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Supporting Information for

Boosting the Methanolysis of Polycarbonate by the Synergy between Ultrasounds Irradiation and Task Specific Ionic Liquids

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Set up of the experimental conditions by using ultrasonic probe

The optimization of the experimental conditions, when ultrasonic probe was used, was firstly performed by using commercially available [TBA][OH]•30 H_2O. The investigation was performed by irradiating 2g of PC were irradiated in a MeOH/THF (1:3, w/w) solvent mixture. In particular, using an output power of 50 W, at 30 °C, the reaction time was raised from 30 up to 120 minutes (Table S1) and the n_c/n_{ru} ratio was decreased from 1:6 down to 1:12 (entries 1,2 and 6, Table S9). Finally, we also performed the process using an output power of 60 W, as well as operating at 40 °C (entries 3-5, Table S9).

Analysis of data collected allowed to identify as optimal reaction conditions the ones set with a reaction time equal to 105 minutes, an output power amplitude of 50 W, a reaction temperature equal to 30 °C and a n_c/n_{ru} equal to 1:8. Indeed, the gradual increase in reaction time induced a parallel increase in conversions, that changed from 33 (30 min) up to 54% (105 min) (Table S1). Less significant changes were detected in the yields that ranged from 13 (30 min) up to 24% (105 min) (Table S1). The further increase in the sonication time did not change the above results. The above data testifies the ability of [TBA][OH]•30H_2O to induce the PC fragmentation in the oligomers, but an inadequate efficiency in the BPA obtainment.

Similar considerations can be drawn as far as the output power is taken in consideration (entries 4-6, Table S9). Indeed, the increase in the above parameter up to 60 W gave rise to a conversion equal to 60%, but without changing the yield. On the other hand, the increase in temperature from 30 up to 40 °C induced a decrease in the conversion down to 46% (entries 2-3, Table S9). Probably, this was a consequence of the increased vapor pressure of the solvent mixture that, producing vapor entering in the bubbles, disfavors cavitation process.[1] An analogous trend was detected both increasing or decreasing the n_c/n_{RU} (Table S9). On the whole, considerations in terms both materials and energy saving account for the suitability of the experimental conditions chosen.

Catalysts characterization

N-Butyl-N,N,N-triethylammonium phosphate [$bEt_3N]_3[PO_4]$

Pale yellow oil. Yield: 100% ^{1}H NMR (300 MHz, CD_3OD); δ= 3.31 (t, J = 6 Hz, 6H); 3.16 (m, 2H); 1.66 (m, 2H); 1.43 (sext, J = 6 Hz, 2H); 1.29 (m, 9H); 1.02 (t, J = 6 Hz, 3H) ppm.

Cholinium Glycinate [Ch][Gly]

Pale yellow oil. Yield: 100%. T_d: 175 °C.[2] ^{1}H NMR (300 MHz, D_2O); δ= 4.06 (m, 2H); 3.51 (m, 2H); 3.19 (s, 9H); 3.16 (s, 2H) ppm.

Cholinium Alaninate [Ch][Ala]

Orange oil. Yield: 95 % . T_d: 163 °C.[3] ^{1}H NMR (300 MHz; DMSO), δ: 3.85 (m, 2H); 3.43 (t, J = 6 Hz, 2H); 3.13 (s, 9H); 2.89 (s, 1H); 1.03 (d, J = 6 Hz, 3H) ppm.

Cholinium Imidazolate [Ch][Im]

Pale Yellow liquid. Yield: 98 %. T_d: 135 °C.[4] ^{1}H NMR (300 MHz; d_6-DMSO), δ: 7.12 (s, 1H), 6.69 (m, 2H), 3.85 (m, 2H); 3.27 (t, J = 6 Hz, 2H); 3.11 (s, 9H).

Cholinium Phosphate $[Ch]_3[PO_4]$

Light brown liquid. Yield: 100%. ^{1}H-NMR (300 MHz; CD_3OD), δ: 3.99 (m, 2H); 3.48 (m, 2H); 3.32 (s, 1H); 3.19 (s, 9H) ppm.

Cholinium Lysinate [Ch][Lys]

Yellow viscous oil. Yield: 100%. T_d: 165 °C.[3] ^{1}H-NMR (300 MHz; CD_3OD), δ: 3.99 (m, 2H); 3.48 (t, J = 6 Hz, 2H); 3.28 (m, 1H); 3.19 (s, 9H); 2.74 (t, J = 6 Hz, 2H); 1.53 (m, 6H) ppm.

