Supporting Information

Effect of reduction temperature on structure and catalytic performance of mesoporous Ni-Fe-Al_2O_3 in oxidative dehydrogenation of ethane

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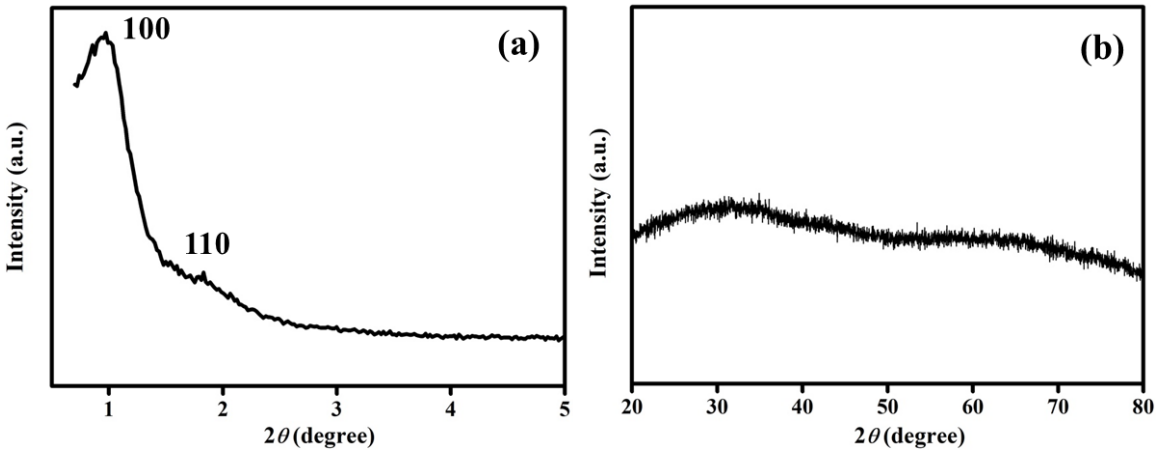

Figure S1. (a) Small- and (b) wide-angle XRD patterns of fresh Ni-Fe-Al_2O_3 catalyst.

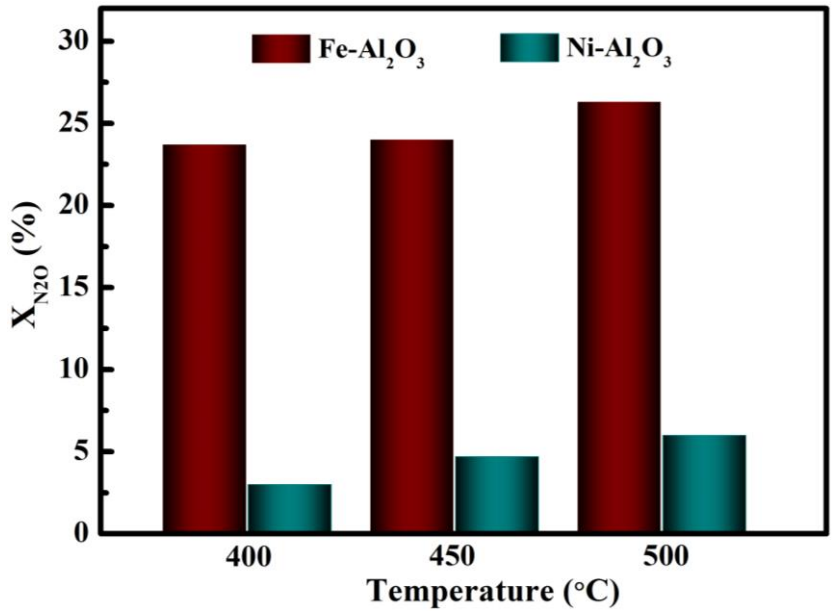

Figure S2. N_2O splitting as a function of reaction temperature over mesoporous Ni-Al_2O_3 with 10% molar fraction of Ni, and Fe-Al_2O_3 with 10% molar fraction of Fe. Reaction conditions: Feed gas flow rate = 25 mL min^{-1}, N_2O concentration = 10 vol%, He as balance gas.

