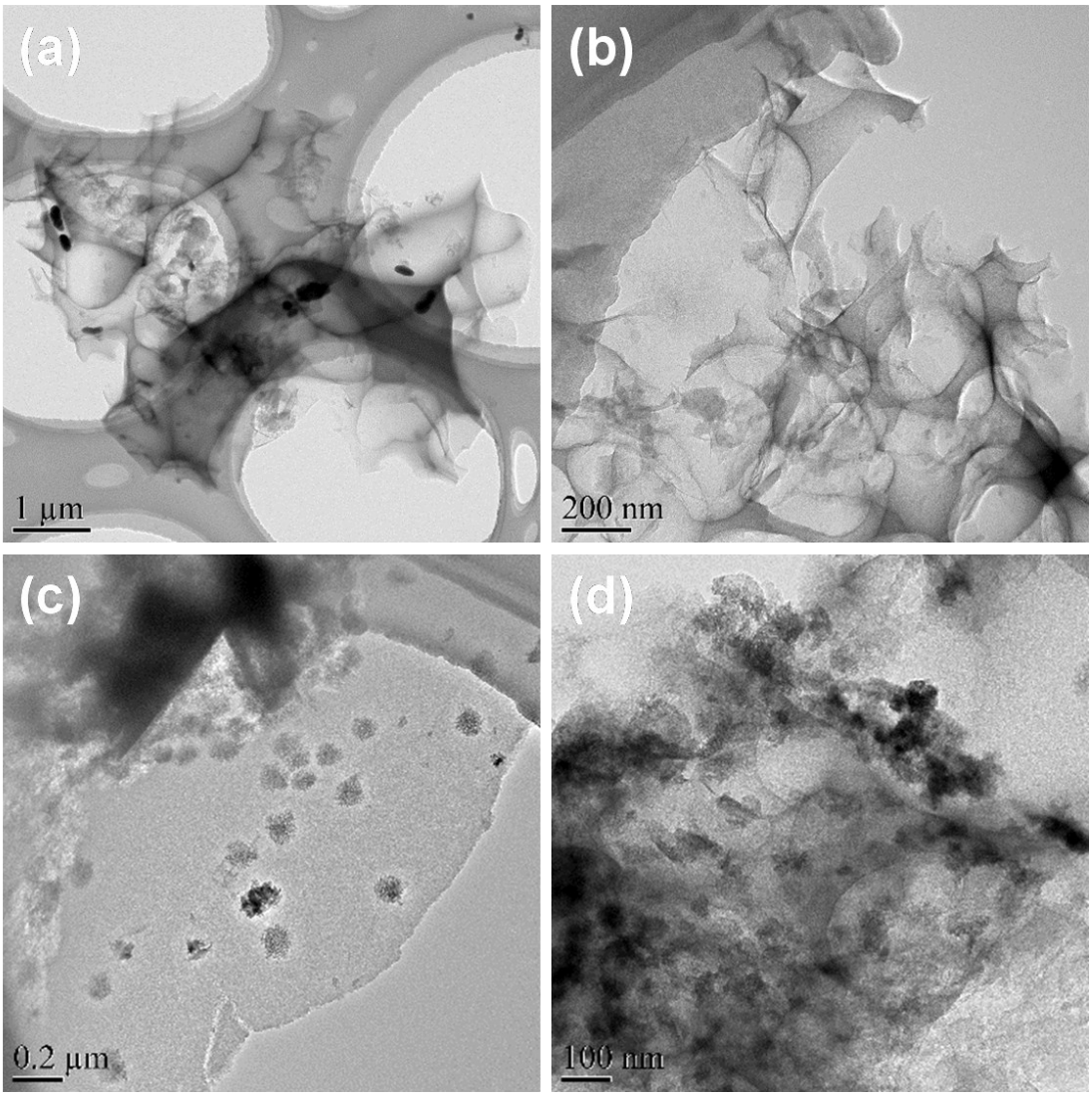

Fig. S3 TEM images of Mn-NCA-600 (a, b) and Mn-NCA-800 (c, d).