Table S1. Conversion and yield values for the methanolysis of PC, under ultrasounds irradiation (50 W; 250 KHz), in the presence of [TBA][OH]·30H_2O (n_c/n_{ru} = 1:8), at 30 °C, at different irradiation times.

Entry	Irradiation time (min)	Conversion (%)	Yield (%)[a]
1	30	33	13
2	60	26	9
3	90	55	28
4	105	54	24
5	120	56	26

[a] Yields were reproducible within ± 3%.

Table S2. Conversion and yield values for the methanolysis of PC, under ultrasounds irradiation (50 W; 250 KHz), in the presence [Ch][X] catalysts, at 30 °C and for 105 min, at different n_c/n_{ru} ratios.

Entry	Catalyst	n_c/nr_u	Conversion (%)	Yield (%)[a]
1	[Ch][OH]	1:8	81	74
2	$[Ch]_3[PO_4]$	1:8	96	41
3	$[Ch]_3[PO_4]$	1:12	93	68
4	$[Ch]_3[PO_4]$	1:16	80	72

[a] Yields were reproducible within ± 3%.

Table S3. Conversion and yield values for the methanolysis of PC, under ultrasounds irradiation (50 W; 250 KHz), in the presence [Ch][X] catalysts, at 30 °C and for 105 min, at n_c/n_{ru} = 1:12.

Entry	Catalyst	Conversion (%)	Yield (%)[a]
1	[Ch][OH]	81	74
2	[Ch][Gly]	84	73
3	[Ch][Ala]	58	58
4	[Ch][Lys]	35	27
5	[Ch][Im]	83	78
6	$[Ch]_3[PO_4]$	93	68
7	$[bEt_3N]_3[PO_4]$	59	48

[a] Yields were reproducible within ± 3%.

Table S4. Hammett basicity functions (H_-) for different [Ch][X] catalysts, in MeOH solution and using *p*-nitrophenol as probe.

Entry	Catalyst	H_-
1	[Ch][Gly]	11.24
2	[Ch][Ala]	11.36
3	[Ch][Lys]	11.22
4	[Ch][Im]	11.48
5	[Ch][OH]	11.82
6	$[Ch]_3[PO_4]$	11.97

Table S5. *G'* and *G"* crossover points detected by rheology measurements for different PC samples.

Sample	*Crossover point (rad/s)*
Commercial PC	0.0158
[Ch][Im] treated PC	0.1
[Ch][OH] treated PC	------
[TBA][OH].30H_2O treated PC	0.63

Table S6. Conversion and yield values for the alcoholysis of PC, under ultrasounds irradiation (50 W; 250 KHz), in the presence [Ch][Im], at 30 °C and for 105 min, at n_c/n_{ru} = 1:12, as a function of the different nature of the alcohol.

Entry	Alcohol	Conversion (%)	Yield (%)[a]
1	MeOH	83	78
2	EtOH	63	65
3	PrOH	71	60
4	BuOH	43	32

[a] Yields were reproducible within ± 3%.

Table S7. Conversion and yield values for the methanolysis of PC, under ultrasounds irradiation (50 W; 250 KHz), in the presence $[Ch]_3[PO_4]$ at 30 °C and for 105 min, at n_c/n_{ru} = 1:12, for different cycles of catalyst reusing.

Cycle	Conversion (%)	Yield (%)[a]
1	93	68
2	86	68
3	87	68
4	86	68
5	86	69
6	74	57

[a] Yields were reproducible within ± 3%.

Table S8. Conversion and yield values for the methanolysis of PC, under ultrasounds irradiation (50 W; 250 KHz), in the presence $[Ch]_3[PO_4]$ or [Ch][Im], at 30 °C and for 105 min, at n_c/n_{ru} = 1:12, for different PC samples.

Sample	Conversion (%) $[Ch]_3[PO_4]$	Yield (%)[a] $[Ch]_3[PO_4]$	Conversion (%) [Ch][Im]	Yield (%)[a] [Ch][Im]
Commercial PC	93	68	83	78
PC sheet	80	70	94	63
PC Compact Disk	96	70	91	67

Table S9. Conversion and yield values for the methanolysis of PC, under ultrasounds irradiation (250 KHz), in the presence of [TBA][OH]·30H_2O, at 30 °C and for 105 min, at different n_c/n_{ru} ratios.

Entry	T (°C)	P (W)	n_c/n_{ru}	Conversion (%)	Yield (%)[a]
1	30	50	1:6	46	20
2	30	50	1:8	54	24
3	40	50	1:8	46	24
4	30	40	1:8	38	19
5	30	60	1:8	60	27
6	30	50	1:12	46	25

[a] Yields were reproducible within ± 3%.

