Electronic Supplementary Material

Light Olefin Synthesis from a Diversity of Renewable and Fossil Feedstocks: State-of the-Art and Outlook

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Table S1. Catalytic literature data used in Figure 11. Abbreviations: DDH – non-oxidative dehydration, ODH – oxidative dehydration, X – alkane conversion, S – selectivity to corresponding olefin, Y – molar yield of corresponding olefin

Catalyst	T (°C)	Alkane concentration (%)	X (mol.%)	S (mol.%)	Y (mol.%)	Ref.
Propane DDH						
Pt/GaAL	620	20	40	96	38.4	1
$PtZn_{ALD}/SiO_2$	600	16.7	49	97	47.53	2
ZnO-S-1_3	550	40	31	87	26.97	3
Pt-Sn/SBA-15	600	50	30	93	27.9	4
PtLa/mz-deGa	580	100	42	98	41.16	5
0.1Pt0.17Zn/SiO2 IMA	600	50	48	97	46.56	6
$Pt1Sn1/SiO_2$	580	16	63	99	62.37	7
$Pt1Sn1/SiO_2$	580	100	40	98	39.2	7
PtZn4@S-1-H	600	25	66.7	90.8	60.5636	8
Sn-Beta-30	630	20	40	85	34	9
Ethane DDH						
Pt/M-TS-1	700	100	44	92	40.48	10
VN	680	5	30	65	19.5	11
OMS-2	770	Ethane	46.7	96	44.8	12

Propane ODH						
Catalyst	**T (°C)**	**Propane : O_2 ratio, propane concentration (%)**	**X**	**S**	**Y**	**Ref.**
DFNS/BN	450	1:1, 8	20	55	11	[13]
h-BN/SiO_2	520	2:3, 16.7	23	78	17.94	[14]
g-C_3N_4	515	4:1, 44	24	57	13.68	[15]
B/SiO_2	500	2:1, 10	20	60	12	[16]
BS-1	570	1:1, 20	40	82*	32.8	[17]
BN1450	530	23:15, 23	42	67	28.1	[18]
N_2-BN	520	2:3. 1/6	26	75	19.5	[19]
BN	490	2:1, 30	14	79*	11.06	[20]
Pt/(Al2O3@35cIn$_2$O$_3$)	450	2:1, 10	47	77	36.2	[21]
Ethane ODH						
Catalyst	**T**	**Ethane : O_2 ratio, ethane concentration (%)**	**X**	**S**	**Y**	**Ref.**
MoVNbTeO$_x$@FoamSiC	460	3:2, 30	60.3	89.1	53.7	[22]
HDS-MoVO	440	2:1, 10	12	77.3	9.3	[23]
SnO_2-NiO	480	7:6, 7	40	55	22	[24]
92NiNb-O	450	3:1, 10	18.5	86.2	15.947	[25]

Propane CO_2-ODH						
Catalyst	**T (°C)**	**Propane : CO_2 ratio, propane concentration (%)**	**X**	**S**	**Y**	**Ref.**
CrOx/silicalite-1	550	5:1, 80	43	73	31.39	[26]
V_{15}/ZSM-5	550	1:2, 2.5	37	96	35.52	[27]
3Cr-ZrO	550	1:2, 2.5	60	67	40.2	[28]
2Cr-Ca/ZrO_2	550	1:3, 10	20.2	93.5	18.887	[29]
Pt–Co–In/CeO_2	550	1:1, 25	50	97	48.5	[30]
Ethane CO_2-ODH						
Catalyst	**T**	**Ethane : CO_2 ratio, ethane concentration (%)**	**X**	**S**	**Y**	**Ref.**
Cr/SBA-15@7	650	1:1, 50	25.8	81	20.898	
5Mo/5CeTi	600	1:1, 5	15	73	10.95	[31]
SrCr/SiO_2#H2	700	1:1, 20	31.7	79.8	25.2966	[32]
Cr-TUD-1	650	01:05.2	34	93	31.62	[33]
Fe/NiMgZr	600	1.2:1	22	75	16.5	[34]
PtCe@MZ	600	1:2	38	85	32.3	[35]
Looping ODH with air/oxygen						
Catalyst	**T**	**Alkane**	**X**	**S**	**Y**	**Ref.**
$La_{0.8}Sr_{0.2}FeO_3$	700	Ethane	62	88	54.6	[36]
Mo–V–O	500	Propane	36	89	32.04	[37]
$Na_2WO_4/CuMn_2O_4$	720	Ethane	58.8	86.4	50.8	[38]
NaW-$LaMnO_3$	750	Ethane	54.6	86.1	47	[39]
VO_x/TiO_2	500	Propane	20	80	16	[40]
3Ni/HY	600	Ethane	18	97	17.46	[41]
Looping ODH with CO_2						
0.2Ce/$SrFeO_3$	725	Ethane	28	68	19	[42]
CeO_2	600	Ethane	10	95	9.5	[43]
OMS-2	770	Ethane	46.7	96	44.8	[12]