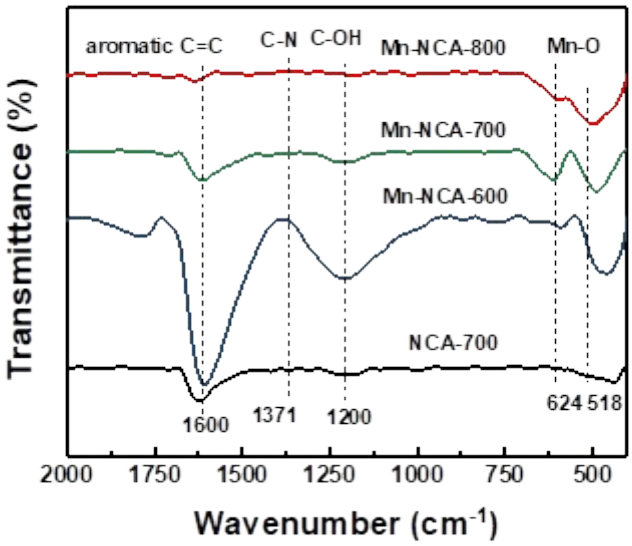

Fig. S4 FT-IR spectra of NCA-700 and Mn-NCA-T.

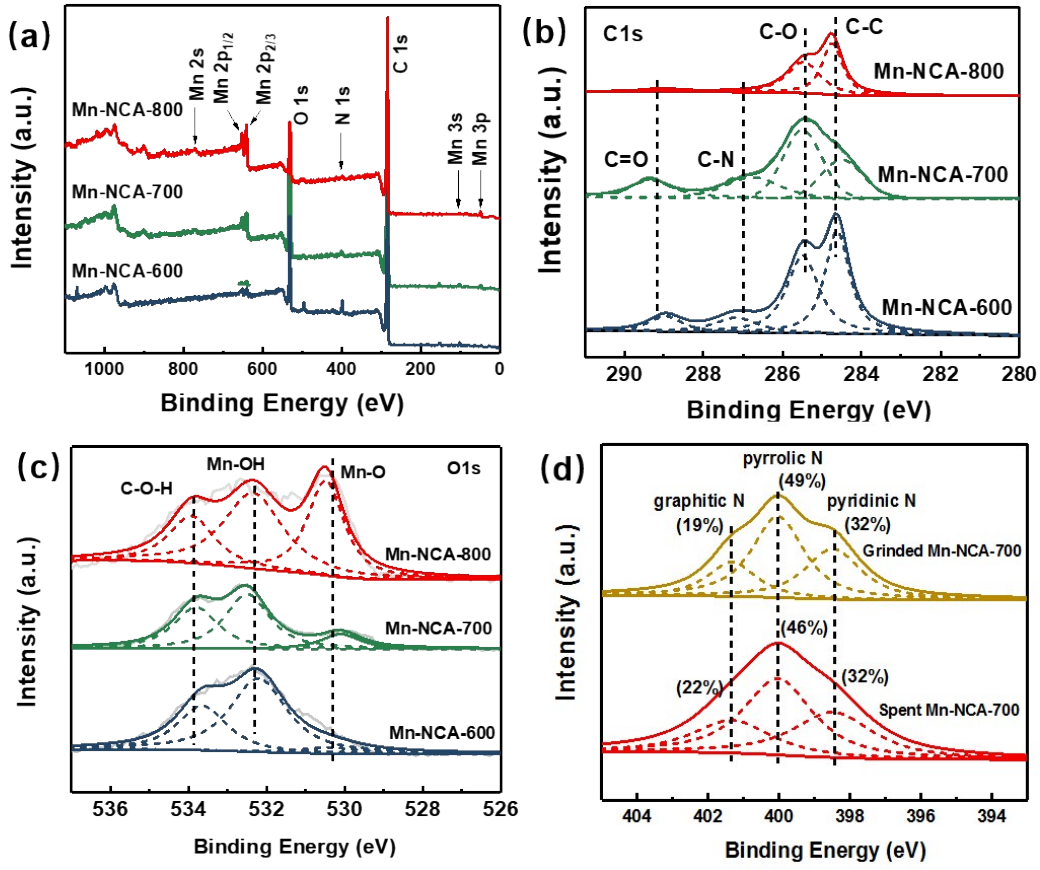

Fig. S5 XPS spectrum of survey scan (a), C 1s peaks (b), O 1s peaks (c) of Mn-NCA-T and N 1s peaks (d) of grinded and spent Mn-NCA-700 catalysts.