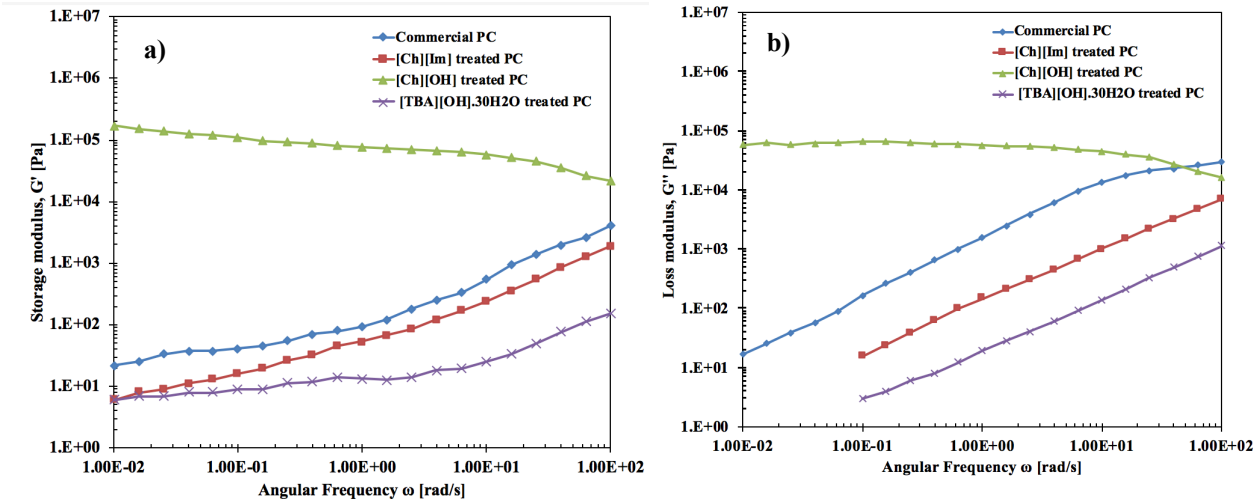


Figure S1. a) Storage, *G'* and **b)** loss, *G''* moduli of all investigated samples.

