Supporting Information

Mn-decorated CeO$_2$ nanorod supported iron-based catalyst for high-temperature Fischer–Tropsch synthesis of light olefins

Xian Wu[a], Weixin Qian[a], Haitao Zhang[a], Zhonghao Han[a], Hewei Zhang[a], Hongfang Ma[a, *], Dianhua Liu[a], Qiwen Sun[b], Weiyong Ying[a]

[a] Engineering Research Center of Large Scale Reactor Engineering and Technology, Ministry of Education, State Key Laboratory of Chemical Engineering, School of chemical engineering, East China University of Science and Technology, Shanghai 200237, China

[b] State Key Laboratory of Coal Liquefaction and Coal Chemical Technology, Shanghai 201203, China

Corresponding Author

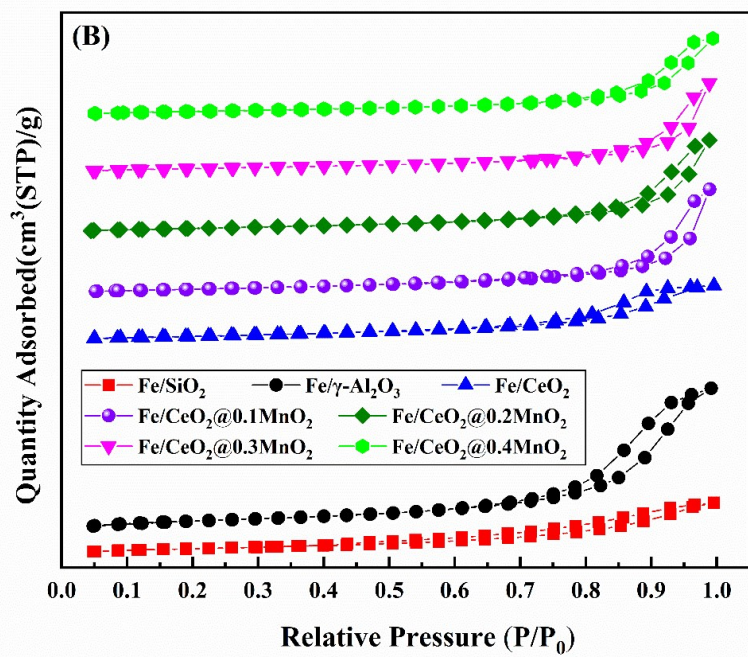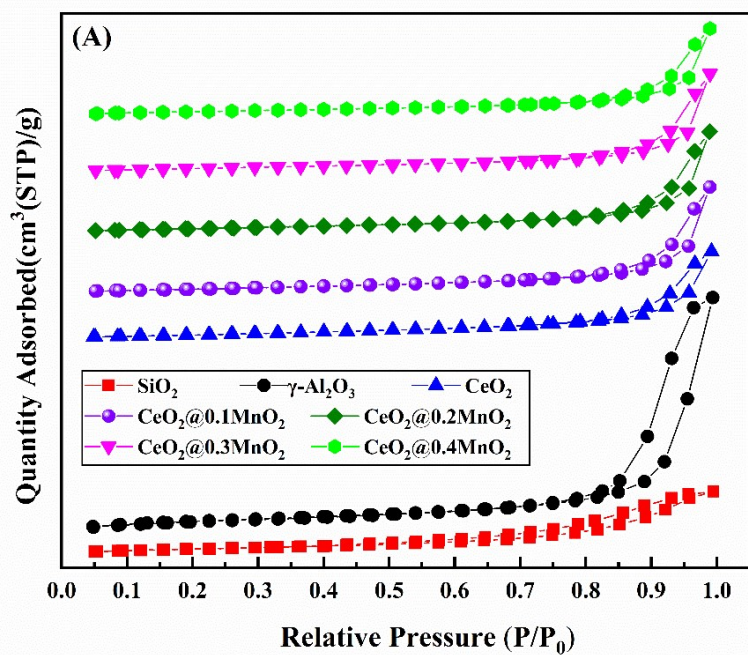*E-mail address:* mark@ecust.edu.cn (Hongfang Ma)

