Supporting Information

Co-pyrolysis of mixed plastics and cellulose: An interaction study by Py-GC×GC/MS

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S1. FTIR and DSC of PE powder sample

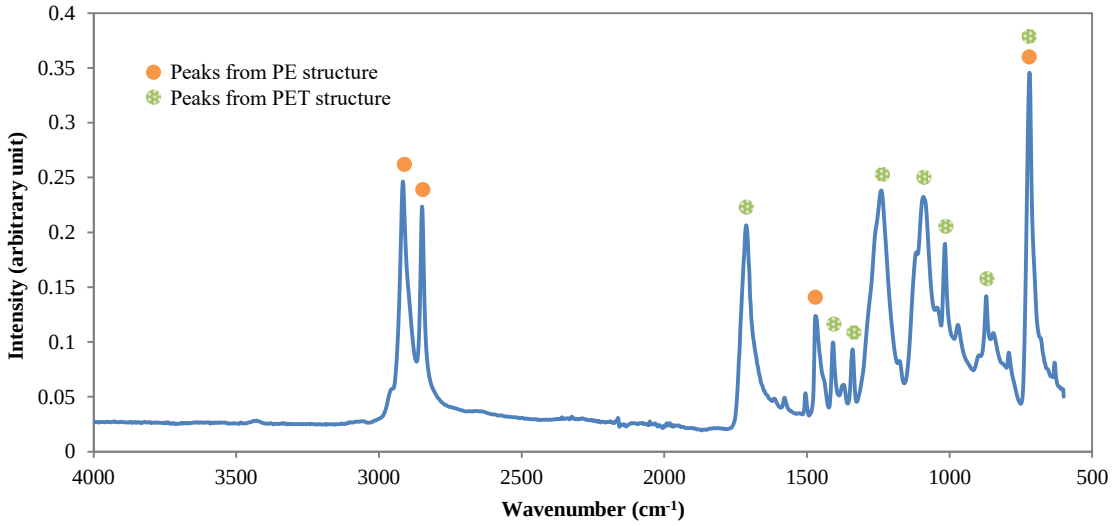

Figure S1. FTIR spectrum of PE powder sample showing PET contamination

The absorption bands were identified according to the references.[1,2] Assignments of different absorption bands are shown in Table S1.

Table S1. Absorption bands assignment

Wave number (cm^{-1})	Assignment	Signal strength
PE		
2919	CH_2 asymmetric stretching	Very strong
2851	CH_2 symmetric stretching	Very strong
1473, 1463	Bending and deformation	Strong
720	Rocking deformation	Medium
PET		
3100 – 2800	CH Stretching	Weak
1713 – 1727	carbonyl bond stretching	Strong
1409	Aromatic skeleton stretching	Weak
1342	Glycol CH_2 – CH_2 wagging	Weak
1235 – 1300	Ester group stretching for both amorphous and crystalline	Strong
1120, 1175	Aromatic – 1, 4 substituted ring	Medium

1095	C-O-C stretching	Strong
1017	In-plane stretching of C–H bond	Weak
872, 848	Glycol – CH_2– rocking	Weak
725	In-plane bending benzene ring	Strong

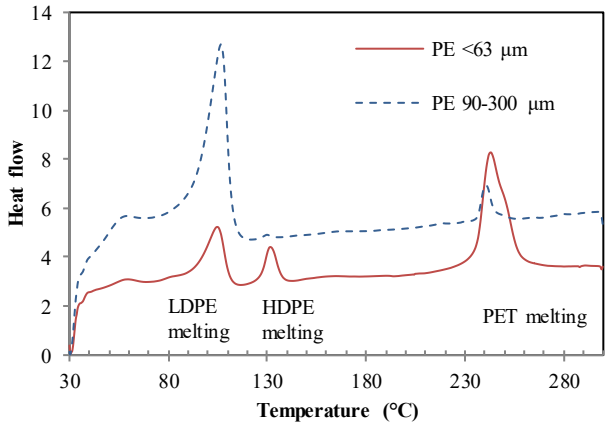

Figure S2. DSC curves of different particle size of PE powder sample with the heating rate of 10 K/min.

It was found that the different particle size of PE has different plastic composition. The fraction used in this work is <63 micron. This fraction has 3 compositions which are LDPE, HDPE and PET. The amount of each was estimated by the calculation using the heat of fusion of different plastics (LDPE 280 J/g, HDPE 292 J/g and PET 140 J/g) and the heat from the integration of the peak area. The estimated compositions are 60%wt PET and 40% PE.

S2. 2D Pyrogram

Depending on the type of column set used as the second column, the retention time on the second column (2^{nd}RT) of the products can roughly indicate polarities of compounds. In our case, the DB-17 column is mid-polar. Therefore, the products with low polarity e.g. hydrocarbon will interact less with the column and appear at early 2^{nd}RT while oxygenated compounds will appear at higher 2^{nd}RT.

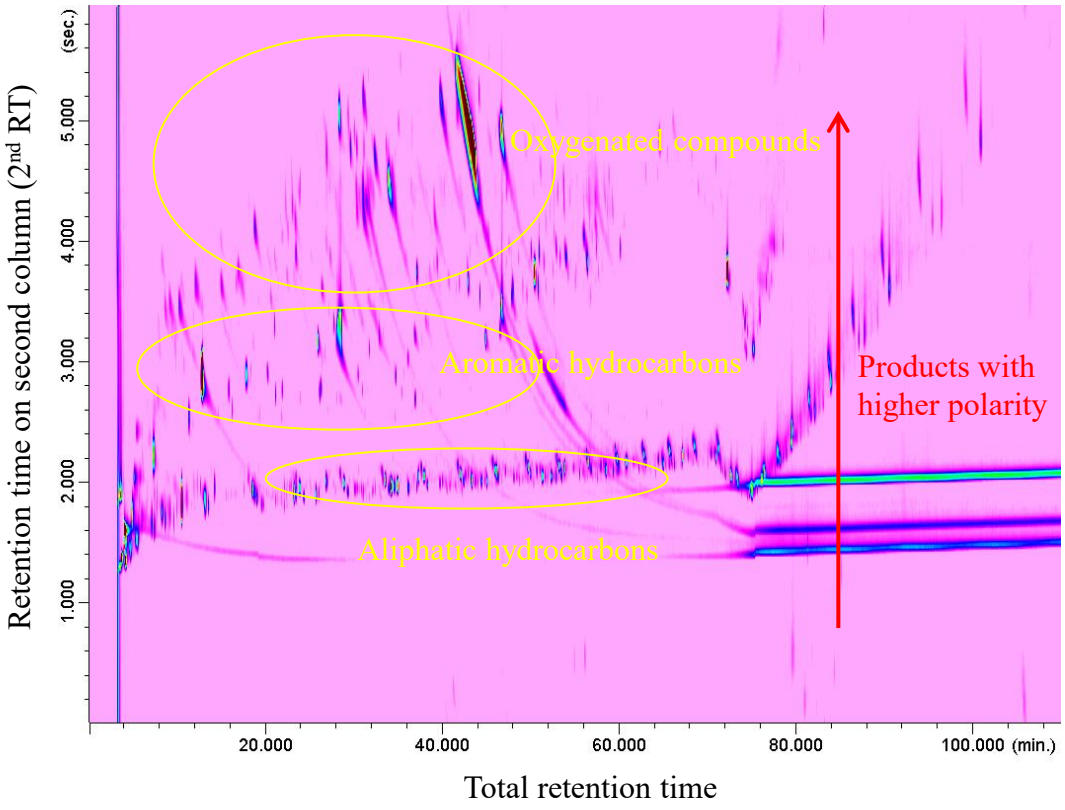

Figure S3. 2D pyrogram of products from co-pyrolysis of PE, PP, PS and cellulose showing the separation of different groups of compounds.