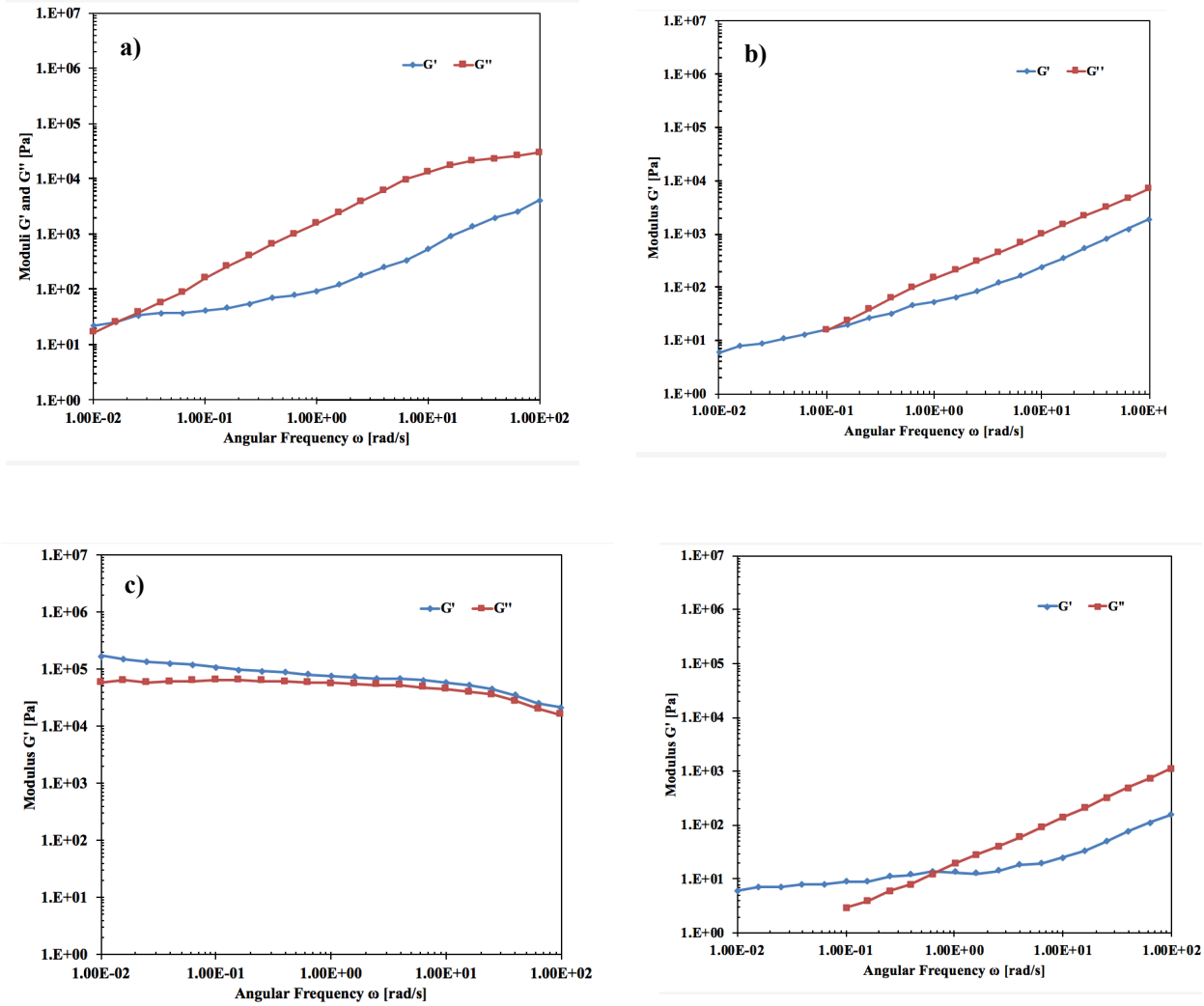


Figure S2. Storage, *G'* and loss *G''* moduli for: **a)** commercial PC; **b)** [Ch][Im] treated PC; **c)** [Ch][OH] treated PC**; d)** [TBA][OH]·30H_2O treated PC.

