Supplementary material

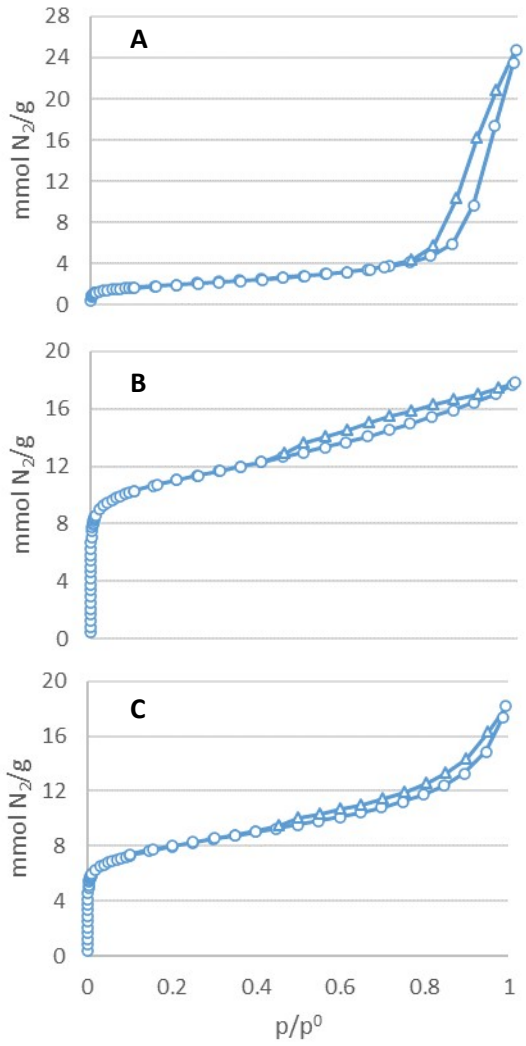


***Figure S1**: N_2 physisorption isotherms for A) 5 wt% Pt/Al_2O_3; B) 5 wt% Pt/C; C) 5 wt% $PtSn_2/C$. ○: adsorption; Δ: desorption*

***Table S1:** Textural properties of catalysts, based on N_2 physisorption*

Catalyst	Surface Area[a] (m^2/g)	Pore volume[b] (cm^3/g)	Average pore diameter[b] (nm)
Pt/C	796	0.35	4.8
$PtSn_2/C$	581	0.45	7.3
Pt/Al_2O_3	154	0.81	21.4

[a]*Based on BET method*
[b]*Based on BJH method*

Table S2: *XPS data for Pt/C and $PtSn_2C$*

Pt/C	Binding energy (eV)	FWHM (eV)	Concentration (at. %)
C 1s	284.5 ± 0.1	3.1 ± 0.2	91.8 ± 1.0
Na 1s	1071.5 ± 0.1	2.8 ± 0.1	0.6 ± 0.2
O 1s	532.7 ± 0.3	4.2 ± 0.3	6.4 ± 1.2
Pt $4f_{5/2}$ (Pt(0))	74.2 ± 0.0	1.1 ± 0.0	0.5 ± 0.0
Pt $4f_{7/2}$ (Pt(0))	70.9 ± 0.0	1.1 ± 0.0	0.7 ± 0.0
$PtSn_2/C$			
C 1s	284.6 ± 0.2	3.1 ± 0.1	83.6 ± 12.3
Cl 2p	199.7 ± 0.4	3.6 ± 1.0	0.1 ± 0.1
O 1s	532.4 ± 0.4	4.1 ± 0.1	6.7 ± 3.1
Pt $4f_{5/2}$ (Pt(0))	74.5 ± 0.0	1.2 ± 0.0	0.2 ± 0.0
Pt $4f_{7/2}$ (Pt(0))	71.2 ± 0.0	1.2 ± 0.0	0.2 ± 0.0
Sn $3d_{3/2}$ (SnO)	494.6 ± 0.0	1.5 ± 0.0	0.1 ± 0.0
Sn $3d_{5/2}$ (SnO)	486.1 ± 0.0	1.5 ± 0.0	0.2 ± 0.0
Sn $3d_{3/2}$ (SnO_2)	495.8 ± 0.0	1.5 ± 0.0	0.4 ± 0.1
Sn $3d_{5/2}$ (SnO_2)	487.4 ± 0.0	1.5 ± 0.0	0.5 ± 0.1