S3. Py-GC/MS Experiments of individual feedstock

Table S2. Compounds from cellulose pyrolysis at 600˚C analyzed by Py-GCxGC/MS.UnCxxxx are unidentified compounds.

Total RT (min)	Second RT (sec)	Compound names	weight-normalized TIC Area (x10^7)
3.431	1.860	1-Propene, 2-methyl- (mix)	0.64 ± 0.11
3.723	1.380	Methyl glyoxal (mix)	8.91 ± 0.39
4.025	1.460	Propanal, 2-methyl- (mix)	2.01 ± 0.15
4.027	1.620	Acetaldehyde, hydroxy- (mix)	23.15 ± 3.53
5.134	2.060	2-Propanone, 1-hydroxy-	2.31 ± 0.12
5.340	2.420	unC5324	0.93 ± 0.13
5.734	2.040	unC5720	0.58 ± 0.25
8.165	3.880	Succindialdehyde	0.41 ± 0.08
9.059	3.540	unC9135	1.77 ± 0.33
10.159	3.520	Furfural	2.80 ± 0.20

11.652	3.120	2-Furanmethanol	0.70 ± 0.25
12.061	3.680	2(3H)-Furanone, dihydro-4-hydroxy-	2.87 ± 0.28
14.961	3.660	unC15037	0.80 ± 0.17
16.864	3.820	unC16838	0.68 ± 0.06
18.769	4.140	unC18841	1.43 ± 0.11
23.370	4.200	unC23442 (sugars)	0.60 ± 0.13
23.465	3.880	unC23438	0.73 ± 0.16
26.361	3.620	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	0.46 ± 0.10
28.385	5.080	unC28451	4.74 ± 0.38
28.658	3.460	4H-Pyran-4-one, 3,5-dihydroxy-2-methyl-	0.75 ± 0.26
29.680	4.780	1,4:3,6-Dianhydro-α-d-glucopyranose	1.64 ± 0.29
30.380	4.800	unC30448	0.34 ± 0.04
31.074	4.400	unC31144	3.65 ± 0.91
31.088	5.240	2-Butene-1,4-diol, (Z)-	1.34 ± 0.12
31.286	5.160	unC31352 (sugars)	0.77 ± 0.19
31.373	4.380	5-Hydroxymethylfurfural	2.93 ± 0.54
31.484	5.040	unC31550	0.41 ± 0.09
32.479	4.720	unC32547	3.29 ± 0.43
33.977	4.600	unC34046	16.56 ± 1.82
34.771	4.240	unC34842 (sugars)	1.40 ± 0.15
39.986	5.160	unC40052 (sugars)	6.48 ± 1.15
44.376	4.540	β-D-Glucopyranose, 1,6-anhydro-	375.99 ± 36.84
45.764	3.840	unC45838 (sugars)	1.59 ± 0.33
46.077	4.580	unC46146 (sugars)	0.79 ± 0.03
47.280	4.780	1,6-Anhydro-β-D-glucofuranose	28.08 ± 4.40
		Total	**502.51**

Table S3. Compounds from PS pyrolysis at 600˚C analyzed by Py-GCxGC/MS. UnPSxxxx are unidentified compounds.

Total RT (min)	**Second RT (sec)**	**Compound names**	**weight-normalized TIC Area (x10^7)**
4.929	1.740	Benzene	0.39 ± 0.03
7.338	2.260	Toluene	19.91 ± 1.18
11.343	2.580	Ethylbenzene	1.65 ± 0.16
13.052	3.060	Styrene	361.10 ± 35.10
15.847	2.840	Benzene, 1-ethenyl-2-methyl-	2.04 ± 0.34
17.849	2.940	α-Methylstyrene	9.58 ± 0.17
20.349	2.940	Benzene, 2-propenyl-	1.18 ± 0.07
21.147	2.780	Benzene, 3-butenyl-	0.84 ± 0.06
39.464	3.840	Diphenylmethane	0.21 ± 0.02
42.864	3.820	Ethylene, 1,1-diphenyl-	0.70 ± 0.04
42.962	3.680	Bibenzyl	14.16 ± 0.19
44.260	3.560	(1) Benzene, 1,1'-(1-methyl-1,2-ethanediyl)bis-	5.71 ± 0.28

45.660	3.560	unPS45635	0.44 ± 0.02
46.266	3.920	benzene, 1,1'-(1-methylene-1,2-ethanediyl)bis- (mix)	0.46 ± 0.00
46.658	3.460	unPS46634 (2-ring)	0.58 ± 0.01
46.861	3.660	(1) Benzene, 1,1'-(1-butene-1,4-diyl)bis-, (Z)-	1.51 ± 0.16
48.060	3.600	Benzene, 1,1'-(1,3-propanediyl)bis-	2.61 ± 0.23
48.764	3.840	(1) 1,2-Diphenylcyclopropane	0.56 ± 0.08
49.660	3.560	Benzene, 1,1'-[1-(2-propenyl)-1,2-ethanediyl]bis-	0.78 ± 0.04
50.166	3.920	Stilbene	3.02 ± 0.20
50.465	3.840	Styrene Dimer	65.54 ± 5.28
50.861	3.640	(2) Benzene, 1,1'-(1-methyl-1,2-ethanediyl)bis-	8.53 ± 0.30
51.066	3.920	(2) 1,2-Diphenylcyclopropane	4.76 ± 0.16
51.564	3.840	(2) Benzene, 1,1'-(1-butene-1,4-diyl)bis-, (Z)-	2.19 ± 0.05
51.770	4.180	(1) Benzene, 1,1'-(1,3-butadienylidene)bis-	0.75 ± 0.00
53.074	4.440	(2) Benzene, 1,1'-(1,3-butadienylidene)bis-	1.54 ± 0.05
53.365	3.880	(3) Benzene, 1,1'-(3-methyl-1-propene-1,3-diyl)bis-	0.58 ± 0.15
53.775	4.500	(1) 1,3-Butadiene, 1,4-diphenyl-, (E,E)-	3.61 ± 0.45
53.866	3.960	(2) Benzene, 1,1'-(1,3-butadienylidene)bis-	2.07 ± 0.09
54.065	3.900	(3) Benzene, 1,1'-(1-butene-1,4-diyl)bis-, (Z)-	10.11 ± 0.97
54.263	3.760	unPS54237	1.92 ± 0.28
56.465	3.860	2,5-Diphenyl-1,5-hexadiene	14.46 ± 0.39
57.467	3.980	unPS57439 (2-rings)	2.34 ± 0.14
58.474	4.400	(2) 1,3-Butadiene, 1,4-diphenyl-, (E,E)-	1.18 ± 0.12
58.972	4.280	(2) 1,3-Pentadiene, 1,1-diphenyl-, (Z)-	0.32 ± 0.01
59.371	4.260	unPS59443	3.94 ± 0.35
60.166	3.960	1,5-Diphenyl-1,5-hexadiene	5.62 ± 0.28
60.670	4.160	1,4-Diphenyl-1,3-butadiene	0.56 ± 0.22
63.077	4.580	Benzene, 1,1',1''-(1-ethanyl-2-ylidene)tris-	1.97 ± 0.10
64.873	4.380	unPS64843 (more-ring)	1.14 ± 0.05
67.778	4.640	unPS67846	0.52 ± 0.04
69.872	4.300	Benzene, 1,1',1'',1'''-(1,6-hexanediylidene)tetrakis-	0.66 ± 0.07
71.373	4.360	Benzene, 1,1',1'',1'''-(1,5-hexadiene-1,3,4,6-tetrayl)tetrakis-	1.09 ± 0.12
72.363	3.780	Styrene Trimer	73.96 ± 5.04
73.357	3.420	benzene, 1,1',1''-[5-methyl-1-pentene-1,3,5-triyl]tris-	0.64 ± 0.18
74.054	3.240	unPS74132	0.50 ± 0.18
74.058	3.440	unPS74134	1.65 ± 0.11
74.256	3.340	unPS74333	1.74 ± 0.07
74.352	3.100	unPS74431	1.65 ± 0.00
74.654	3.220	unPS74732	2.39 ± 0.26
75.252	3.120	unPS75331	2.63 ± 0.41