Fig. S1. Ar adsorption-desorption isotherms of the samples: (A) supports (B) Fe-based catalysts.
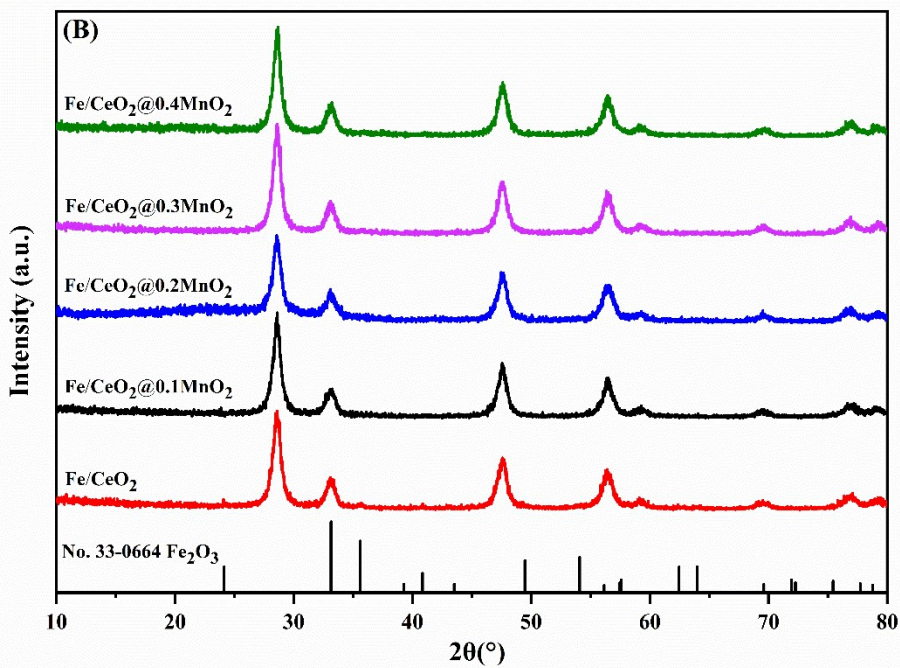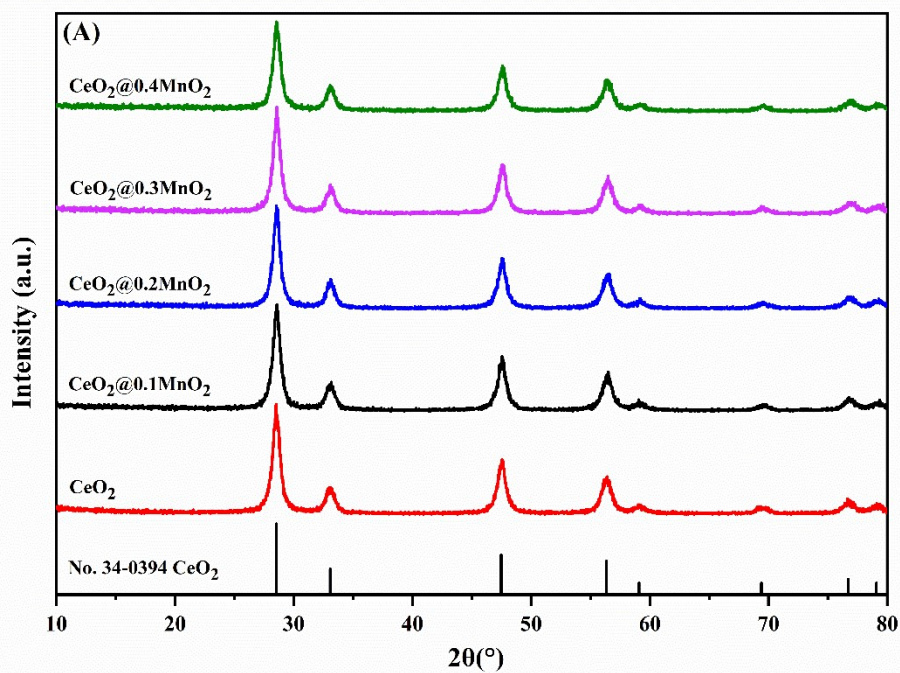
Fig. S2. XRD patterns of the samples: (A) Mn-doped CeO_2 (B) Mn-doped CeO_2 supported Fe-based catalysts.
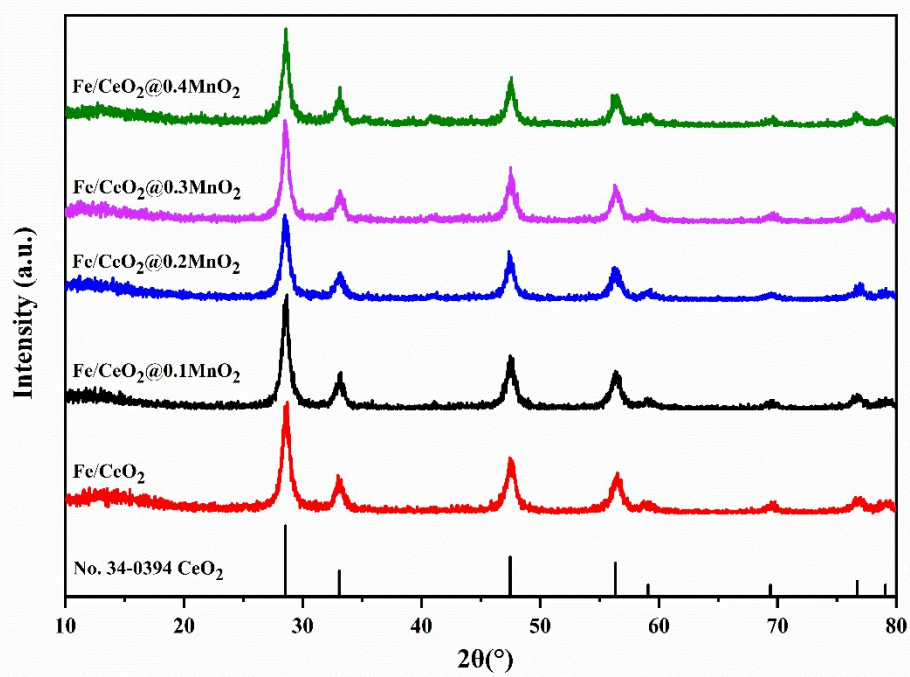
Fig. S3. XRD patterns of the samples after reaction of 48 h.