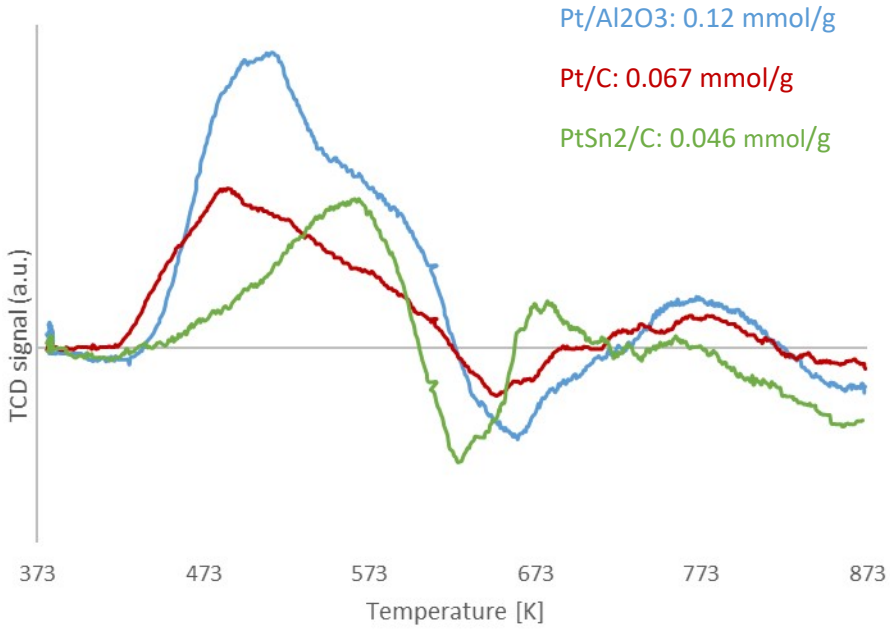


Figure S2: *NH_3 temperature programmed desorption for Pt/Al_2O_3, Pt/C, $PtSn_2/C$ between 373K and 873K*

