Supporting information

Table S1. Comparison of catalytic activity for Fe catalysts in a packed-bed reactor.

Catalysts	Feedstock composition	P (MPa)	T (°C)	WHSV (mL g_{cat}^{-1} h^{-1})[a]	CO conversion (%)	CO_2 selectivity (%)	Hydrocarbon distribution (%)			Olefin selectivity in C2-C4 (%)	α	Ref.
							CH_4	C2-C4	C5+			
$Na_{0.2}/Fe_1Zn_{1.2}O_x$ (400)	24% CO, 64% H_2, 8% CO_2, 4% Ar	2.0	340	36,000	76.7	31.6	15.4	33.5	51.1	87.1	0.8	In this study
Fe-Zn-0.81Na (Zn/Fe = 1)	24% CO, 64% H_2, 8% CO_2, 4% Ar	2.0	340	60,000	77.2	23.8	12.7	34.0	53.3	87.8	0.7	28
100Fe/33Mn/28Na	22.2% CO, 77.8% H_2	1.0	325	(2,000)	96.2	26.8	16.7	39.1	44.2	78.2	-	30
10 wt% Fe/CNT (Na/Fe = 0.1)	33.3% CO, 66.7% H_2	2.0	300	16,000	75.3	39.4	3.4	21.4	75.2	84.6	-	32
10 wt%Fe/SiO_2 (d_p = 50 nm)	32.3% CO, 67.7% H_2	2.0	300	16,200	33.8	12.2	15.8	29.3	54.9	54.3	-	44
10 wt% Fe/CNF	45% CO, 45% H_2, 10% He	2.0	340	(1,500)	88.0	42.0	23.0	65.0	12.0	93.8	0.4	51

[a] Data in parentheses represent the gas hourly space velocity (h^{-1}).

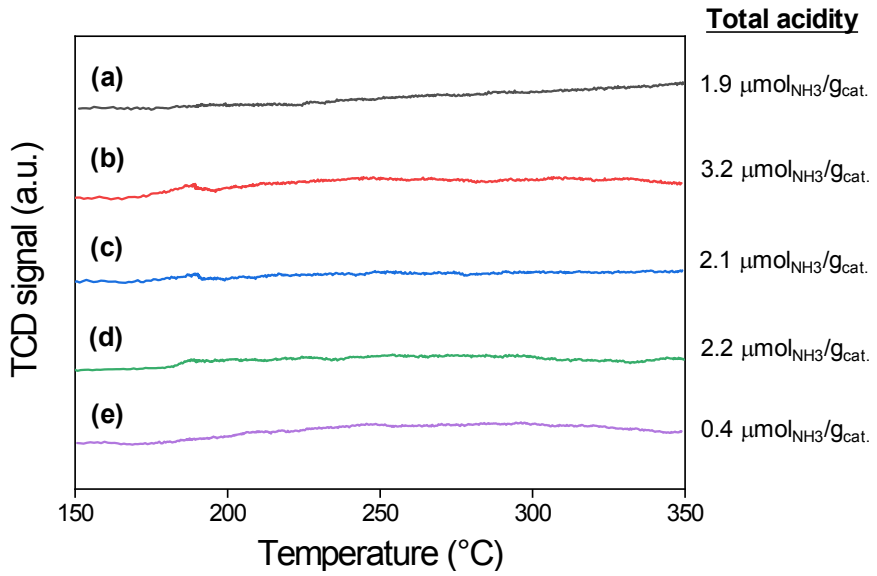

Fig. S1. NH_3-TPD patterns of (a) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (350), (b) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (400), (c) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (500), (d) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (600), (e) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (700)