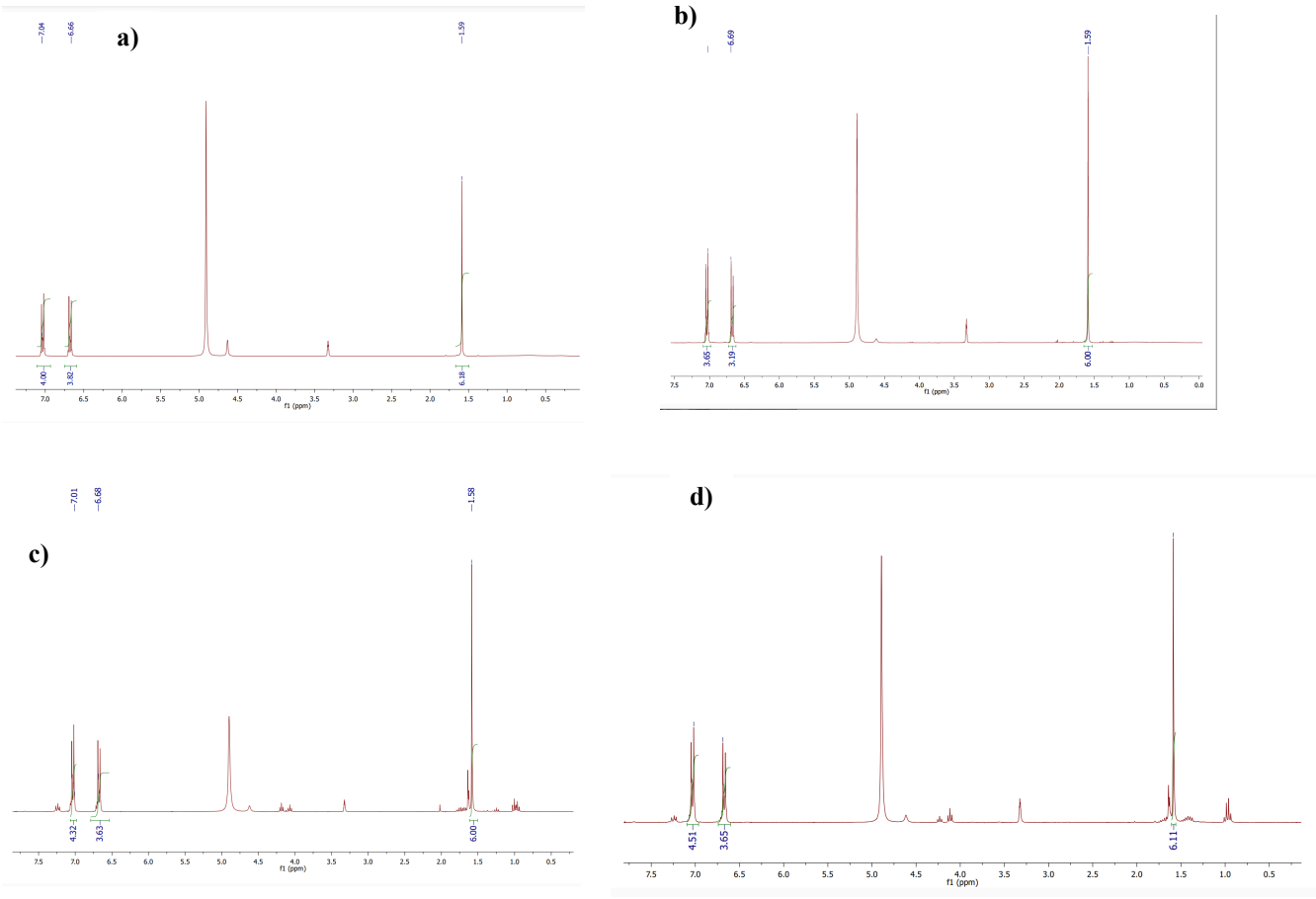
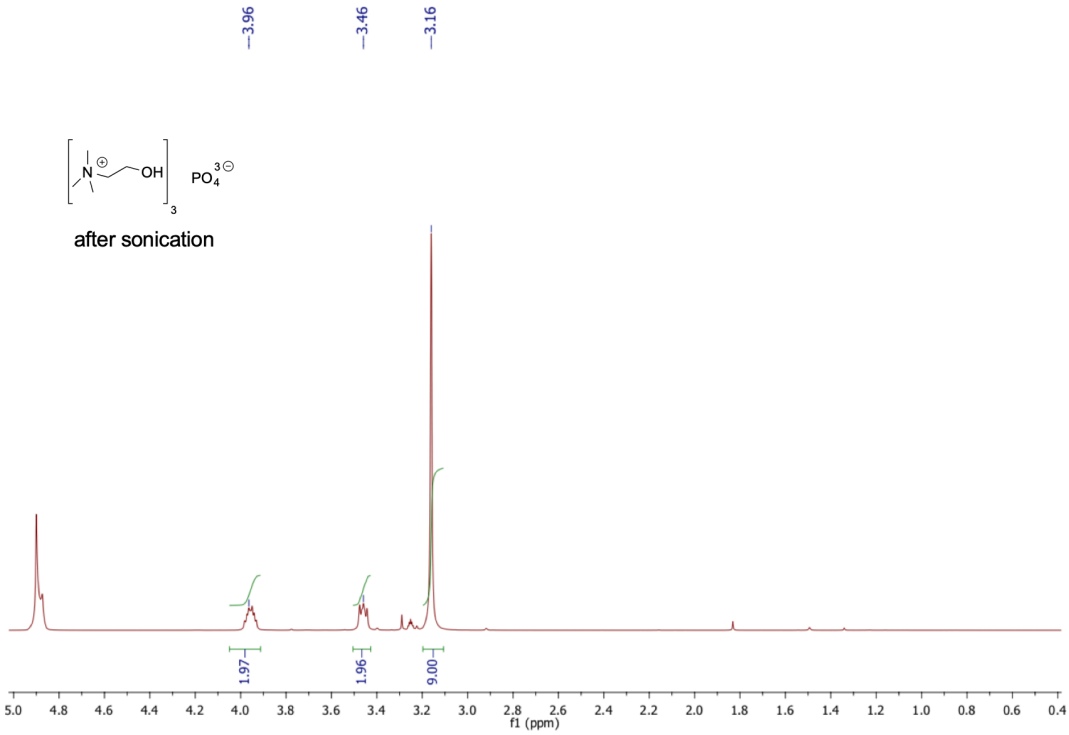
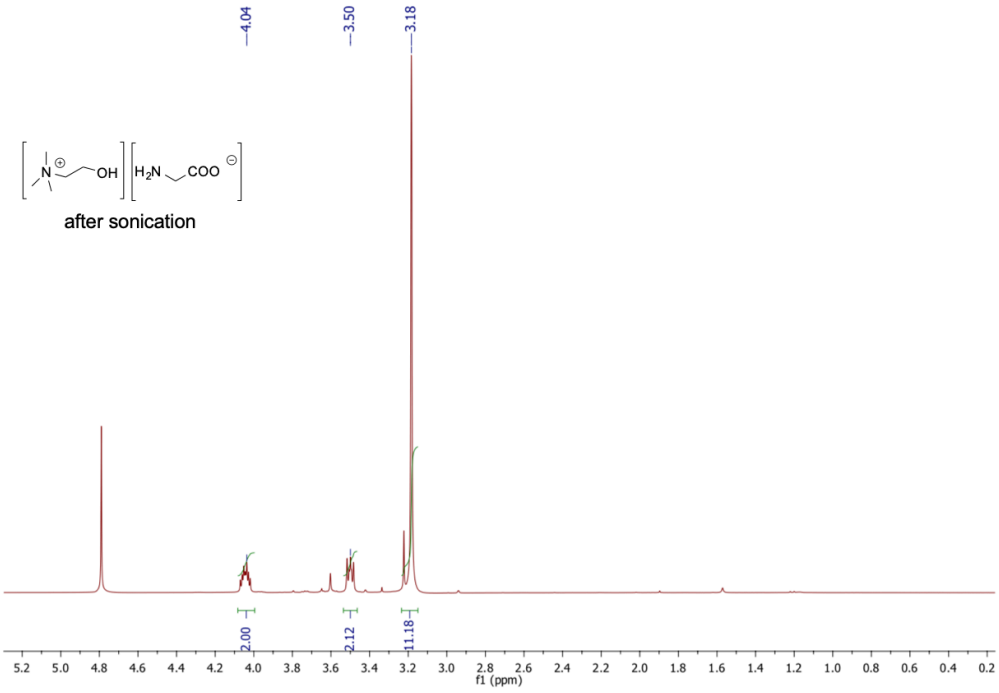