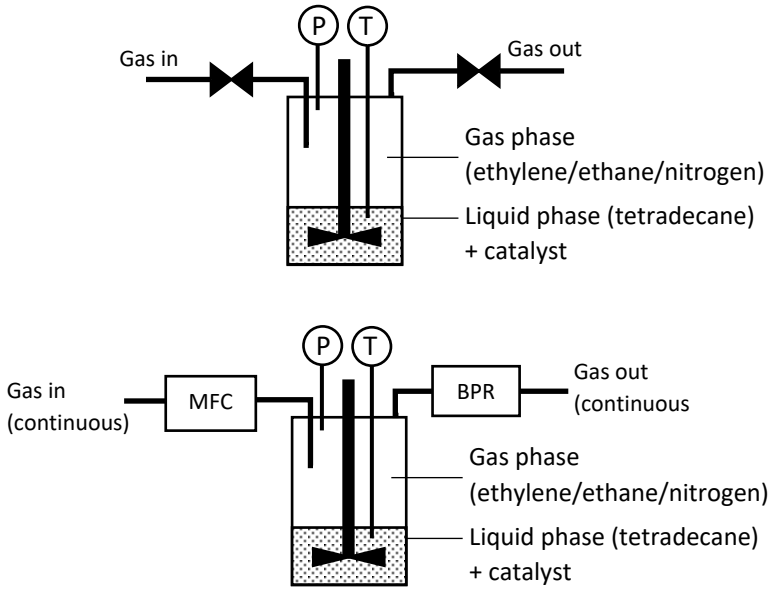
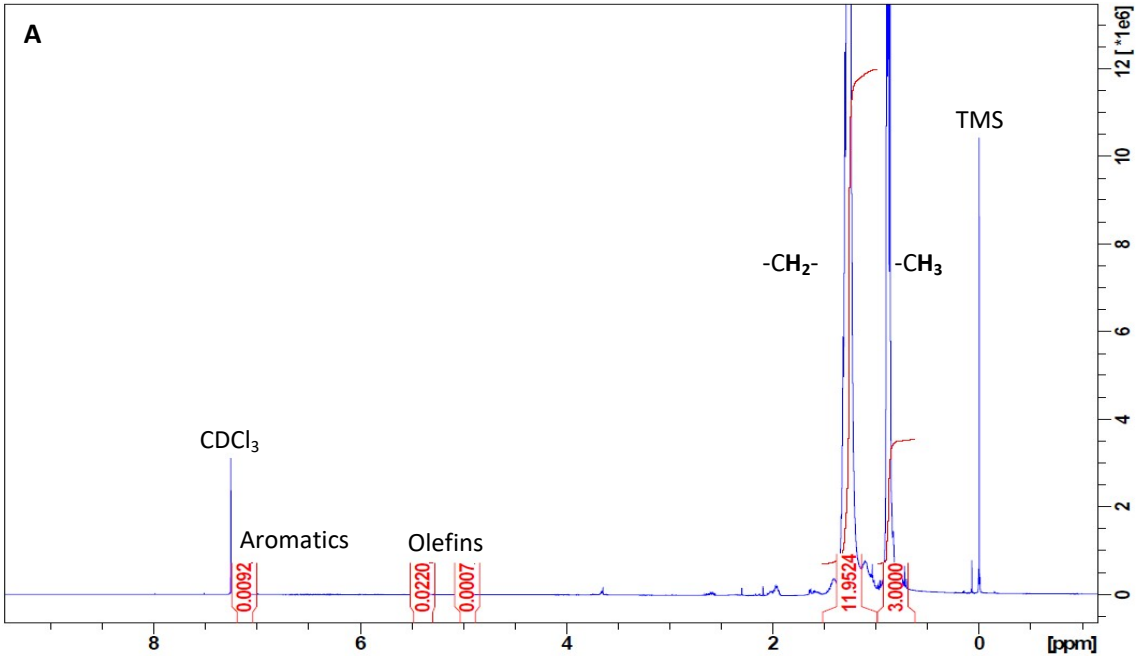
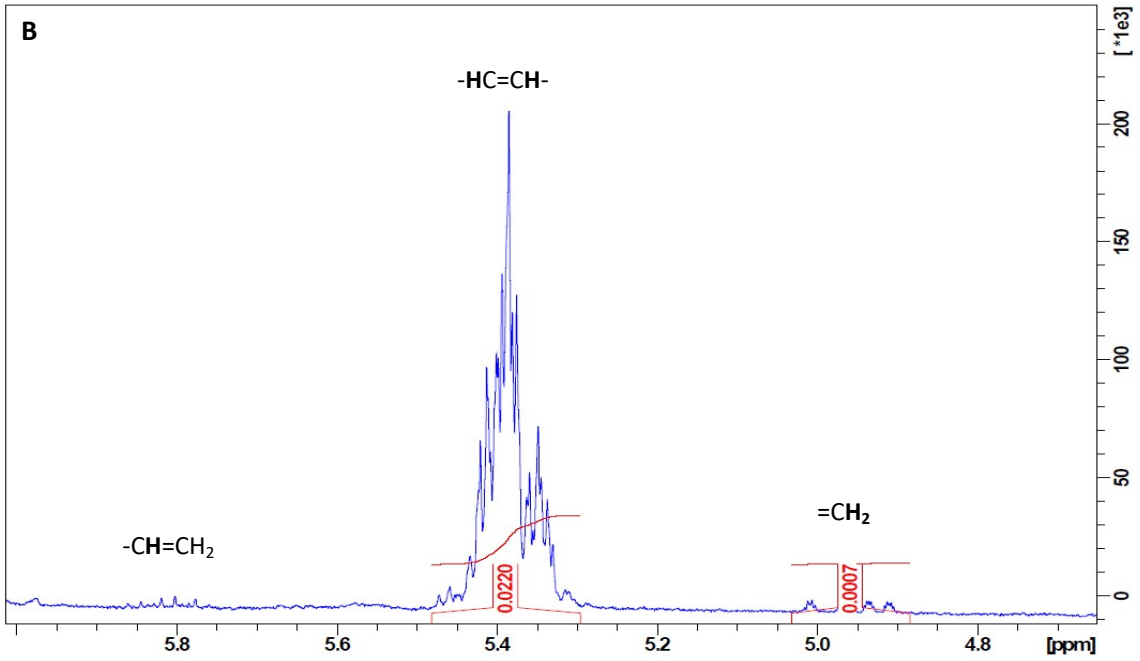


Figure S3: *Simplified diagram of reactor set-ups for batch and continuous ethylene addition. P: digital pressure sensor; T: thermocouple; MFC: mass flow controller (0.06-1 ml_n/min); BPR: back-pressure regulator (0-2 barg)*


A
TMS
-CH2-
-CH3
CDCl3
Aromatics
Olefins
0.0092
0.0220
0.0007
11.9524
3.0000
8
6
4
2
0
[ppm]
12 [*1e6]
10
8
6
4
2
0