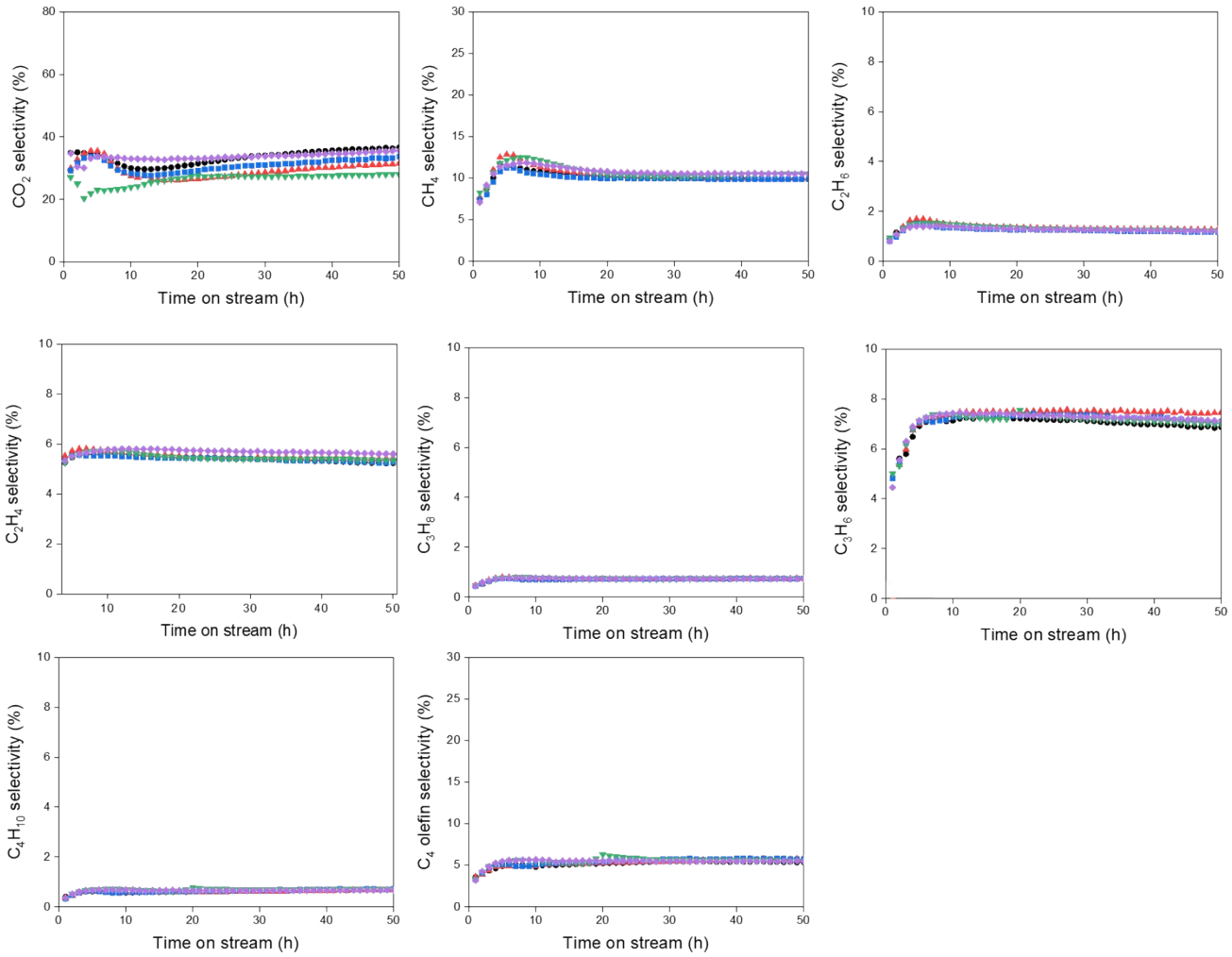

Fig. S2. Gas phase carbon selectivity for (●) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (350), (▲) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (400), (■) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (500), (▼) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (600), (◆) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (700).