Figure S3. ^{1}H NMR in CD_3OD obtained for BPA from: **a)** methanolysis; **b)** ethanolysis; **c)** propanolysis and **d)** butanolysis.





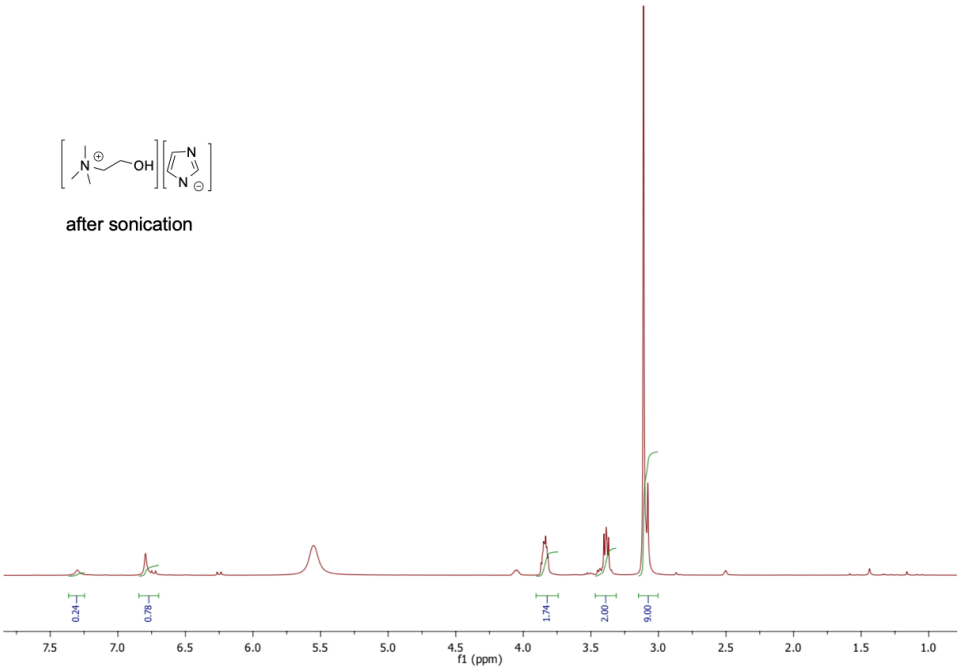


Figure S4. ^{1}H NMR spectrum of $[Ch]_3[PO_4]$, [Ch][Gly] and [Ch][Im] after sonication.