B
-HC=CH-
-CH=CH2
=CH2
0.0220
0.0007
5.8
5.6
5.4
5.2
5.0
4.8
[ppm]
[*1e3]
200
150
100
50
0

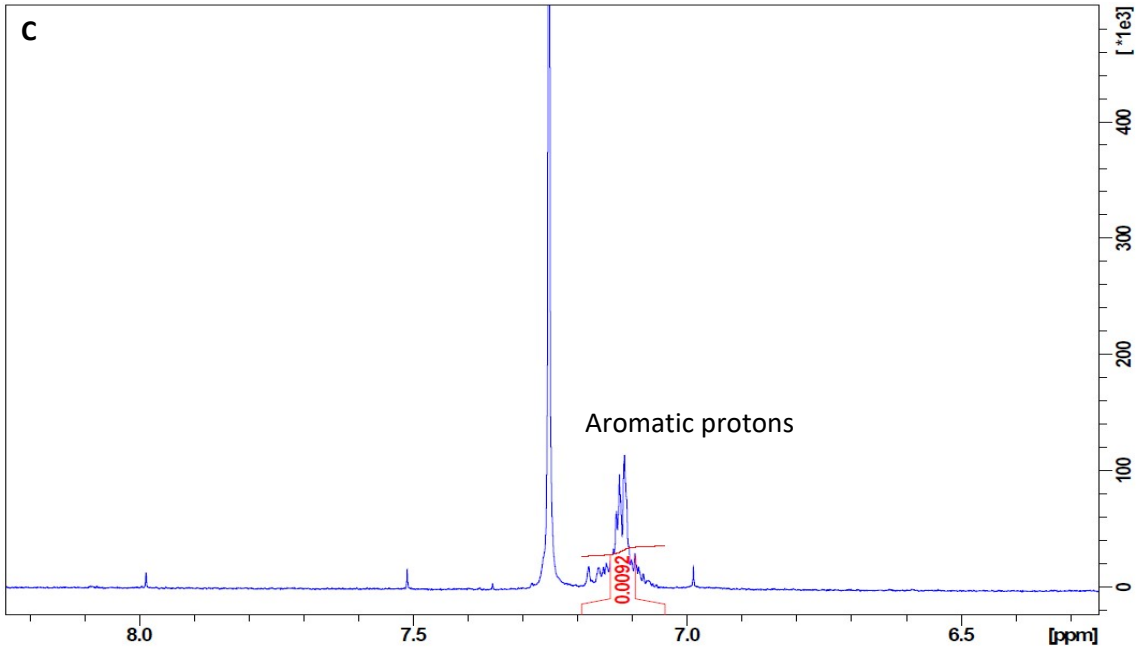
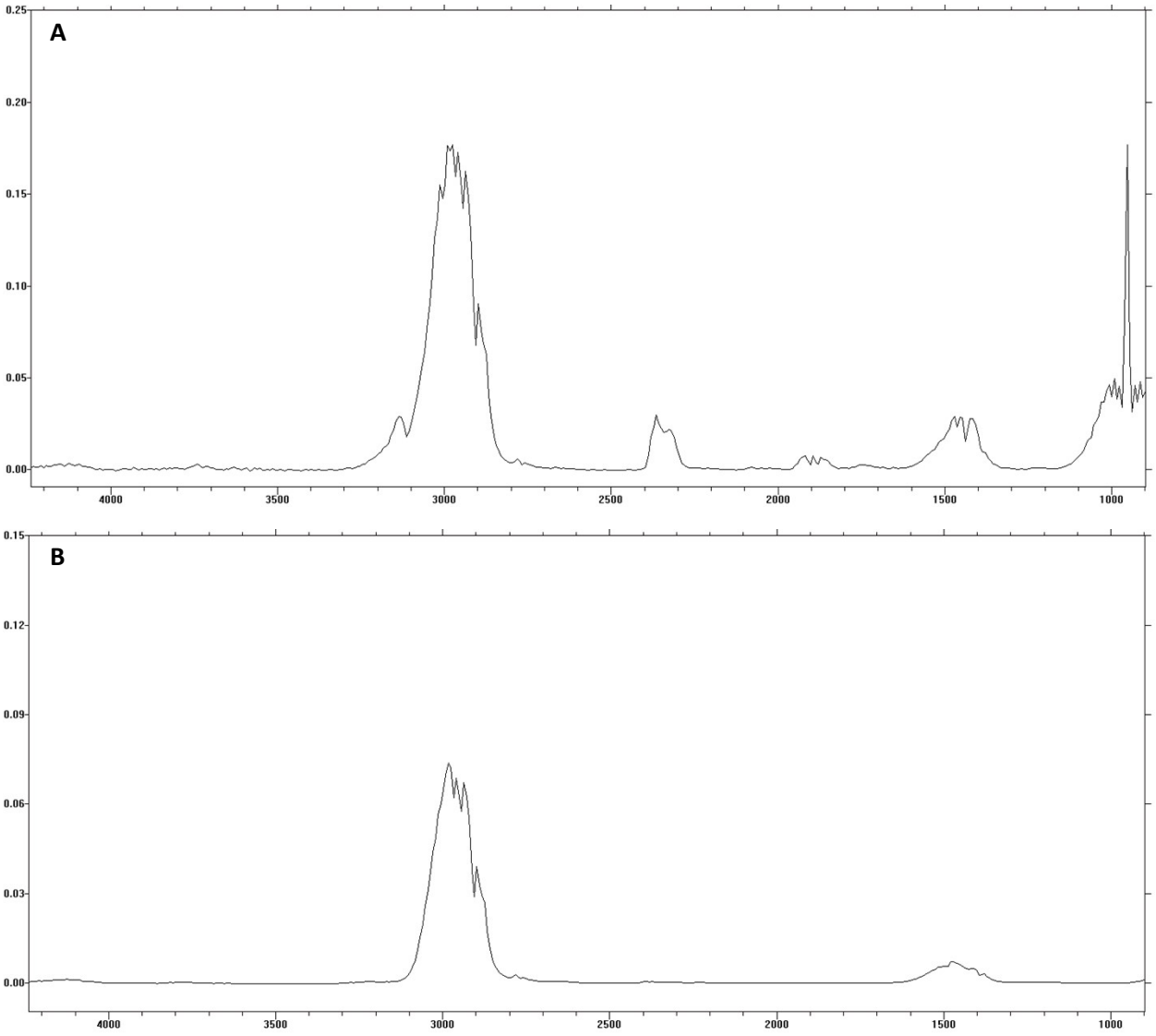