Table S2. Methanol conversion to LO over different SAPO-34 and ZSM-5 zeolite catalysts
[a] ethene+propene; [b] ethene+propene+butene

Catalyst		WHSV	T (°C)	MeOH conversion (%)	Tot LO Selectivity (%)	Selectivity (%)			Stability	Ref.
						C_2H_4	C_3H_6	C_4H_8		
SAPO-34	SAPO-34 (SAPO-34-B)	5.0 h^{-1}	450	100	79.2 [a]	-	-	-	19 min	44
	Sapo-34-B decorated with CLD of TEOS (SAPO-34-L)	5.0 h^{-1}	450	100	73.6 [a]	-	-	-	35 min	44
	Sapo-34-B etched with CH_3COOH (SAPO-34-H)	5.0 h^{-1}	450	100	81.6 [a]	-	-	-	69 min	44
	SAPO-34	4 h^{-1}	475	100	80 [a]	40	40	-	55 min	45
	SAPO-34 with 1 µm crystal size (ZEOS)	6.6 $g_{MeOH} g_{cat} h^{-1}$	450	100	85 [a]	49	36	-	124 min	46
	ZEOS precoked and steam treated	6.6 $g_{MeOH} g_{cat} h^{-1}$	450	100	86	56	30	-	-	46
	SAPO-34 with 10 µm crystal size (ZEOL)	6.6 $g_{MeOH} g_{cat} h^{-1}$	450	100	75 [a]	38	37	-	18 min	46
	ZEOL precoked and steam treated	6.6 $g_{MeOH} g_{cat} h^{-1}$	450	100	89	60	29	-	-	46
	SAPO-34 with $n_{Si}/(n_{Si}+n_{Al}+n_P)=0.05$	1 h^{-1}	400	100	85 [a]	45	40	-	210 min	47
	Zn modified SAPO-34	2 h^{-1}	475	100	83 [a]	56	27	-	-	48
ZSM-5	HZSM-5	0.16 h^{-1}	400	100	68 [b]	19	31	18	-	49
	ZSM-5 containing Ta and Al	0.16 h^{-1}	400	97	81.8 [b]	4.1	52	25.7	> 50 h	49
	ZSM-5 containing Sn and Al	5 h^{-1}	450	100	77.4 [b]	9.8	42.5	25.1	35 h	50
	Hierarchical macro/microporous ZSM-5	2 h^{-1}	450	100	53 [b]	17	25	11	28h	51
	ZSM-5	2 h^{-1}	450	100	61 [b]	20	2	39	17 h	51

Table S3. Ex-situ catalytic pyrolysis results with different types of lignocellulosic biomass feedstock. (C = cellulose; HC = hemicellulose; L = lignin; PT= pyrolysis temperature)

Feedstock	Composition (wt%)			PT (°C)	Catalyst	Tot. LO Y (C-mol%)	Selectivity (C-mol%)			Ref.
	C	HC	L				C_2H_4	C_3H_6	C_4H_8	
Cellulose	100	0	0	600	ZSM-5	4	72	19	9	52
				600	3%Fe/ZSM-5	6.98	63.99	28.84	7.17	
Hemicellulose	0	100	0	600	3%Fe/ZSM-5	4.11	79.00	19.50	1.50	
Lignin	0	0	100	600	3%Fe/ZSM-5	1.39	82.61	12.32	5.07	
Corn stalk	-	-	-	600	3%Fe/ZSM-5	5.27	69.83	24.29	5.88	
Cellulose	100	0	0	500	HZSM-5	9.0	43.5	51.0	5.7	53
Lignin	0	0	100	500	HZSM-5	4.0	53.6	39.1	7.5	
Poplar wood	45.3	18.2	30.0	500	HZSM-5	7.7	50.5	43.7	5.9	
Pine wood	45.88	19.40	26.72	500	ZSM-5	4.2	-	-	-	54
				500	Sn/M-ZSM-5	12.39	-	-	-	
Lignin	0	0	100	600	ZSM-5	2.6	70	30	0	55
					3%Fe/ZSM-5	3.8	85	10	5	
Cellulose	100	0	0	600	La/HZSM-5	30.9	54.0	40.9	5.1	56
Hemicellulose	0	100	0	600	La/HZSM-5	27.6	54.9	42.4	2.7	
Lignin	0	0	100	600	La/HZSM-5	8.6	41.9	46.5	11.6	
Sugarcane bagasse	44	26	22	600	La/HZSM-5	21.2	62.7	33.4	3.9	
Sawdust	42	19	30	600	La/HZSM-5	14.7	51.7	42.7	5.6	
Rice husk	44	22	26	600	La/HZSM-5	20.1	58.6	37.3	4.1	