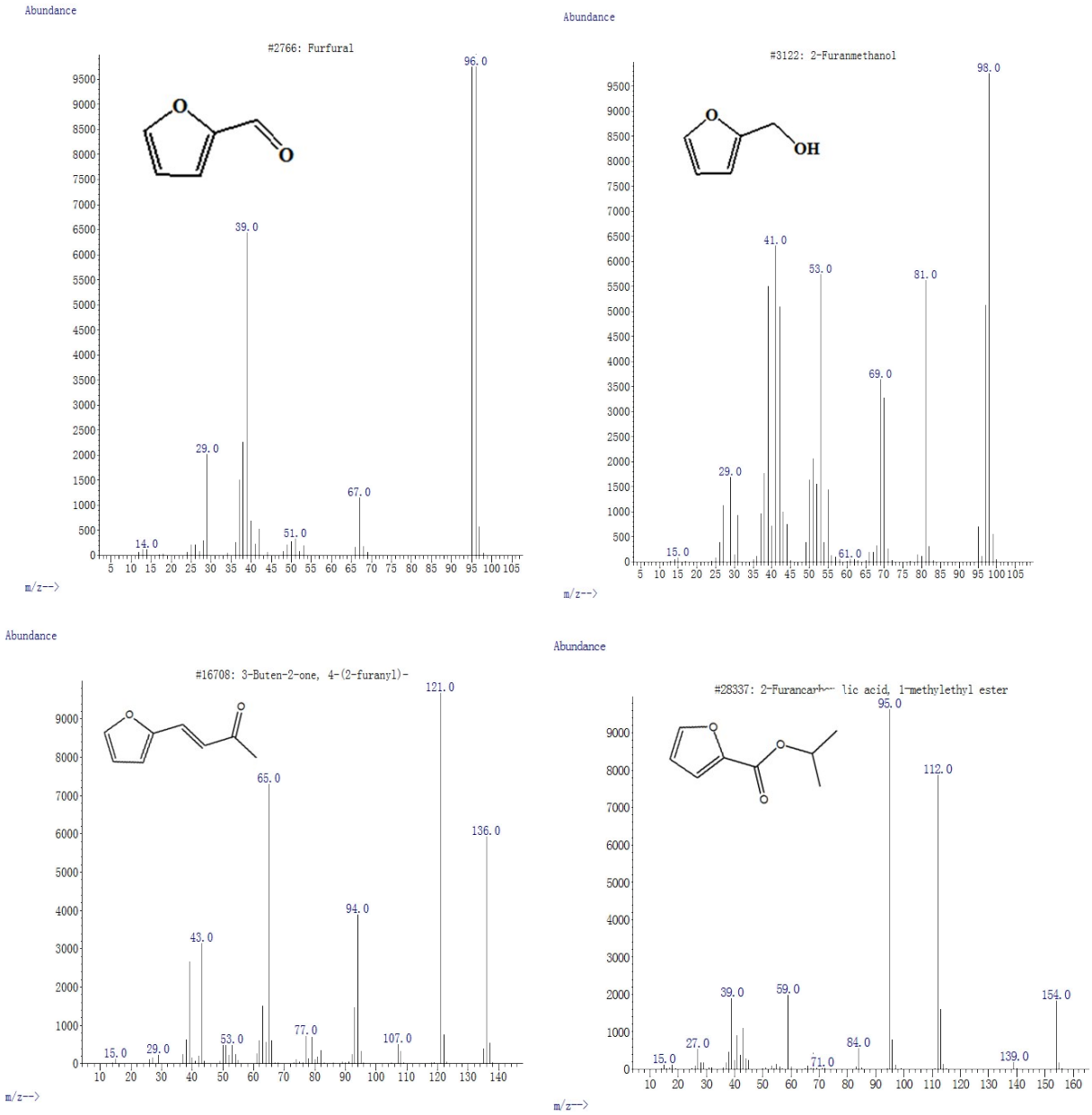

Fig. S6 Representative MS spectra of the reaction mixture.

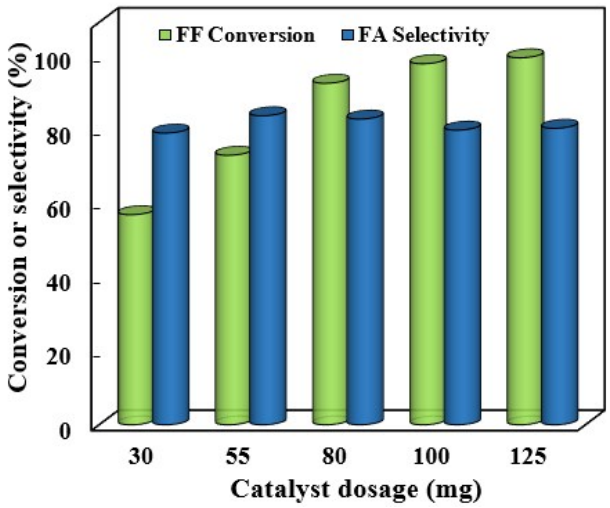

Fig. S7 Effect of the Mn-NCA-700 catalyst dosage on the conversion of FF to FA; Reaction conditions: 0.05mmol furfural in 5ml isopropanol, 160 °C, 30 min.