Figure S4: *^{1}H-NMR spectrum of partially dehydrogenated n-tetradecane (Bruker Avance 400 MHz, zg30 pulse program, $CDCl_3$, relative to TMS). Reaction conditions: 0.25mmol Pt in 10 ml n-tetradecane, 250°C, 22h, 1 bar ethylene at start* ***A)*** *Full spectrum with peak integration: olefin yield 2.2% internal + 0.07% terminal (GC yield 2.3%), aromatics yield 0.46% (GC yield 0.5%)* ***B)*** *Spectrum zoomed in to olefin region (4.6-6 ppm)* ***C)*** *Spectrum zoomed in to aromatic region (6.5-8 ppm)*


A
0.25
0.20
0.15
0.10
0.05
0.00
4000
3500
3000
2500
2000
1500
1000
B
0.15
0.12
0.09
0.06
0.03
0.00
4000
3500
3000
2500
2000
1500
1000

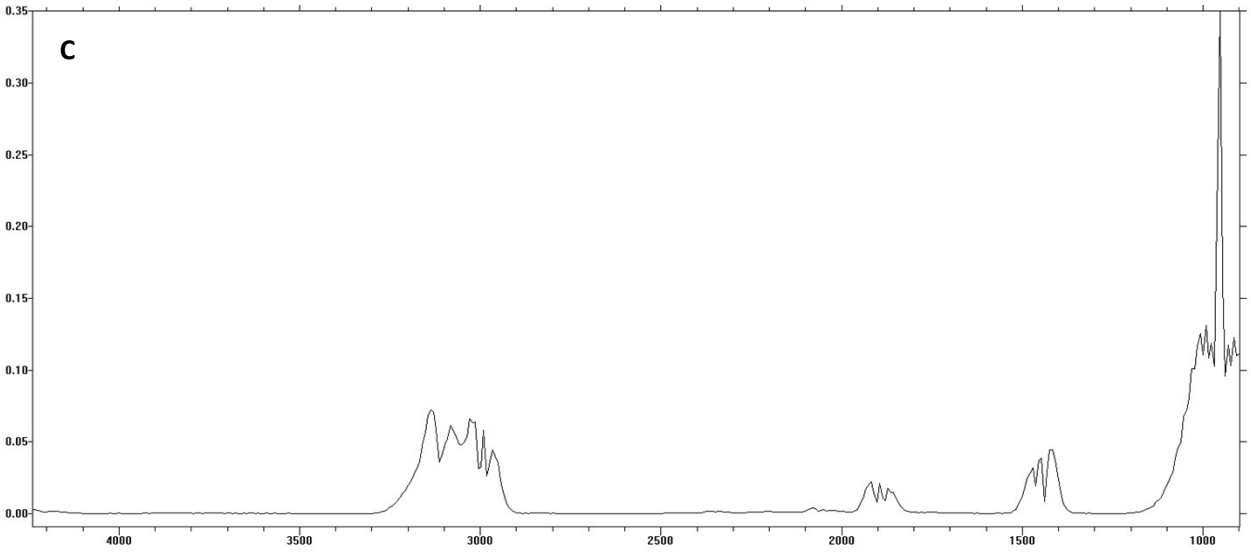


Figure S5: *Gas phase FTIR spectra, Gasmet DX4000 FTIR analyzer* ***A)*** *Gas phase sample (55% ethane/45% ethylene). Peak at 2300-2400 cm^{-1} corresponds to CO_2 introduced during sample injection, not present in reactor.* ***B)*** *Reference (100% ethane).* ***C)*** *reference (100% ethylene)*