Table S4. Catalytic data for LO production using FT synthesis

Catalyst	**Temp. (°C)**	**P (bar)**	**H_2/CO**	**CO conv. (%)**	**CO_2 select. (%)**	**CO_2-free selectivity (%)**					**Ref.**
						CH_4	C_2-C_4=	C_2-C_4 alkanes	C_{5+}	Oxy	
Co_1Mn_3-Na_2S	240	1	2	0.8	0	17	54	3	26	-	[57]
	240	10	2	18	<3	4	30	7	59	-	
CoMn catalyst (Advanced Research Institute)	250	1	2	31.8	47.3	5.0	60.8	2.0	31.4	0.8	[58]
		1	1	11.5	48.0	3.7	50.0	1.3	43.5	1.5	
Fe/CNF	340	20	1	88	42	13	52	12	18	5	[59]
Fe/ α-Al_2O_3 (25 wt % Fe)			1	80	40	11	53	6	21	9	
FeBi/CNT-in	350	10	1	60	45.2	25.5	45.0	12.0	17.5	-	[60]
FePbK/CNT-in				76.2	48.1	18.2	52.6	8.6	21.0		
FeMn@Si	320	20	2	50	14	9	27.5	4.6	-	-	[61]
Fe-S-Na/ α-Al_2O_3	350	1	1	-	-	15	64	2	19	-	[62]
Fe/SiO_2	350	10	1	11	15	24	31	5	40	-	[63]
FeSn/SiO_2				53	49	23	17	13	47		
FeSb/SiO_2				47	47	14	17	10	59		
Fe@NaY	300	30	2	91.2	49.0	31.2	36.2	34.2	3.3		[64]
FeMn (4 :1)	260	20	1	5.49	20.72	18.9	48.7	-	-	-	[65]

Table S5. Catalytic literature data for LO synthesis using the methanol mediated route. Data were used in Figures 29 and 30.
Abbreviations: SV means space velocity, X – CO_2 or CO conversion, S(CO) – selectivity to CO, S(LO) – CO-free selectivity to light olefins

Catalyst	P (bar)	T (°C)	SV ($NL/g_{cat}/h$)	X(CO_x) (mol.%)	S (CO) (mol.%)	S(LO)	Ref
	10			10	65	86	[66]
	20			13	48	84	
	30	380		13	49	81	
	40			14	48	80	
	50			14	47	79	
		360	3.6	8	40	85	
		370		10	45	85	
		390		15	55	83	
		400		18	63	82	
ZnZrO/SAPO		370		10	45	85	
			1.8	16	55	68	
	20		5.4	10	46	86	
			9	8	40	89	
			15	7	35	92	
		380	20	6	33	94	
				14	60	76	
			3.6	12	55	78	
				10	47	82	
				8	46	84	
	10			20	80	45	[67]
	20			25	73	63	
Mn_2O_3-ZnO/SAPO-34	30	380	3.6	31	55	82	
	40			32	54	79	
	50			33	53	77	
	15	350		5	82	80	[68]
	15	375		7	83	90	
In_2O_3/ZrO_2-SAPO	15	400	12	12	86	90	
	15	425		17	90	90	
	15	450		24	94	86	
	30	300		2	19	72	[69]
	30	350		8	40	85	
$ZnGa_2O_4$/SAPO	30	370	5.4	12	48	85	
	30	400		22	60	82	
	30	450		37	82	45	
	20	350		12	56	70	[70]
	20	375		14	65	75	
NiCu/CeO_2-SAPO-34	20	400	12	16	71	72	
	20	425		18	76	70	
	20	450		21	85	60	

Zn/ZrO$_2$/SSZ-13	30	250	3	0	0	8	[71]
	30	300		3	10	21	
	30	350		10	27	42	
	30	400		23	42	72	
	30	450		27	40	52	
	10	400		10	n/d	87	
	20			15		80	
	30			24		73	
	40			28		65	

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