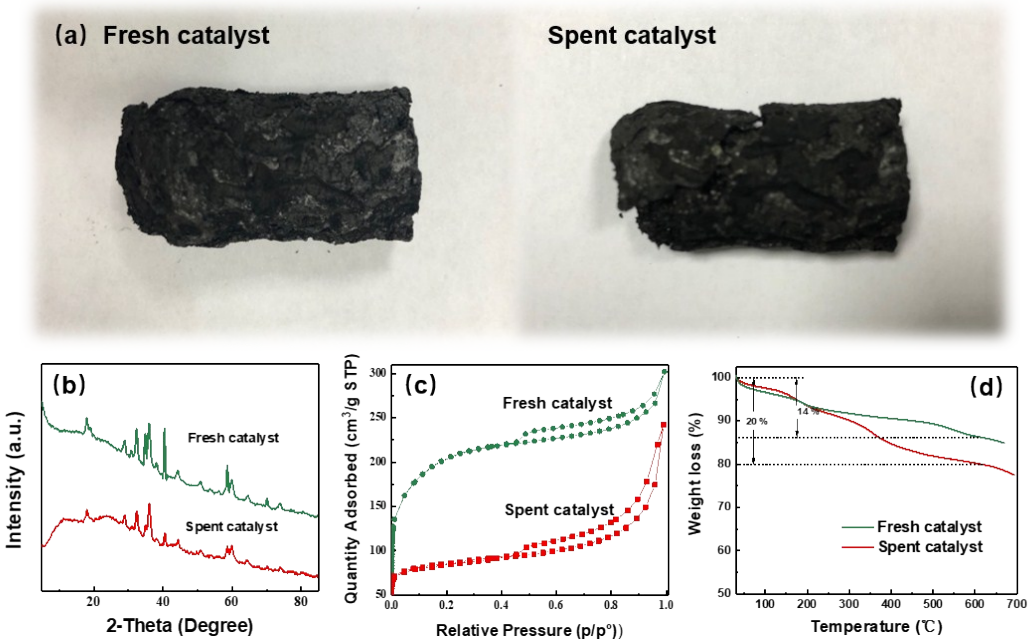

Fig. S8 Analyses of fresh and recovered Mn-NCA-700 catalyst after five cycles: photograph (a), XRD patterns (b), N_2 adsorption-desorption isotherms (c), TG analyses (d).

Table S1 The physical properties and Raman results of various catalysts

Catalysts	Surface area ($m^2 \cdot g^{-1}$)	Pore volume (cm^3/g)	Average pore diameter (nm)	I_D/I_G	I_{2D}/I_G
NCA-700	1083.14	0.61	3.46	0.9852	0.3014
Mn-NCA-600	308.49	0.18	8.27	1.053	0.4942
Mn-NCA-700	676.95	0.41	4.89	1.006	0.6690
Mn-NCA-800	909.83	0.52	2.42	1.010	-

Table S2 The compositions of various catalysts

Catalysts	Content (wt.%)					
	Metal [a]	Na [a]	N [b]	C [b]	H [b]	O (Calculated)
MnO_x	63.87	-	-	-	-	36.13
CA-700	-	0.11	0.52	77.35	2.3	19.68
NCA-700	-	0.293	2.66	65.66	5.7	25.65
Mn-CA-700	13.14	0.286	1.4	62.38	2.3	20.44
Mn-NCA-600	15.07	0.088	6.98	47.98	2.5	27.28
Mn-NCA-700	19.97	0.290	2.27	46.72	3.8	26.86
Mn-NCA-800	30.82	0.103	0.45	46.88	4.0	17.74
Grinded Mn-NCA-700	19.97	0.290	2.27	46.72	3.8	26.86
Co-NCA-700	17.11	0.197	0.6	65.26	2.7	14.12
Fe-NCA-700	20.23	0.345	0.76	67.31	1.9	9.38
Cu-NCA-700	31.12	0.538	3.47	35.64	4.0	25.21
Ni-NCA-700	15.50	0.477	0.88	72.42	1.5	9.20
Recycled Mn-NCA-700	18.46	0.174	2.09	49.95	2.8	26.51

[a] Determined by ICP-OES.