75.756	3.340	unPS75833	0.46 ± 0.05
75.959	3.520	unPS76035	1.05 ± 0.02
80.491	5.420	1,1':2',1''-Terphenyl, 4'-phenyl-	0.15 ± 0.00
84.817	1.000	unPS84810	1.66 ± 0.29
52.270	4.200	mix (Naphthalene, 1,2,3,4-tetrahydro-1-phenyl- and Anthracene, 9-methyl)	0.86 ± 0.03
54.573	4.340	1,2-Dihydro-3-phenylnaphthalene	0.52 ± 0.00
58.976	4.520	Naphthalene, 2-phenyl-	0.51 ± 0.11
21.056	3.340	Indene	1.60 ± 0.04
56.672	4.280	1H-Indene, 2-methyl-3-phenyl-	0.74 ± 0.02
52.966	3.960	unPS52939 (mix HC)	3.35 ± 0.01
55.163	3.780	unPS55137	1.12 ± 0.06
56.073	4.340	unPS56043 (un HC)	0.39 ± 0.03
57.068	4.060	unPS57040	0.62 ± 0.11
57.763	3.740	unPS57737	0.64 ± 0.05
58.771	4.240	unPS58842	2.18 ± 0.11
69.074	4.440	unPS69144	2.54 ± 0.33
72.661	3.660	unPS72737	1.96 ± 0.50
72.861	3.620	unPS72936	0.93 ± 0.22
75.655	3.280	unPS75733	0.53 ± 0.16
76.461	3.680	unPS76537	0.59 ± 0.05
76.863	3.780	unPS76938	0.94 ± 0.10
77.262	3.700	unPS77237	0.41 ± 0.08
77.566	3.980	unPS77640	0.64 ± 0.07
78.174	4.420	unPS78244	0.23 ± 0.03
78.776	4.540	unPS78845	0.29 ± 0.01
85.221	1.280	unPS85213	0.77 ± 0.35
68.374	4.400	unPS68344 (unox)	2.80 ± 0.27
		Total	**676.50**

Table S4. Compounds from PP pyrolysis at 600˚C analyzed by Py-GCxGC/MS. UnPPxxxx are unidentified compounds, where "mix" indicates two or more unseparated compounds in a blob. "ke", "dke" and "ka" indicates that the compound is classified as alkenes, dialkenes or alkanes, respectively.

Total RT (min)	**Second RT (sec)**	**Compound names**	**weight-normalized TIC Area (x10^7)**
3.722	1.300	Pentane (mix C5)	31.93 ± 2.02
4.223	1.380	1-Pentene, 2-methyl-	42.61 ± 4.43
4.724	1.460	1-Pentene, 2,4-dimethyl- (mix)	30.91 ± 0.36
5.025	1.480	unPP5014 (C7)	2.24 ± 0.03
5.326	1.540	1-Hexene, 2-methyl-	3.55 ± 0.23

5.627	1.640	1,3-Pentadiene, 2,4-dimethyl-/mix	4.13 ± 0.39
6.330	1.780	1,3-Pentadiene, 2,3-dimethyl-	0.64 ± 0.14
6.527	1.620	unPP6516 (C7H12)/mix	0.58 ± 0.03
6.631	1.860	1,3,5-Heptatriene, (E,E)-	0.35 ± 0.00
6.728	1.660	2-Hexene, 2,3-dimethyl-	0.80 ± 0.12
6.928	1.660	1-Hexene, 2,5-dimethyl-	1.30 ± 0.04
7.128	1.700	unPP7117 (C8H16)	11.75 ± 0.27
7.428	1.660	Hexane, 2,3-dimethyl-	4.39 ± 0.44
7.432	1.920	unPP7519	0.96 ± 0.20
7.731	1.840	1,4-Hexadiene, 2,5-dimethyl-	6.36 ± 0.15
8.531	1.860	1,3-Dimethyl-1-cyclohexene	1.78 ± 0.13
8.929	1.760	unPP9017 (mix C9H18)	3.74 ± 0.49
9.129	1.760	1-Hexene, 3,3,5-trimethyl-	6.74 ± 1.17
9.629	1.720	Heptane, 2,4-dimethyl-	1.21 ± 0.06
9.733	2.000	Cyclohexene, 1,4-dimethyl-	1.69 ± 0.31
9.930	1.820	(1) Cyclohexane, 1,3,5-trimethyl-	3.37 ± 0.18
10.131	1.880	unPP10119 (C9)	1.68 ± 0.56
10.532	1.920	2,4-Dimethyl-1-heptene	111.51 ± 5.90
10.932	1.880	unPP10919	1.10 ± 0.20
11.032	1.900	(2) Cyclohexane, 1,3,5-trimethyl-	4.56 ± 0.24
11.833	2.000	(1) Cyclohexene, 3,3,5-trimethyl-	2.33 ± 0.02
12.334	2.040	(2) Cyclohexene, 3,3,5-trimethyl-	1.60 ± 0.16
12.832	1.900	1-Heptene, 2,6-dimethyl-	1.20 ± 0.13
13.131	1.880	unPP13118 (C10H20)	21.94 ± 1.71
13.532	1.920	unPP13418 (mix C11)	0.95 ± 0.09
13.833	1.980	unPP13820 (mix C9-11)	0.71 ± 0.02
14.233	2.000	1,1'-Bicyclohexyl	9.74 ± 0.20
15.532	1.920	unPP15519 (mix C11-12)	0.76 ± 0.11
15.732	1.900	unPP15619 (mix C)	0.61 ± 0.20
16.032	1.940	unPP16119 (mix C12)	1.10 ± 0.04
16.633	1.960	4-Decene, 7-methyl-, (E)-	0.61 ± 0.04
17.135	2.120	unPP17220 (C10H18)	0.88 ± 0.07
18.037	2.220	unPP18021 (C10H18)	0.54 ± 0.03
18.733	1.980	(1) 1-Undecene, 7-methyl-	17.16 ± 0.30
19.332	1.920	unPP19319 (C12 ke)	0.78 ± 0.05
19.531	1.860	(1) Nonane, 2,6-dimethyl-	2.26 ± 0.06
19.731	1.860	(2) Nonane, 2,6-dimethyl-	1.86 ± 0.08
20.932	1.920	1-Undecene, 5-methyl-	0.62 ± 0.06
21.131	1.860	(2) 1-Undecene, 7-methyl-	1.10 ± 0.14
21.332	1.880	unPP21318 (C12-14)	0.83 ± 0.03
21.832	1.880	(1) 1-Nonene, 4,6,8-trimethyl-	0.65 ± 0.11
22.133	1.980	unPP22119 (C10-14)	1.12 ± 0.00
22.734	2.000	unPP22720 (C12-16)	0.86 ± 0.07
22.933	1.980	1,7-Nonadiene, 4,8-dimethyl-	1.90 ± 0.02
23.232	1.920	1-Decene, 2,4-dimethyl-	36.82 ± 1.09