Table S1. Textural properties of the fresh catalysts

Catalyst	Content (wt.%) [a]	
	Na	K
Fe/SiO$_2$	< 10^{-5}	< 10^{-5}
Fe/γ-Al$_2$O$_3$	< 10^{-5}	< 10^{-5}
Fe/CeO$_2$	0.12	< 10^{-5}
Fe/CeO$_2$@0.1MnO$_2$	0.05	0.09
Fe/CeO$_2$@0.2MnO$_2$	0.10	0.15
Fe/CeO$_2$@0.3MnO$_2$	0.09	0.22
Fe/CeO$_2$@0.4MnO$_2$	0.07	0.17

[a] Measured by ICP-AES.
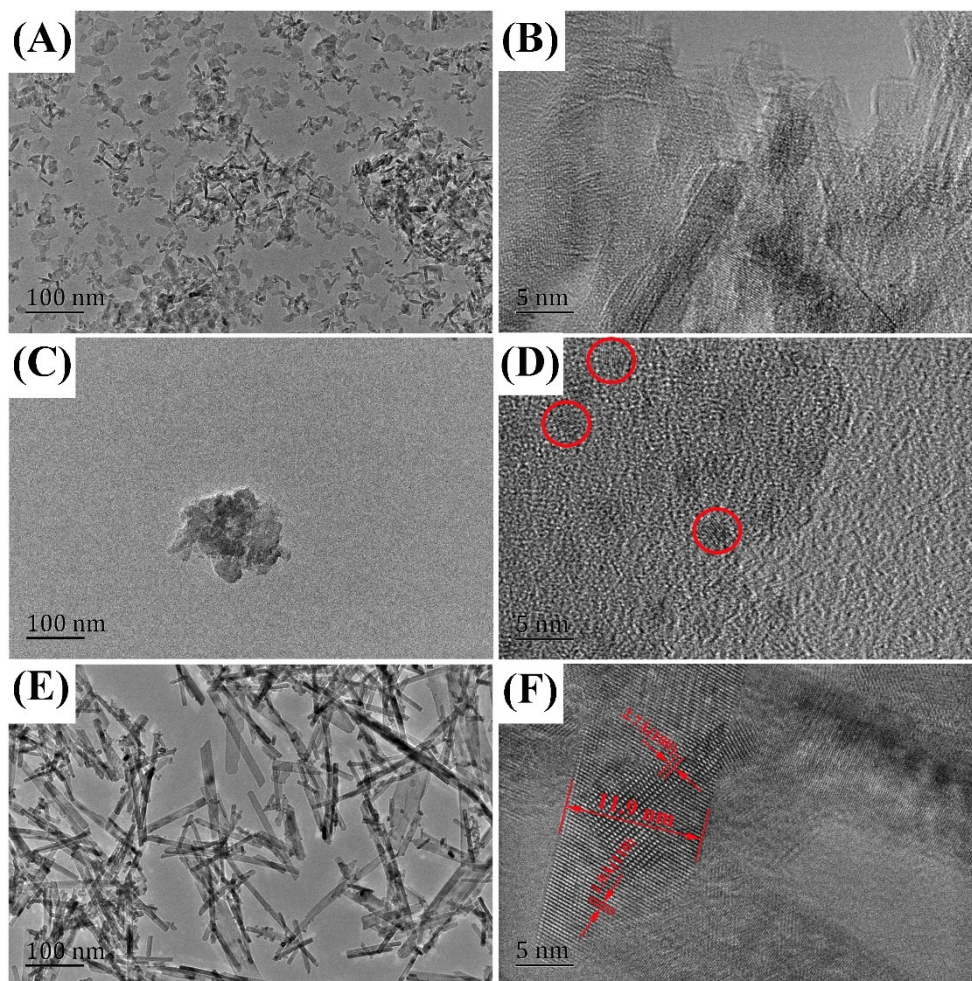
Fig. S4. HRTEM images of the supports: (A, B) SiO_2; (C, D) γ-Al_2O_3; (E, F) CeO_2.
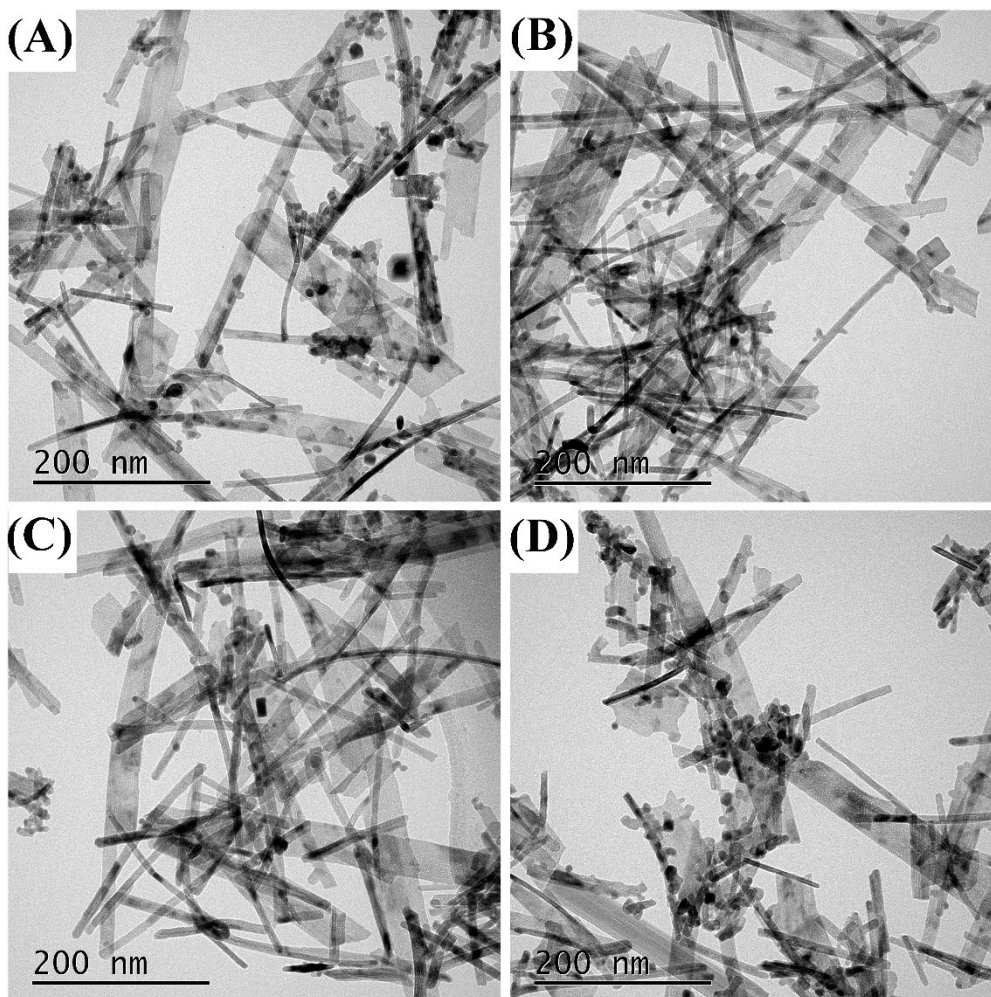
Fig. S5. HRTEM images of Mn-doped CeO_2 supports: (A) $CeO_2@0.1MnO_2$, (B) $CeO_2@0.2MnO_2$, (C) $CeO_2@0.3MnO_2$, (D) $CeO_2@0.4MnO_2$.
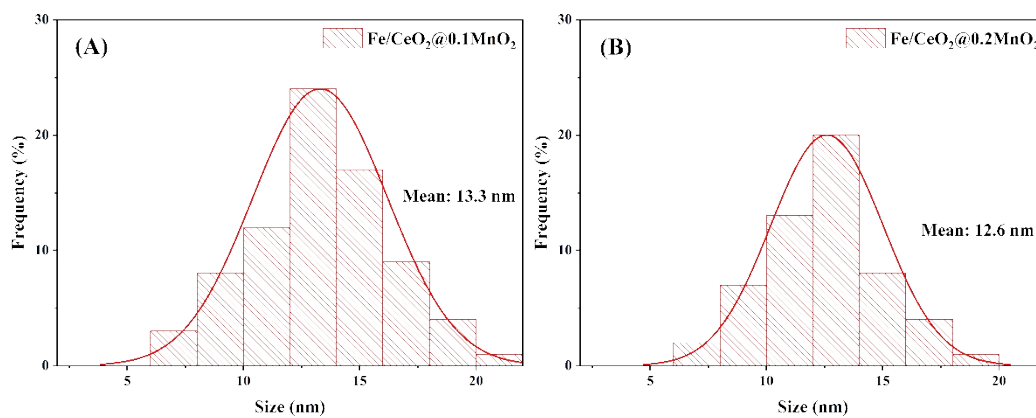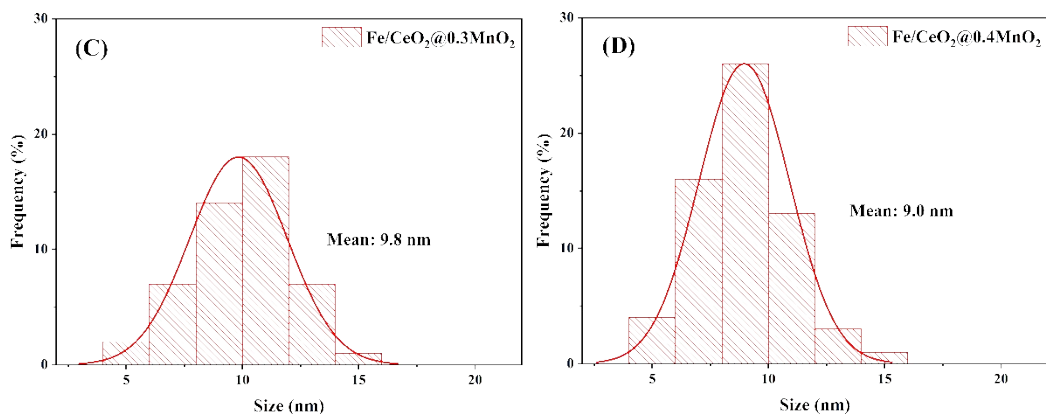
Fig. S6. Particle size distribution histograms: (A) $CeO_2@0.1MnO_2$, (B) $CeO_2@0.2MnO_2$, (C) $CeO_2@0.3MnO_2$, (D) $CeO_2@0.4MnO_2$.