[b] Determined by elemental analysis.

Table S3 The comparison of CTH of FF with H_2 or H-donor reaction systems with previously reported catalysts.

Entry	Catalyst	H-donor	Reaction conditions	FF Conv. (%)	FA Sel. (%)	Ref.
1	2%Pt-1%Re/TiO_2-ZrO_2	5 MPa H_2	130 °C, 8 h	100	95.7	[1]
2	Co/SBA-15	2 MPa H_2	150 °C, 1 h	80	96	[2]
3	Cu-Fe(7:1)/SiO_2	H_2	-	-	-	[3]
4	Cu:Zn:Cr:Zr(3:2:1:3)	2 MPa H_2	170 °C, 3.5 h	100	96	[4]
5	Fe-L4(L5)/C-800	2-propanol	160 °C, 15h	91.6	83	[5]
6	Pd/Fe_2O_3	2-propanol	180 °C, 7.5h	100	34	[6]
7	Cu/MgO-Al_2O_3	2-propanol	210 °C, 1h,	100	89	[7]
8	$DyCl_3$	2-propanol	180 °C, 3h, (2Mpa N_2)	98	97	[8]
9	Al_7Zr_3@Fe_3O_4	2-propanol	180 °C, 4h	99.1	90.5	[9]
10	Fe_2O_3@HAP	2-propanol	180 °C, 10h	96.2	95.3	[10]
11	$NiFe_2O_4$	2-propanol	180 °C, 6h	99	95	[11]
12	Cu_2Al	methanol	200 °C, 2.5h, (1Mpa N_2)	100	94	[12]
13	Al_2O_3-S	2-propanol	130 °C, 6h	98	97	[13]
14	γ-Al_2O_3	2-propanol	150 °C, 6h	100	90	[14]
15	Mn-NCA-700	2-propanol	200 °C, 0.5h	99	89	This work
16	Mn-NCA-700	2-propanol	160 °C, 1h	99	85	This work
17	Mn-NCA-700	2-propanol	140 °C, 1.2h	95	80	This work

References

[1] B. Chen, F. Li, Z. Huang, G. Yuan, *Appl. Catal., A: Gen.*, 2015, **500**, 23-29.

[2] M. Audemar, C. Ciotonea, O.V.K. De, S. Royer, A. Ungureanu, B. Dragoi, E. Dumitriu, F. Jérôme, *ChemSuSchem*, 2015, **8**, 1885-1891.

[3] H. Sheng, R.F. Lobo, *ChemCatChem*, 2016, **8**, 3402-3408.

[4] R.V. Sharma, U. Das, R. Sammynaiken, A.K. Dalai, *Appl. Catal., A: Gen.*, 2013, **454**, 127-136.

[5] J. Li, J.L. Liu, H.J. Zhou, Y. Fu, *ChemSusChem*, 2016, **9**, 1339-1347.

[6] D. Scholz, C. Aellig, I. Hermans, *ChemSusChem*, 2014, **7**, 268-275.

[7] H. Chen, H. Ruan, X. Lu, J. Fu, T. Langrish, X. Lu, *Mol. Catal.*, 2018, **445**, 94-101.

[8] P. Panagiotopoulou, N. Martin, D.G. Vlachos, *ChemSusChem*, 2015, **8**, 17-24.

[9] J. He, H. Li, A. Riisager, S. Yang, *ChemCatChem*, 2018, **10**, 430-438.

[10] F. Wang, Z. Zhang, *ACS Sustainable Chem. Eng.*, 2016, **5**, 942-947.

[11] J. He, S. Yang, A. Riisager, *Catal. Sci. Technol.*, 2017, **8**, 790-797.

[12] J. Zhang, J. Chen, *ACS Sustainable Chem. Eng.*, 2017, **5**, 5982-5993.

[13] S.K. Min, S. Lim, J. Jae, J.M. Ha, H. Lee, *J. Ind. Eng. Chem.*, 2017, **52**, 59-65.

[14] R. López-Asensioa, J.A.Cecilia, C.P. Jiménez-Gómeza, C. García-Sanchob, R. Moreno-Tosta, P. Maireles-Torresa, *Appl. Catal., A: Gen.*, 2018, **556**, 1-9.