25.732	1.920	unPP25719 (mix C12H24)	10.40 ± 0.08
26.032	1.920	unPP26119 (mix C12H24)	2.41 ± 0.01
26.235	2.060	(1) 1,13-Tetradecadiene	0.54 ± 0.01
26.934	2.020	unPP26920 (C13)	12.97 ± 0.58
27.235	2.080	1-Isopropyl-1,4,5-trimethylcyclohexane	1.00 ± 0.00
27.933	1.940	(1) 1-Undecene, 8-methyl-	0.51 ± 0.02
28.233	1.960	(2) 1-Undecene, 8-methyl-	0.28 ± 0.01
29.237	2.180	unPP29321 (C11-12 dke)	0.49 ± 0.13
30.133	1.940	(1) 2-Undecene, 4,5-dimethyl-, [R*,R*-(E)]-	4.03 ± 0.07
30.433	1.960	(2) 2-Undecene, 4,5-dimethyl-, [R*,R*-(E)]-	2.21 ± 0.14
30.633	1.940	(3) 2-Undecene, 4,5-dimethyl-, [R*,R*-(E)]-	0.79 ± 0.07
30.833	1.940	(2) 1-Nonene, 4,6,8-trimethyl-	1.26 ± 0.11
31.133	1.940	(4) 2-Undecene, 4,5-dimethyl-, [R*,R*-(E)]-	2.70 ± 0.03
31.635	2.060	(2) 1,13-Tetradecadiene	0.76 ± 0.03
32.133	1.940	(3) 1-Undecene, 7-methyl-	1.59 ± 0.33
32.433	1.940	(4) 1-Undecene, 7-methyl-	1.30 ± 0.01
32.933	1.940	unPP32919 (mix C)	0.90 ± 0.09
33.334	2.020	unPP33320 (mix C)	3.00 ± 0.04
33.634	2.040	(3) 1,19-Eicosadiene	1.89 ± 0.03
34.034	2.020	(4) 1,19-Eicosadiene	1.32 ± 0.10
34.233	1.980	unPP34219 (mix C15)	28.53 ± 2.24
34.633	1.980	unPP34619 (HC)	8.91 ± 0.26
35.033	1.980	unPP35019 (mix ke)	22.71 ± 2.73
36.233	1.960	unPP36219 (mix ke)	8.02 ± 0.44
37.133	1.980	unPP37119 (mix ke)	2.77 ± 0.08
37.335	2.060	(5) 1,19-Eicosadiene	11.57 ± 0.17
37.635	2.060	unPP37620 (dke)	1.11 ± 0.02
38.035	2.060	unPP38020 (dke)	2.03 ± 0.10
39.734	2.000	unPP39720 (ke)	4.07 ± 0.20
40.034	2.020	unPP40020 (ke)	2.76 ± 0.07
40.434	2.000	unPP40420 (ke)	1.89 ± 0.07
40.833	1.980	unPP40819 (ke)	2.28 ± 0.04
41.533	1.980	unPP41519 (ke)	1.75 ± 0.12
41.547	2.820	unPP41528 (ox)	0.29 ± 0.02
42.635	2.060	unPP42635 (dke)	3.58 ± 0.13
42.935	2.080	unPP43020 (dke)	2.59 ± 0.12
43.434	2.020	unPP43420 (mix HC)	16.91 ± 1.41
43.734	2.020	unPP43820 (mix HC)	4.15 ± 0.01
44.034	2.020	unPP44020 (ke)	1.64 ± 0.03
44.434	2.020	unPP44420 HC	7.09 ± 0.12
44.834	2.020	unPP44820 (ke)	1.20 ± 0.12
45.034	2.020	1-Tricosene	6.56 ± 0.37
46.135	2.100	unPP46121 (dke)	14.95 ± 0.95
46.535	2.100	unPP46521 (mix)	1.22 ± 0.07
47.135	2.100	unPP47121 (mix)	2.42 ± 0.13

48.134	2.040	unPP48120 (ke)	2.74 ± 0.01
48.435	2.060	unPP48420 (ke)	2.19 ± 0.06
48.734	2.040	unPP48720 (ke)	1.28 ± 0.12
49.134	2.040	unPP49120 (ke)	1.00 ± 0.06
49.434	2.040	unPP49420 (ke)	0.97 ± 0.02
49.734	2.040	unPP49720 (ke)	1.15 ± 0.01
50.035	2.060	unPP50020 (ke)	0.63 ± 0.03
50.735	2.100	unPP50721 (dke)	4.23 ± 0.00
51.036	2.120	unPP51021 (dke)	3.18 ± 0.24
51.434	2.040	unPP51320 (HC)	15.54 ± 0.87
51.735	2.060	unPP51720 (HC)	2.75 ± 0.10
52.035	2.060	unPP51920 (ke)	1.83 ± 0.01
52.434	2.040	unPP52320 (ke)	10.28 ± 0.34
52.635	2.060	unPP52620 (HC)	1.47 ± 0.05
52.934	2.040	unPP52820 (ke)	4.09 ± 0.30
53.135	2.060	unPP53120 (HC)	0.79 ± 0.00
53.535	2.060	unPP53520 (HC)	3.57 ± 0.15
53.936	2.120	unPP53821 (dke)	15.04 ± 1.75
54.236	2.120	unPP54121 (dke)	0.81 ± 0.13
54.836	2.120	unPP54821 (mix)	2.76 ± 0.02
55.535	2.080	unPP55520	2.52 ± 0.02
55.935	2.080	unPP55920	1.72 ± 0.15
56.135	2.080	unPP56120 (ke)	1.16 ± 0.03
56.435	2.060	unPP56420 (ke)	0.89 ± 0.09
56.835	2.080	unPP56820 (ke)	0.75 ± 0.13
57.335	2.080	unPP57320 (ke)	0.95 ± 0.06
57.634	2.020	unPP57620 (ka+)	0.71 ± 0.07
57.936	2.140	unPP57921 (C11-C12 HC)	5.26 ± 0.11
58.336	2.160	unPP58321 (dke)	3.37 ± 0.21
58.535	2.100	unPP58521 (HC)	12.05 ± 0.67
58.835	2.100	unPP58721 (ke)	1.78 ± 0.12
59.435	2.100	unPP59321 (HC)	4.44 ± 0.16
59.735	2.100	unPP59621 (ke)	2.02 ± 0.12
59.935	2.100	unPP59921 (HC)	3.44 ± 0.08
60.837	2.180	unPP60821 (mix C)	18.87 ± 0.19
61.236	2.120	unPP61221 (dke)	0.73 ± 0.17
61.637	2.180	unPP61621 (dke)	2.83 ± 0.04
61.937	2.180	unPP61921	1.05 ± 0.01
62.336	2.120	unPP62221 (ke)	2.13 ± 0.19
62.636	2.140	unPP62621 (ke)	1.35 ± 0.04
63.036	2.120	unPP63021 (ke)	0.99 ± 0.03
64.537	2.180	unPP64422 (dke)	6.00 ± 0.03
64.837	2.220	unPP64822 (dke)	3.57 ± 0.11
65.036	2.160	unPP65021 (ke)	11.17 ± 0.51
65.236	2.160	unPP65221 (ke)	1.75 ± 0.19