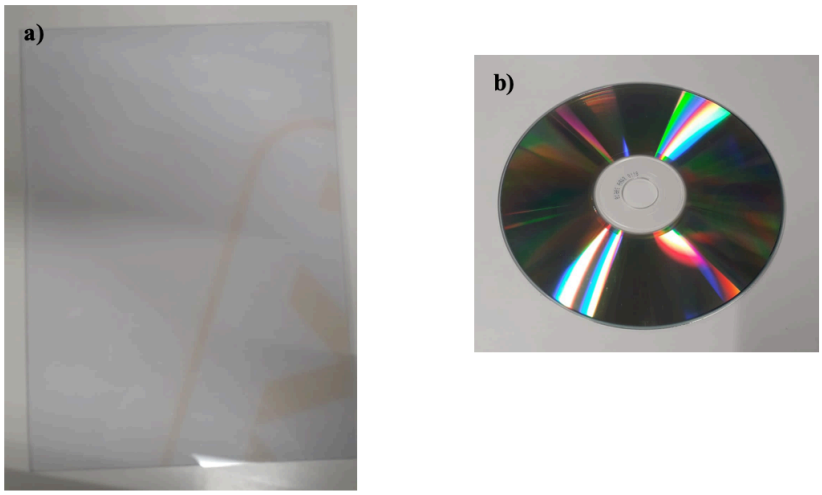


Figure S5. Picture of: a) PC sheet; b) PC digital CD.

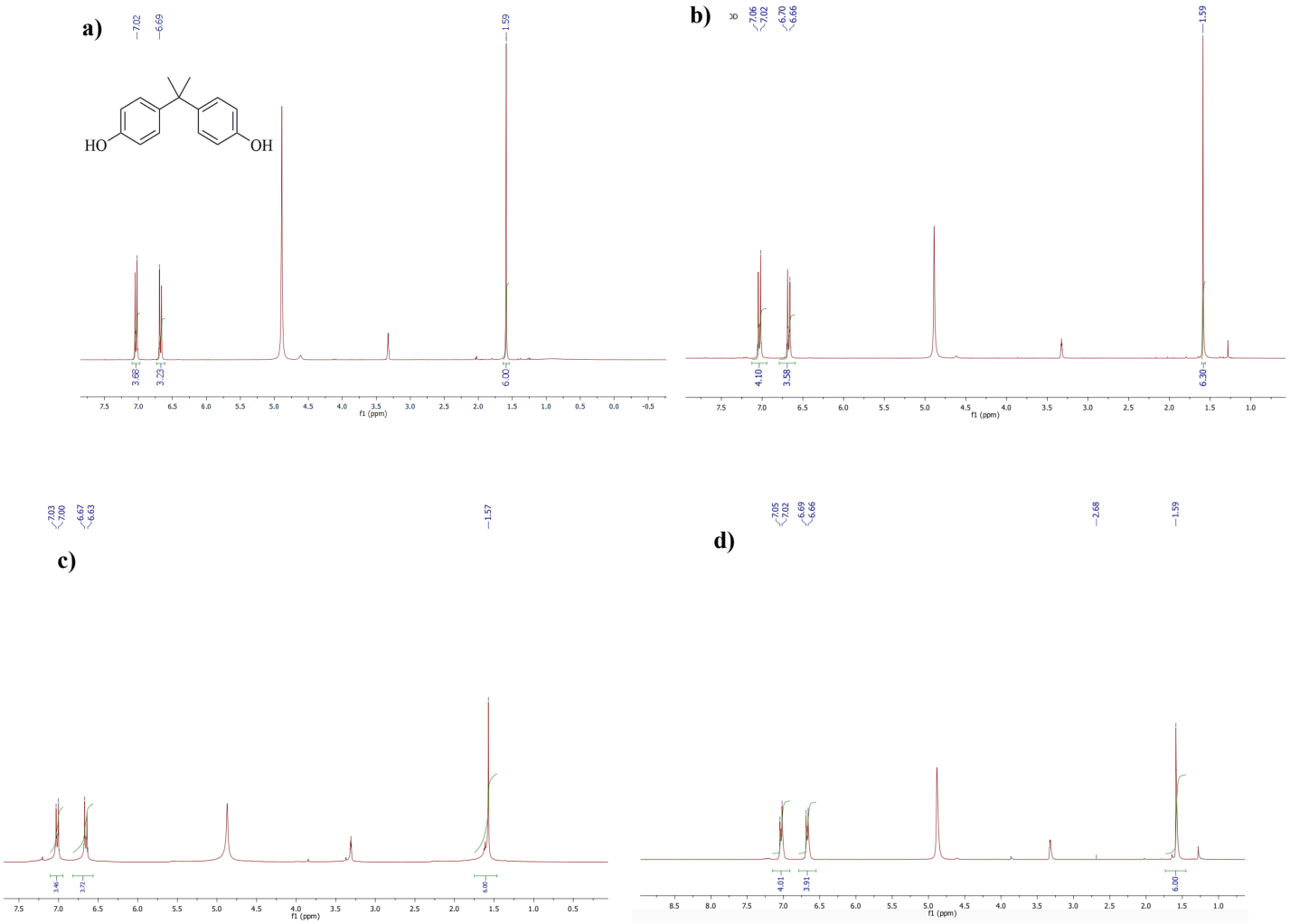
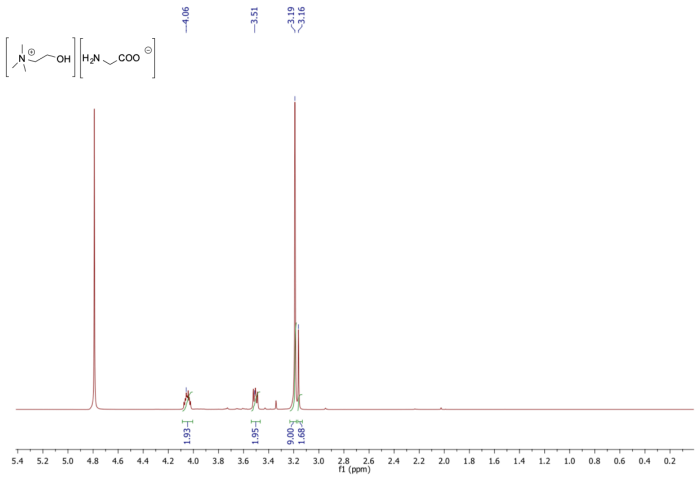