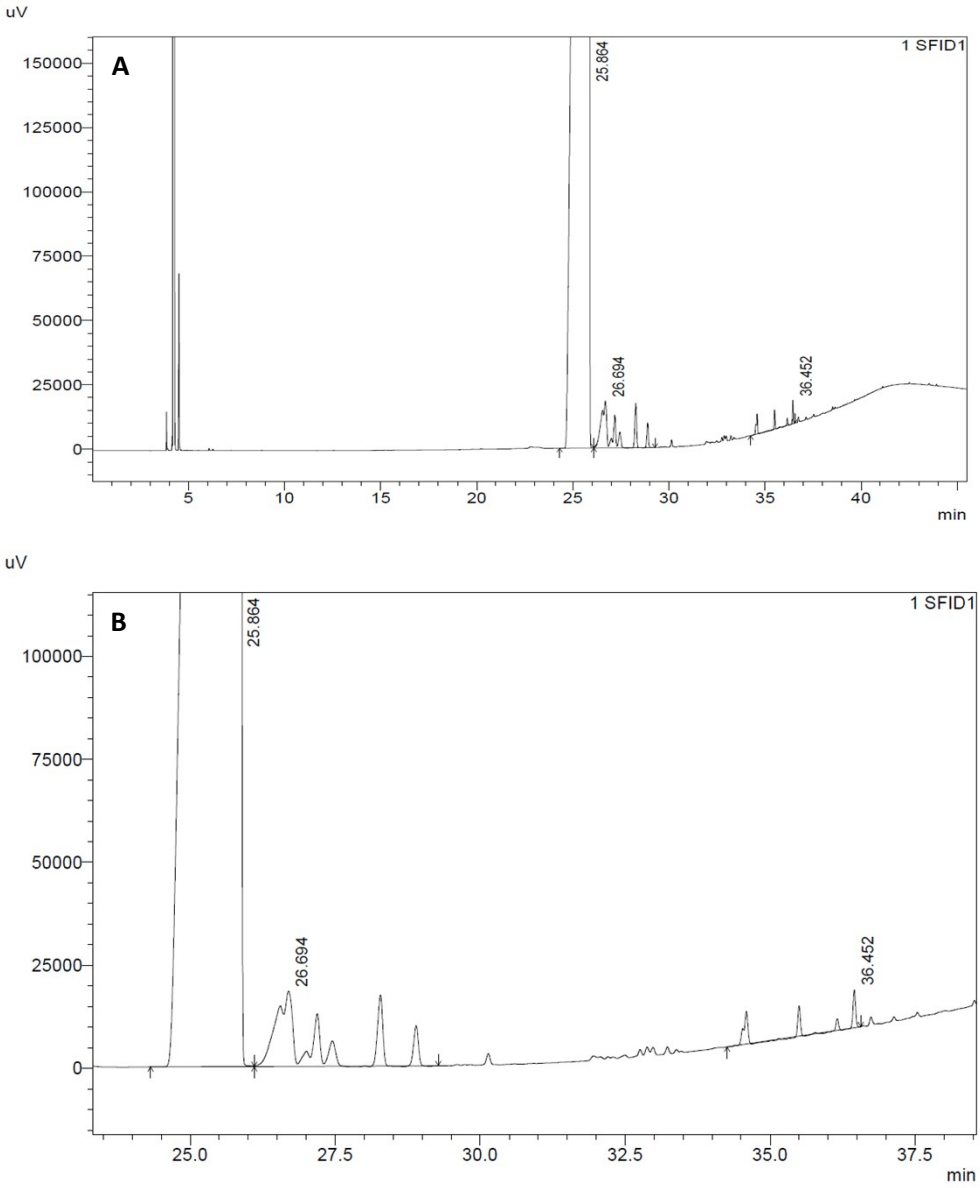


Figure S6: *Typical gas chromatogram of partially dehydrogenated tetradecane, diluted in heptane. DB-FFAP column.* ***A)*** *Full chromatogram.* ***B)*** *Chromatogram zoomed in to relevant region. 25.8 min: tetradecane; 26.7 min: tetradecenes; 36.5 min: C_{14}-alkylaromatics; 30.2 min: n-pentadecane; 32.5 min: tetradecadienes (not quantified)*