65.736	2.160	unPP65721 (HC)	3.77 ± 0.15
66.036	2.160	unPP66021 (HC)	1.94 ± 0.03
66.336	2.140	unPP66221 (ke)	3.75 ± 0.48
67.138	2.240	unPP67122 (HC)	22.19 ± 0.01
67.837	2.220	unPP67822 (dke)	3.27 ± 0.03
68.437	2.180	unPP68421 (ke)	1.39 ± 0.01
70.438	2.240	unPP70422 (dke)	6.62 ± 0.13
70.937	2.220	unPP70922 (ke)	13.86 ± 0.43
71.536	2.120	unPP71521 (ke)	2.37 ± 0.00
71.735	2.100	unPP71721 (HC)	1.15 ± 0.10
72.035	2.060	unPP72020 (HC)	3.44 ± 0.13
72.735	2.060	unPP72720 (HC)	17.80 ± 0.59
74.732	1.920	unPP74719 (ke)	7.36 ± 0.71
75.032	1.900	unPP75019 (HC)	15.06 ± 0.61
75.332	1.920	unPP75319 (ke)	2.18 ± 0.19
75.633	1.960	unPP75620 (ke)	3.36 ± 0.80
76.134	2.020	unPP76120 (ke)	21.31 ± 0.94
77.936	2.160	unPP77922 (ke)	7.51 ± 0.41
78.236	2.180	unPP78221 (ke)	13.90 ± 0.59
78.537	2.200	unPP78622	3.01 ± 0.33
78.937	2.220	unPP78922	2.71 ± 0.26
79.539	2.340	unPP79523	24.35 ± 2.24
79.939	2.360	unPP79924 (ke)	6.25 ± 2.24
81.743	2.560	unPP81725	8.46 ± 0.34
82.143	2.600	unPP82126	14.73 ± 0.03
83.144	2.660	unPP83126	2.76 ± 0.20
83.947	2.840	unPP83928	28.99 ± 0.85
84.548	2.900	unPP84528	3.09 ± 0.03
87.153	3.200	unPP87232	7.52 ± 0.22
87.855	3.280	unPP87832	13.05 ± 0.08
89.256	3.340	unPP89433 (HC)	1.17 ± 0.02
90.661	3.660	unPP90636	29.93 ± 0.26
91.462	3.740	unPP91637 (ke)	2.05 ± 0.14
95.470	4.200	unPP95442	6.27 ± 0.01
96.572	4.340	unPP96543	9.23 ± 0.63
		Total	**1083.71**

Table S5. Compounds from PE pyrolysis at 600˚C analyzed by Py-GCxGC/MS. UnPExxxx are unidentified compounds.

Total RT (min)	**Second RT (sec)**	**Compound names**	**weight-normalized TIC Area (x10^7)**
3.722	1.300	Pentane (mix C5)	7.13 ± 1.50

4.223	1.380	Hexene	9.14 ± 0.22
4.724	1.460	1-Pentene, 2,4-dimethyl- (mix)	0.39 ± 0.08
4.825	1.520	2,4-Hexadiene	0.68 ± 0.06
4.929	1.740	Benzene	9.66 ± 2.23
5.326	1.540	1-Heptene	9.02 ± 0.33
6.330	1.780	2,4-Hexadiene, 2-methyl-	3.63 ± 0.38
7.128	1.700	unPE7117 (HC)	0.39 ± 0.00
7.338	2.260	Toluene	1.44 ± 0.13
7.428	1.660	unPE7416 (HC)	0.15 ± 0.02
7.628	1.660	unPE7616 (C7?)	0.66 ± 0.02
8.031	1.840	1,7-Octadiene	0.27 ± 0.06
8.330	1.780	1-Octene	4.87 ± 0.17
8.729	1.720	Octane	2.52 ± 0.09
10.532	1.920	2,4-Dimethyl-1-heptene	1.03 ± 0.53
11.343	2.580	Ethylbenzene	0.30 ± 0.03
12.633	2.000	1,8-Nonadiene	0.53 ± 0.02
12.848	2.880	1,3,5,7-Cyclooctatetraene	1.15 ± 0.14
13.131	1.880	1-Octene	3.89 ± 0.54
13.530	1.820	Nonane	1.66 ± 0.05
17.533	1.960	Nonane, 5-methylene-	0.34 ± 0.03
18.134	2.060	1,9-Decadiene	0.79 ± 0.13
18.533	1.980	1-Decene	6.83 ± 0.17
19.032	1.900	Decane	1.56 ± 0.07
22.562	3.680	Acetophenone	0.39 ± 0.06
23.435	2.060	1,10-Undecadiene	0.68 ± 0.20
23.933	1.960	1-Undecene	5.19 ± 0.24
24.332	1.880	Undecane	2.02 ± 0.11
25.954	3.200	Vinyl benzoate	17.00 ± 0.85
27.856	3.320	Benzoic acid, ethyl ester	0.32 ± 0.00
28.535	2.080	1,11-Dodecadiene	0.96 ± 0.18
28.934	2.000	1-Dodecene	4.11 ± 0.07
29.332	1.920	Dodecane	1.93 ± 0.09
29.358	3.460	Benzoic acid	65.76 ± 0.74
31.752	3.120	1-Propanone, 2-methyl-1-(2-methylphenyl)-	1.06 ± 0.04
33.055	3.260	Benzoic acid, 4-methyl-	1.15 ± 0.07
33.235	2.100	1,12-Tridecadiene	1.27 ± 0.02
33.634	2.020	1-Tridecene	3.99 ± 0.20
34.033	1.940	Tridecane	1.67 ± 0.09
36.151	3.060	Benzoic acid, 4-ethyl-, 4-cyanophenyl ester	0.94 ± 0.00
36.934	2.040	2-Butyl-1-decene	0.40 ± 0.03
36.954	3.240	1-Penten-3-one, 4-methyl-1-phenyl-	3.42 ± 0.00
37.163	3.760	Biphenyl	7.02 ± 1.32
37.635	2.060	1,13-Tetradecadiene	1.44 ± 0.08
38.035	2.060	1-Tetradecene	5.01 ± 0.30
38.158	3.480	4-Vinylbenzoic acid	1.82 ± 0.02