Table S2. XPS peak positions of the spent catalysts

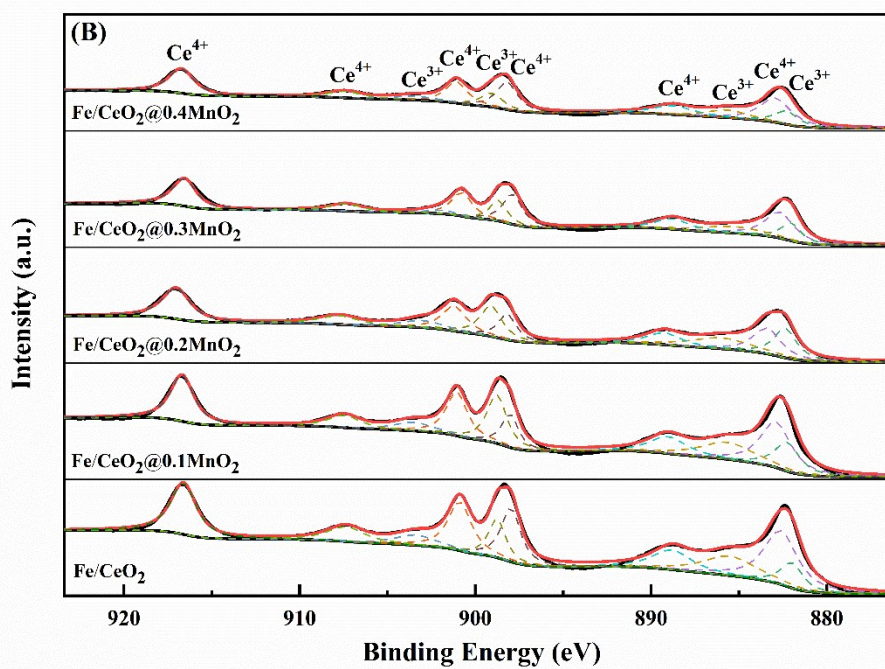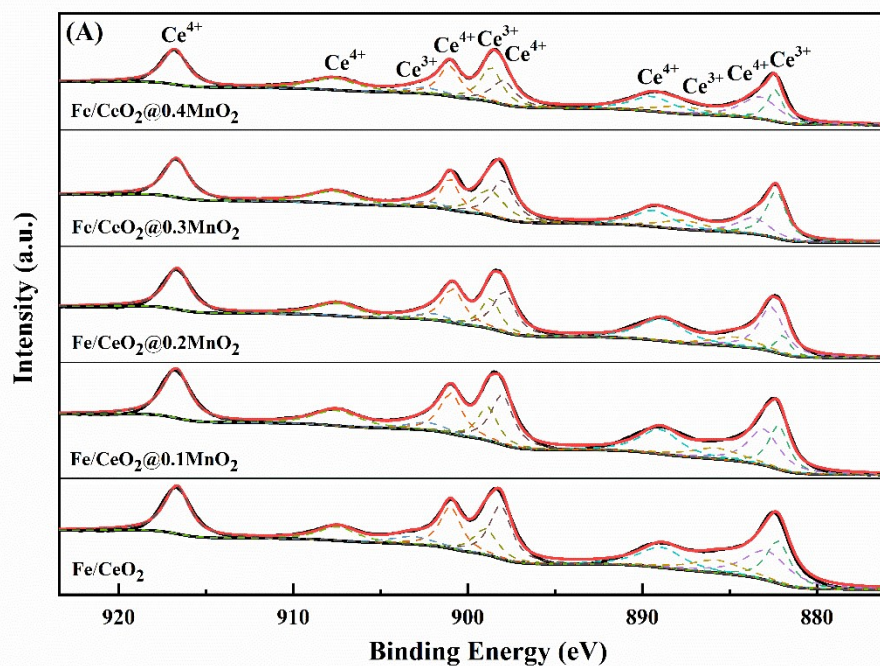| Catalyst	Ce 3d				Fe 2p	
	Peak 1 [a]	Peak 2 [a]	Peak 3 [a]	Peak 4 [a]	Peak 1 [a]	Peak 2 [a]
Fe/CeO$_2$	916.7	900.9	898.4	882.4	733.8	717.7
Fe/CeO$_2$@0.1MnO$_2$	917.0	901.1	898.7	882.7	733.5	717.5
Fe/CeO$_2$@0.2MnO$_2$	917.1	901.3	898.8	882.8	732.8	717.1
Fe/CeO$_2$@0.3MnO$_2$	916.6	900.8	898.3	882.3	733.6	717.7
Fe/CeO$_2$@0.4MnO$_2$	916.7	901.1	898.5	882.6	733.6	717.5