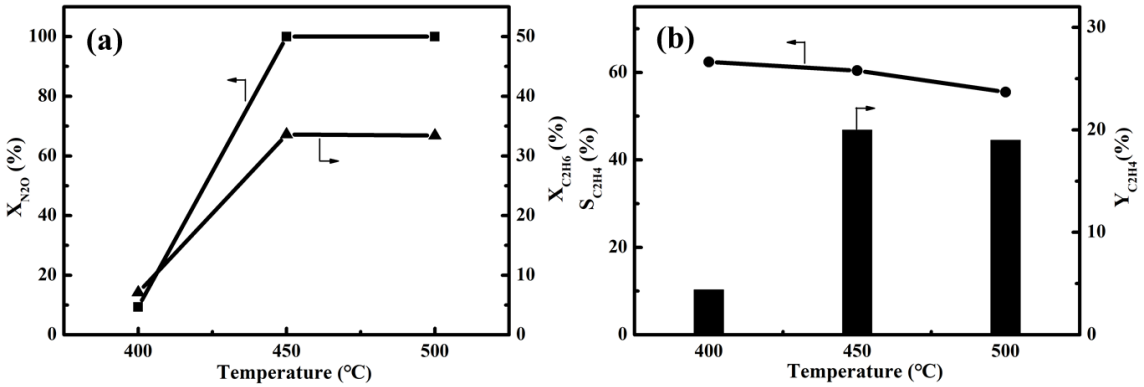

Figure S3. Catalytic performance of fresh Ni-Fe-Al_2O_3 for ODH. Reaction conditions: Feed gas flow rate = 25 mL min^{-1}, C_2H_6 concentration = 10 vol%, N_2O concentration = 10 vol%, He as balance gas.

Table S1 Percentage of Ni and Fe species determined by XPS method

Sample	Ni $2p_{3/2}$			Fe $2p_{3/2}$	
	Sat	Ni^{2+}	Ni^{0}	Fe^{3+}	Fe^{2+}
Ni-Fe-Al_2O_3	49.4	50.6	0	80.3	19.7
Ni-Fe-Al_2O_3-H400	41.4	58.6	0	55.6	44.4
Ni-Fe-Al_2O_3-H600	35.7	53.5	10.8	46.8	53.2

"Sat" represents satellite peak.

Table S2. Catalytic behaviors of Ni-Fe-Al_2O_3 catalysts with different Fe doping amount for ODH.

Catalyst	X_{N2O} (%)	X_{C2H6} (%)	S_{C2H4} (%)	Y_{C2H4} (%)
10Ni-Al_2O_3	9.5 (8.2)	7.2 (6.4)	88.9 (89.9)	6.4 (5.7)
10Ni-0.5Fe-Al_2O_3	51.2 (78.0)	22.8 (27.6)	74.7 (67.9)	17.0 (18.8)
10Ni-1Fe-Al_2O_3	99.1 (95.7)	35.8 (30.6)	59.3 (63.2)	21.2 (19.3)
10Ni-3Fe-Al_2O_3	100 (100)	33.5 (31.8)	57.6 (60.4)	19.3 (19.2)

The values in parenthese are the catalytic results after reaction for 3 h.

Table S3. Representative results reported in literatures toward low temperature (≤ 500 ^{o}C) ODH reaction.

Catalyst	Synthesis	Metal ratio	Feed gas	Y_{C2H4}	Ref.
Ni-Fe-Al_2O_3	EISA	Ni/Fe= 10/3	10%C_2H_6+ 10%N_2O+He	18% (400℃)	This work
Ni-Ce/ Al_2O_3	Impregnation	Ce/Ni= 0.25	6%C_2H_6+6%O_2 +He	7.7% (400℃)	[1]
Ni-Ce/ Al_2O_3	Impregnation	Ni/Ce= 11/3	6%C_2H_6+6%O_2+ He	20% (500℃)	[2]
Ni-Ce/ Al_2O_3	Impregnation	Ce/Ni= 0.13	6%C_2H_6+6%O_2 +He	23.5% (450℃)	[3]
Cordierite monoliths coated with Ni-Ce/γ-Al_2O_3	washcoating	Ni/Ce= 19/8	6%C_2H_6+6%O_2 +He	17% (450℃)	[4]
Ni-Al mixed oxide	Co-precipitation	80 wt% NiO	C_2H_6/N_2O/He= 1/1/48	18% (420℃) 24% (460℃)	[5]
NiO/ Al_2O_3	Impregnation	_	10%C_2H_6+10%O_2 +N_2	38.6% (450℃)	[6]
Ni-Fe/ γ-Al_2O_3	Coprecipitation -deposition	Ni/(Ni+ Fe)=0.9	0.5%C_2H_6+ 0.5%O_2+N_2	40.1% (400℃)	[7]
Fe/Al_2O_3	Vapor deposition	3.6 wt% Fe	11.6%C_2H_6+5.2% O_2+75.2%He+ 8%N_2	2.7% (400℃)	[8]
NiO-CeO_2	Evaporation	Ni/Ce= 12	9.1%C_2H_6+ 3%O_2 +87.9%He	6.1% (275℃)	[9]
NiO/TiO_2	Evaporation	50 wt% NiO	C_2H_6/O_2/He= 3/3/24	41% (450℃)	[10]
Ni-Nb-O/CeZrO	Evaporation	Nb/Ni= 0.176	C_2H_6/O_2=2/1	27.6% (450℃)	[11]

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