38.333	1.980	Tetradecane	1.69 ± 0.10
39.271	4.220	1,2-Ethanediol, monobenzoate	1.01 ± 0.01
40.762	3.720	Diethylene glycol dibenzoate	0.71 ± 0.01
41.836	2.140	Pentadecadiene	1.35 ± 0.13
41.961	3.660	1,1'-Biphenyl, 4-methyl-	0.90 ± 0.04
42.135	2.080	1-Pentadecene	4.58 ± 0.21
42.434	2.020	Pentadecane	1.84 ± 0.07
42.862	3.680	Ethanone, 1,1'-(1,4-phenylene)bis-	1.17 ± 0.14
43.868	4.060	Benzoic acid, 4-propyl-, 4-cyanophenyl ester	0.91 ± 0.01
44.954	3.240	unPE44932 (ox+)	14.04 ± 0.44
44.964	3.800	4-Acetylbenzoic acid	0.45 ± 0.02
45.368	4.080	Fluorene	0.44 ± 0.10
45.737	2.180	1,15-Hexadecadiene	1.84 ± 0.12
46.035	2.100	Hexadecene	4.28 ± 0.18
46.334	2.040	Hexadecane	1.78 ± 0.05
46.655	3.280	unPE46632 (ox)	0.74 ± 0.07
47.061	3.620	4-(vinyloxycarbonyl) benzoic acid	34.91 ± 0.37
47.374	4.440	Benzophenone	0.35 ± 0.01
49.537	2.200	Heptadecadiene	1.68 ± 0.00
49.736	2.140	1-Heptadecene	4.09 ± 0.12
50.035	2.080	Heptadecane	1.72 ± 0.07
50.166	3.920	Stilbene	0.30 ± 0.02
51.177	4.620	9H-Fluoren-9-one	0.63 ± 0.10
52.348	2.860	Terephthalic acid	6.49 ± 0.01
52.576	4.560	Anthracene	0.55 ± 0.16
53.037	2.200	Octadecadiene	1.80 ± 0.23
53.336	0.000	1-Octadecene	4.47 ± 0.19
53.535	2.060	Octadecane	1.62 ± 0.03
56.168	4.040	1,4-Benzenedicarboxylic acid, bis(2-hydroxyethyl) ester	0.75 ± 0.10
56.366	3.940	(1) [1,1'-Biphenyl]-2,2'-dicarboxaldehyde	2.55 ± 0.02
56.438	2.240	Nonadecadiene	2.15 ± 0.12
56.637	2.180	Nonadecene	4.01 ± 0.04
56.774	4.400	Biphenyl-4-carboxylic acid	2.13 ± 0.20
56.836	2.120	Nonadecane	1.72 ± 0.25
59.638	2.260	1,19-Eicosadiene	2.14 ± 0.24
59.837	2.200	Eicosene	3.94 ± 0.15
60.036	2.140	Eicosane	2.00 ± 0.22
62.738	2.280	Heneicosadiene	2.12 ± 0.17
62.938	2.240	Heneicosene	4.19 ± 0.17
63.137	2.180	Heneicosane	1.53 ± 0.07
64.681	4.860	1,2-Ethanediol, dibenzoate	9.65 ± 0.71
65.579	4.720	p-Terphenyl	1.16 ± 0.29
65.639	2.320	Docosadiene	2.40 ± 0.07
65.838	2.260	Docosene	4.32 ± 0.26

66.037	2.200	Docosane	1.63 ± 0.47
68.279	4.740	Ethanedione, (4-methylphenyl)phenyl-	0.78 ± 0.02
68.440	2.360	Tricosadiene	2.89 ± 0.57
68.639	2.300	Tricosene	3.61 ± 0.15
68.738	2.240	Tricosane	1.72 ± 0.02
71.140	2.360	Tetracosadiene	2.50 ± 0.23
71.338	2.260	Tetracosene	4.15 ± 0.65
71.437	2.200	Tetracosane	1.73 ± 0.40
71.574	4.420	Vinyl trans-cinnamate	1.51 ± 0.10
72.576	4.540	Benz[a]anthracene	0.35 ± 0.08
73.434	2.020	unPE73420 (mix C25)	8.49 ± 0.41
74.557	3.420	2-Azetidinone, 1-phenyl-	0.87 ± 0.06
75.033	1.940	unPE75019 (mix C26)	9.36 ± 1.04
75.253	3.140	unPE75231 (unknown)	11.75 ± 0.39
75.959	3.520	Benzoylacrylic acid (PE)	0.57 ± 0.02
76.435	2.100	unPE76421 (mix C27)	8.98 ± 0.73
77.938	2.260	unPE77922 (mix C28)	8.77 ± 0.42
79.539	2.340	unPE79624 (mix C29)	8.49 ± 0.44
81.545	2.680	unPE81526 (mix C30)	8.61 ± 0.55
81.809	0.520	(2) (1,1'-Biphenyl)-2,2'-dicarboxaldehyde	1.05 ± 0.09
83.297	5.840	unPE83258 (un)	2.29 ± 0.07
83.850	3.000	unPE83830 (mix HC)	7.98 ± 0.58
86.556	3.380	unPE86533 (mix HC)	7.42 ± 0.75
89.964	3.860	unPE89938 (mix HC)	6.37 ± 0.63
94.075	4.500	unPE94045 (mix HC)	5.58 ± 0.70
99.387	5.200	unPE99352 (mix HC)	3.66 ± 0.03
		Total	**459.85**

S4. PS and cellulose co-pyrolysis

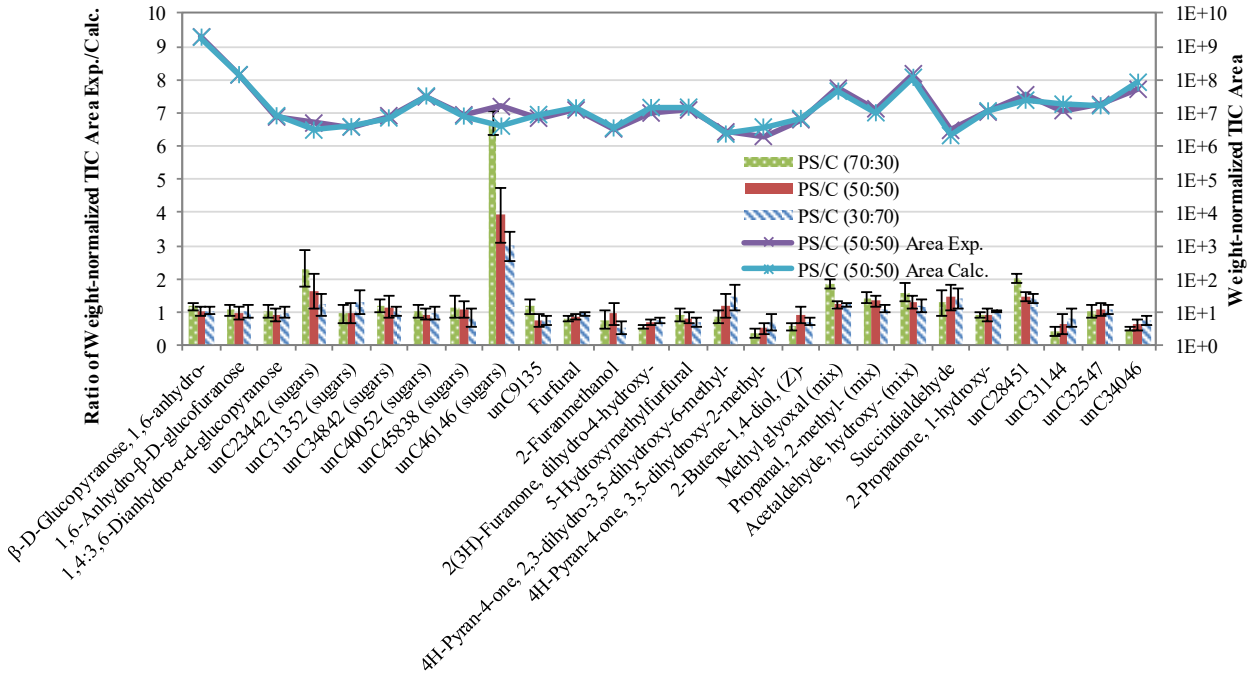

Figure S4. Weight-normalized TIC areas of some anhydrosugars, furans, pyrans, aldehydes and ketones from PS and cellulose co-pyrolysis at 600°C as well as theoretical areas calculated from single component experiments and their ratios.