[a] Binding Energy (eV).

Fig. S7. Fitting results of Ce 3d XPS spectra: (A) fresh samples, (B) spent samples.
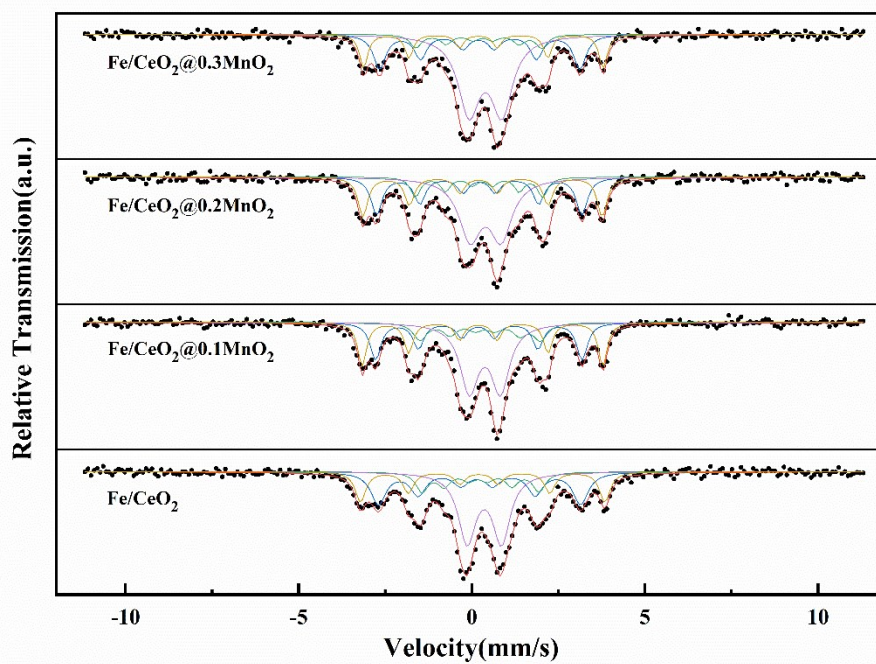
Fig. S8. Mössbauer spectrum of the samples after reaction. Reaction condition: 320 °C, $H_2/CO=2$, 1.5 MPa, 8000 mL/(h·g_{Cat}), 48 h.