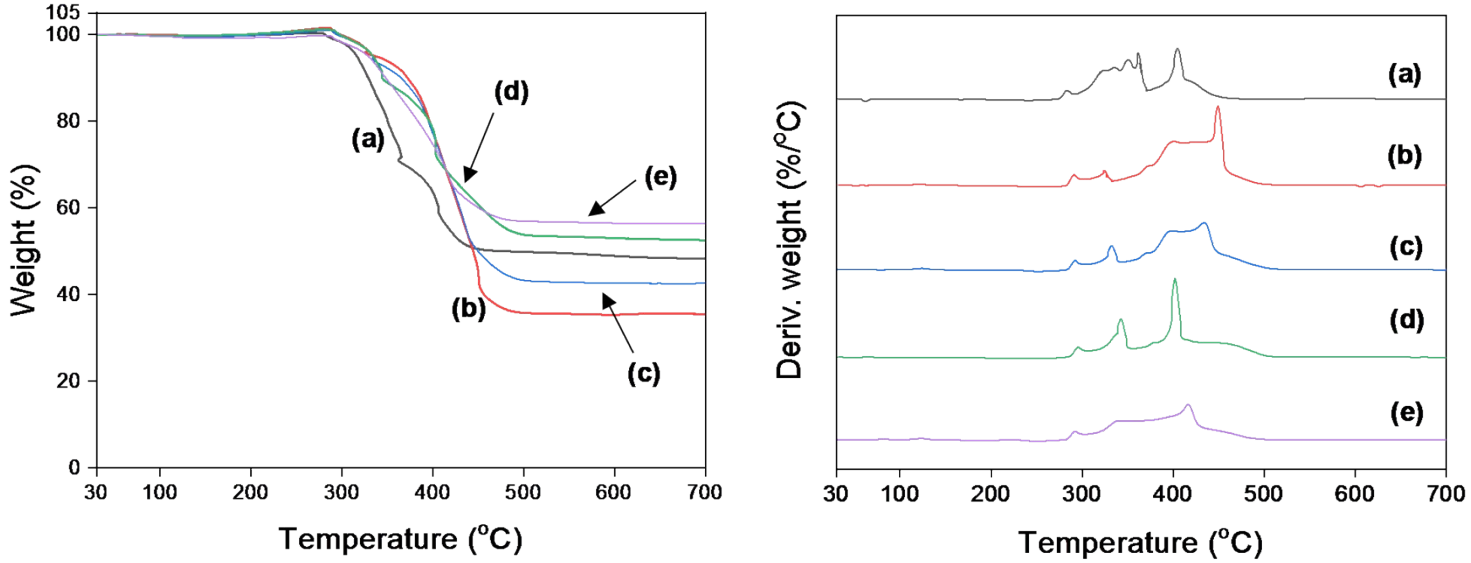

Fig. S3. TGA/DTG patterns of (a) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (350), (b) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (400), (c) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (500), (d) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (600), (e) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (700) after 50 h of reaction.

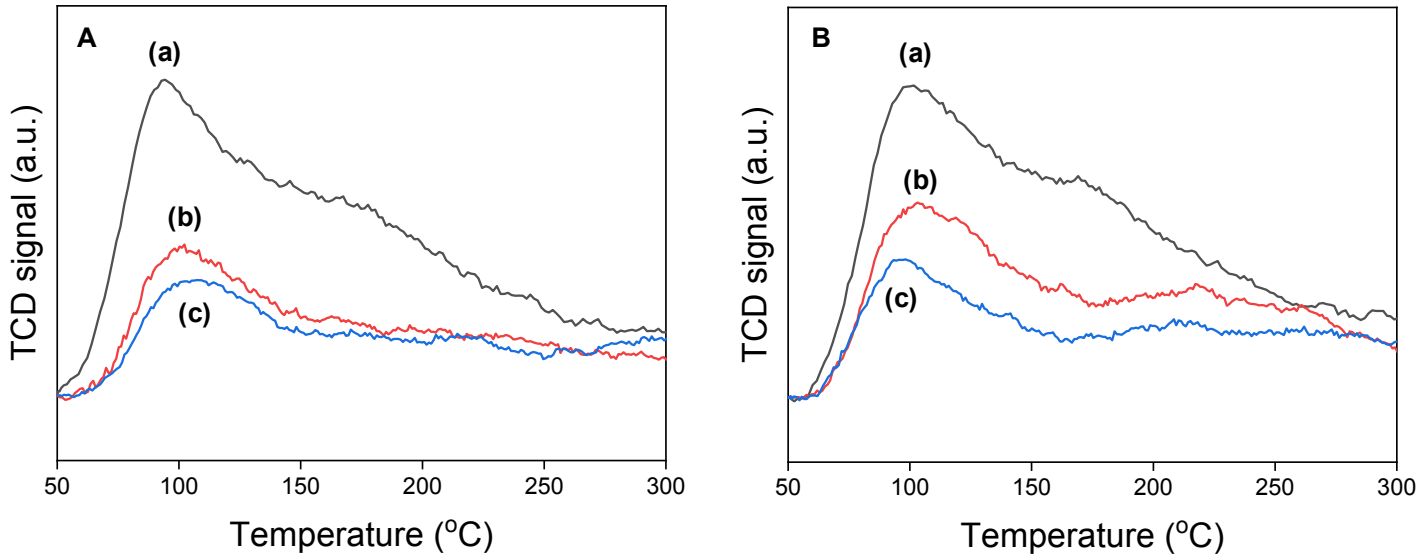

Fig. S4. CO_2-TPD patterns of (A) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (350), (B) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (400) before (a) and after 30 h of reaction (b), and after 50 h of reaction (c).