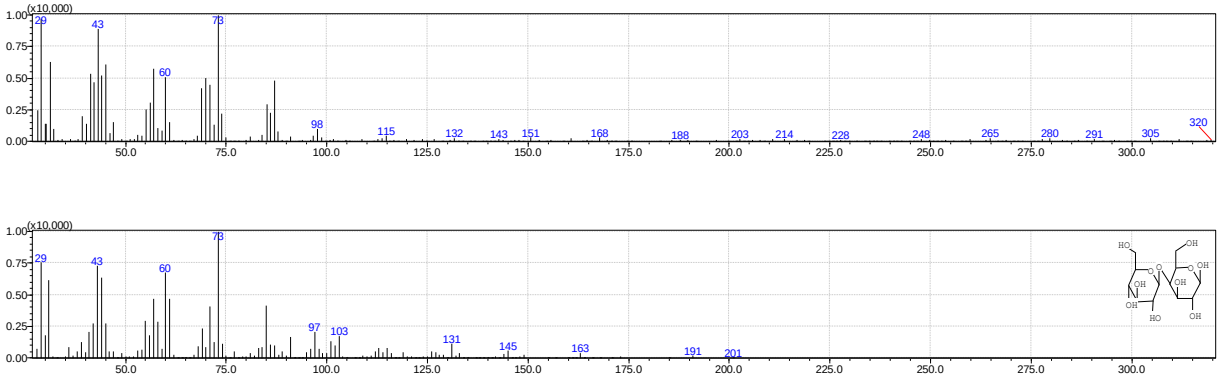

Figure S5. Mass spectrum of unknown "unC46146 (sugars)" (top) as compare to mass spectrum of β -D-Glucopyranose, 4-O-β-D-galactopyranosyl- (bottom).

S5. PP, PS and cellulose co-pyrolysis

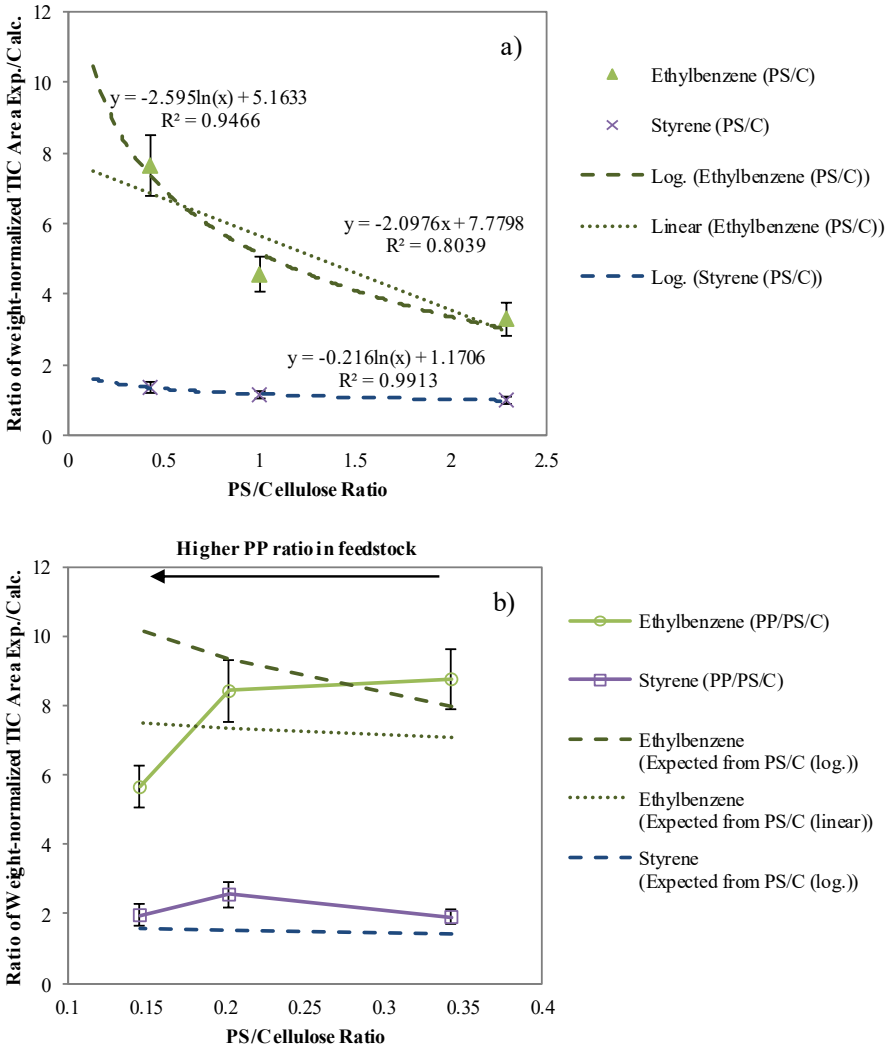

Figure S6. a) From PS and cellulose co-pyrolysis, the expected change in ethylbenzene and styrene were evaluated by curve fitting the area ratio, b) comparison between area ratios from PP/PS/Cellulose pyrolysis to the expected value from PS/Cellulose cases. It was found that PP does not affect hydrogen transfer reaction to produce ethylbenzene to a significant extent, as the experimentally obtained yields during PP/PS/Cellulose co-pyrolysis are in the same range as could be expected based on PS/Cellulose co-pyrolysis results. At a PS/Cellulose ratio of 0.15 in Figure S5b), less ethylbenzene than expected is produced. This might be due to mixing dilution effect that PS pyrolysis products have less chance of meeting cellulose pyrolysis products when there is large fraction of PP pyrolysis products present, thus leading to less interaction between PS and cellulose and less ethylbenzene produced.

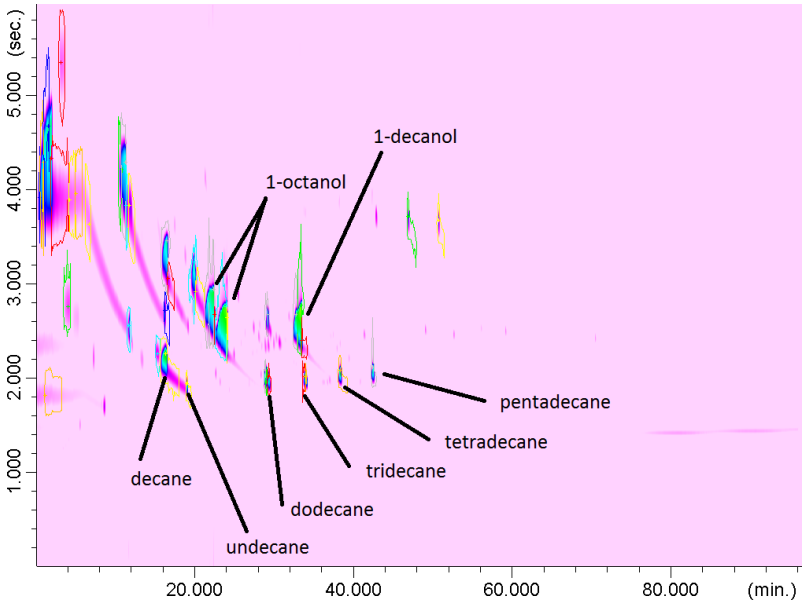

Figure S7. Py-GC×GC/MS system test for the ability to separate aliphatic alcohols and other hydrocarbons.