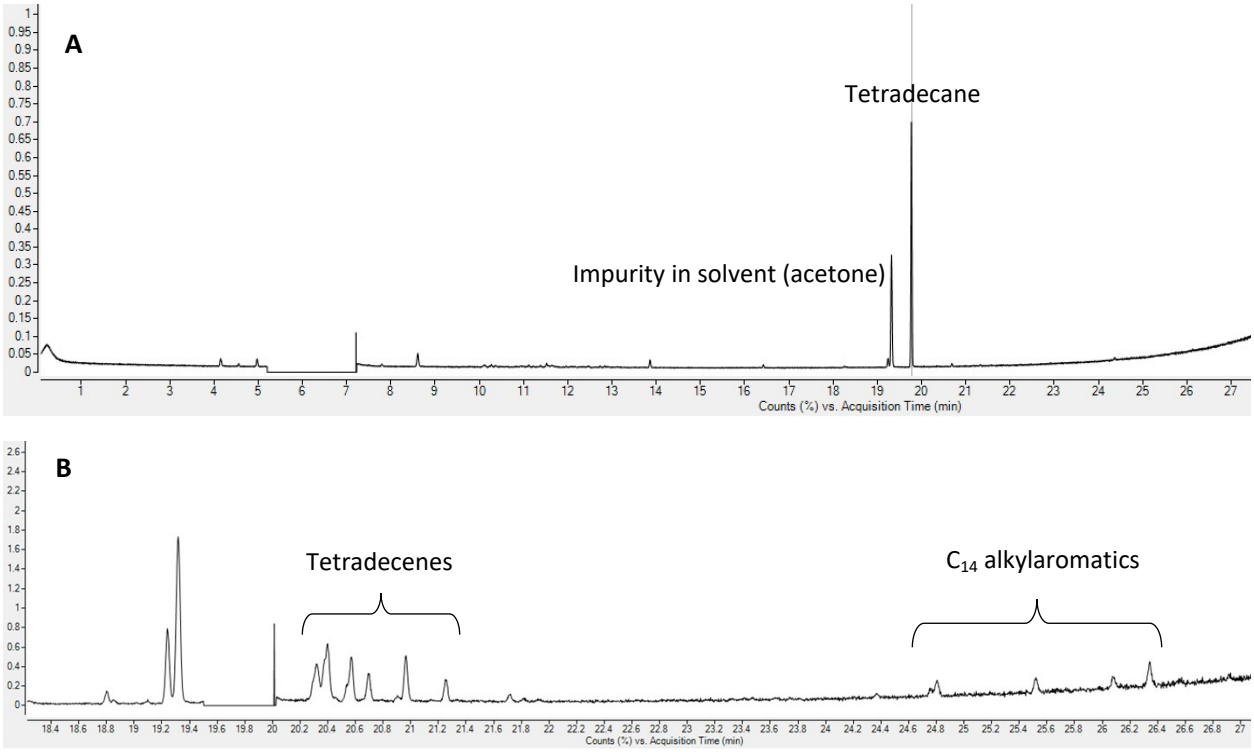


Figure S7: *Typical GC-MS chromatogram of partially dehydrogenated tetradecane diluted in acetone, VF-WAXms column, 40°C for 5 minutes, then 10°C/min ramp to 230°C, hold at 230°C for 2.5 minutes.* ***A)*** *50 ppm sample in acetone* ***B)*** *5000 ppm sample in acetone, detector turned off during tetradecane elution. Zoomed in to relevant region.*