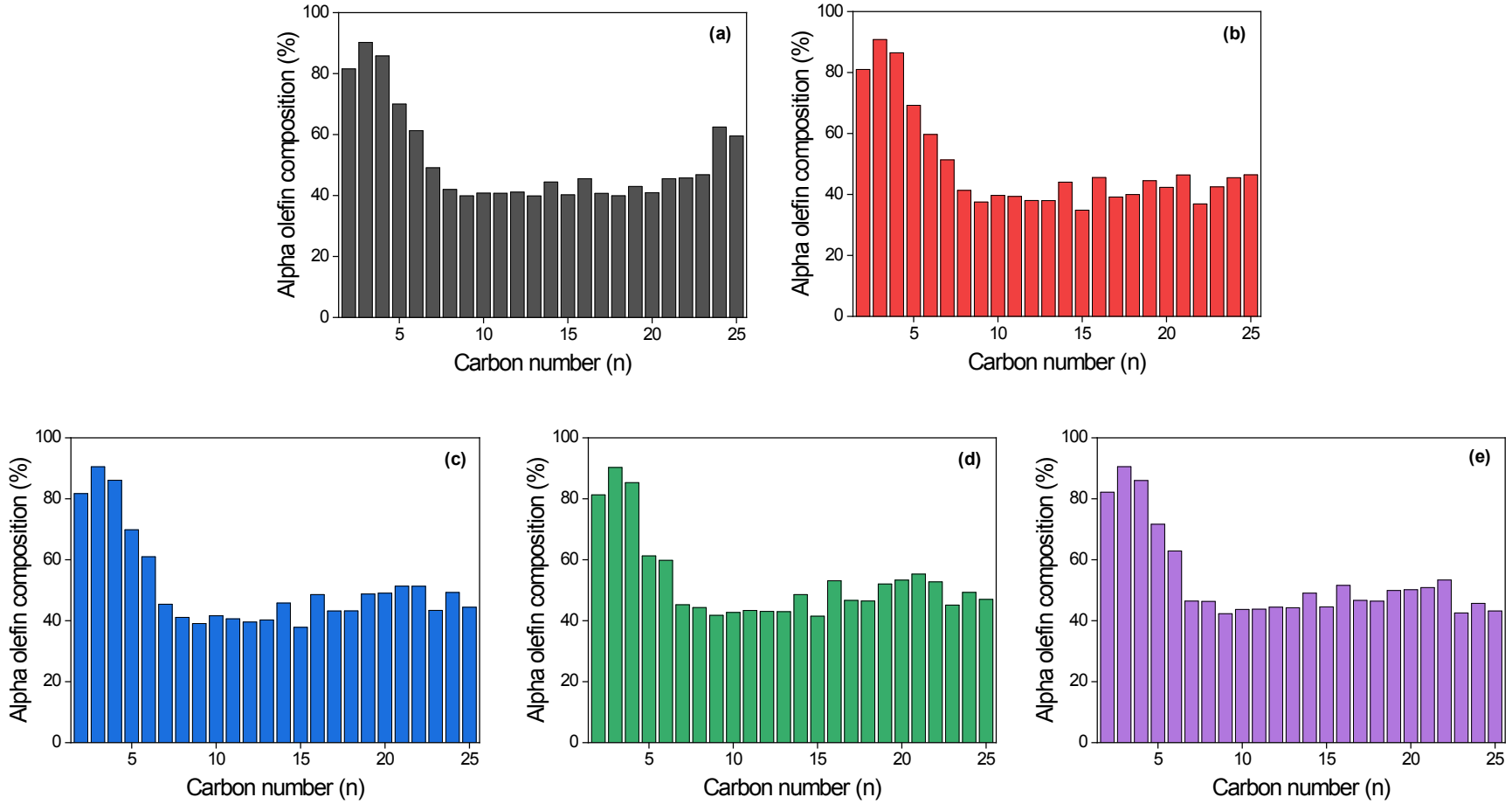

Fig. S5. Ratio of α-olefin to carbon number of Na/Fe-Zn catalysts: (a) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (350), (b) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (400), (c) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (500), (d) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (600), (e) $Na_{0.2}/Fe_1Zn_{1.2}O_x$ (700).