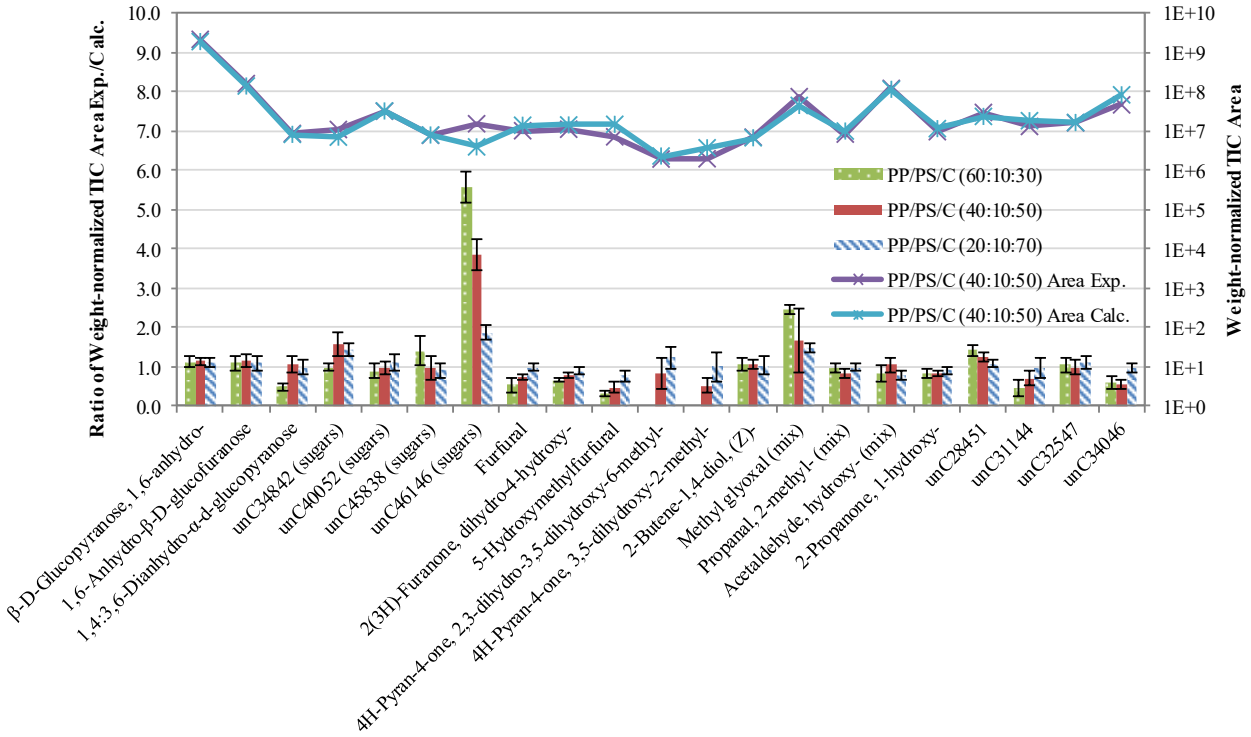

Figure S8. Weight-normalized TIC areas of some oxygenated compounds from PP, PS and cellulose co-pyrolysis at 600°C as well as theoretical areas calculated from single component experiments and their ratios.

S6. PE, PP, PS and cellulose co-pyrolysis

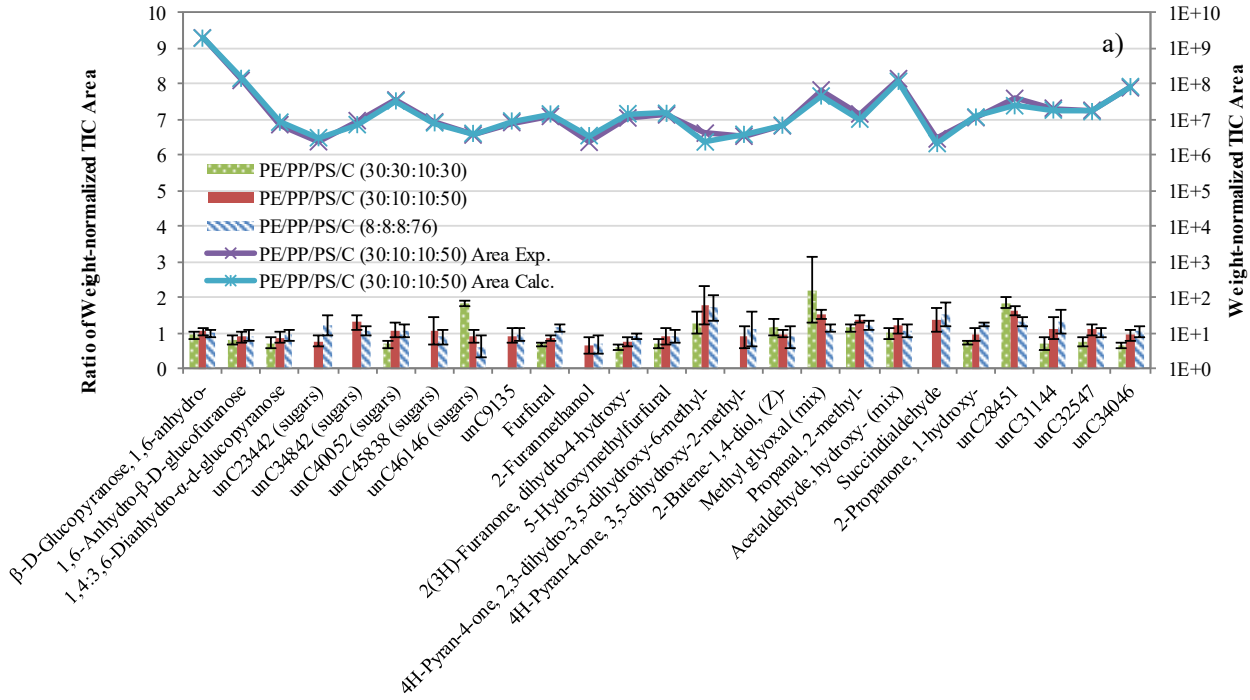

Figure S9. Ratios of Weight-normalized TIC areas of some cellulose-derived oxygenated compounds e.g. anhydrosugars, furans, pyrans, aldehydes from PE/PET, PP, PS and cellulose co-pyrolysis at 600°C.

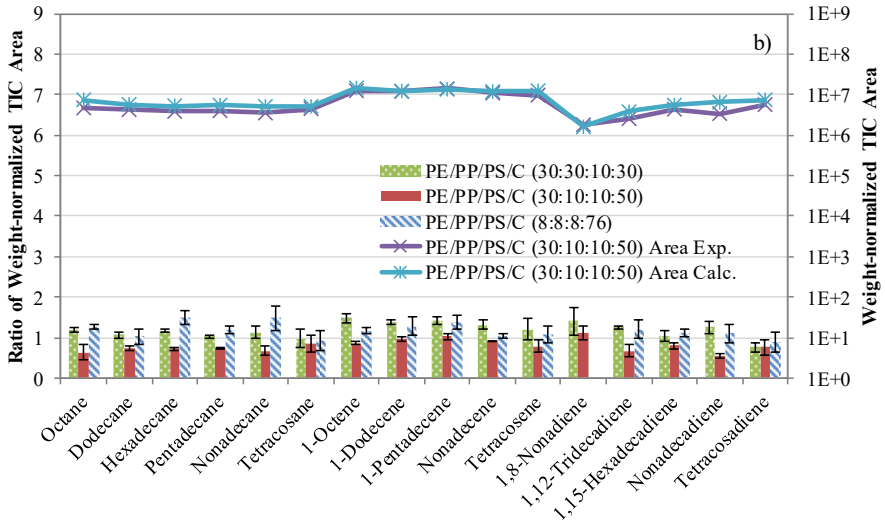

Figure S10. Ratios of Weight-normalized TIC areas of some aliphatic hydrocarbons derived from PE during PE/PET, PP, PS and cellulose co-pyrolysis at 600°C.

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(2) Chen, Z.; Hay, J. N.; Jenkins, M.J. *Euro. Polym. J.* **2012**, 48, 1589-1610.