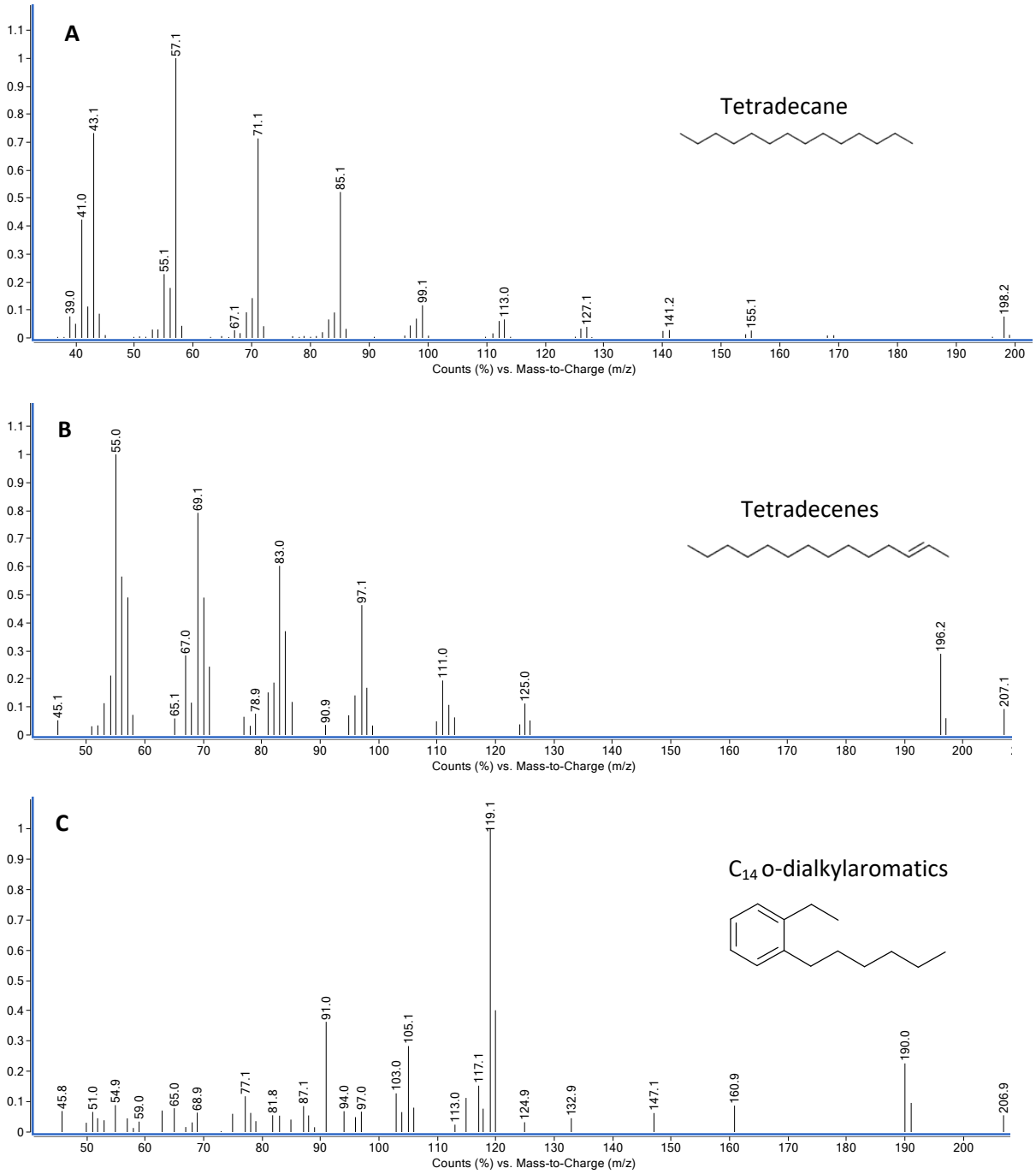


Figure S8: *MS spectra of relevant compounds.* ***A)*** *Tetradecane (19.8 min, Figure S3).* ***B)*** *Tetradecene (20.4 min, Figure S3), all peaks in the region 20.2-21.4 min show similar MS spectra, no distinction between isomers was possible.* ***C)*** *C_{14} alkylaromatic (25.5 min, Figure S3), other peaks in the region 24.5-26.5 min show spectra with similar ions in different distributions, all consistent with C_{14} aromatic compounds.*