Figure S6. ^{1}H NMR in CD_3OD obtained for BPA from methanolysis of: **a)** PC sheet in the presence of $[Ch]_3[PO_4]$; **b)** PC digital CD in the presence of $[Ch]_3[PO_4]$; **c)** PC sheet in the presence of [Ch][Im]; **d)** PC digital CD in the presence of [Ch][Im].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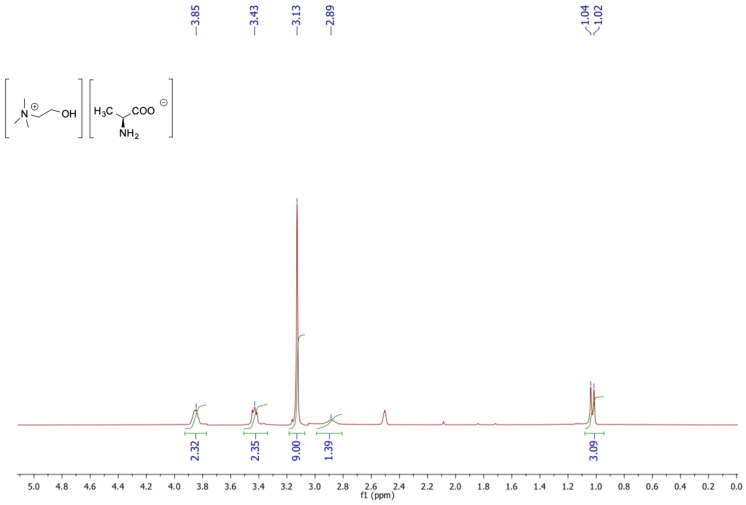
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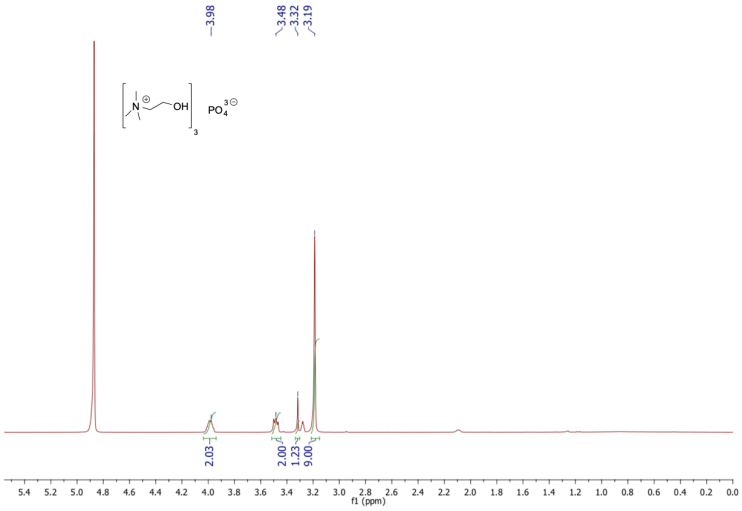
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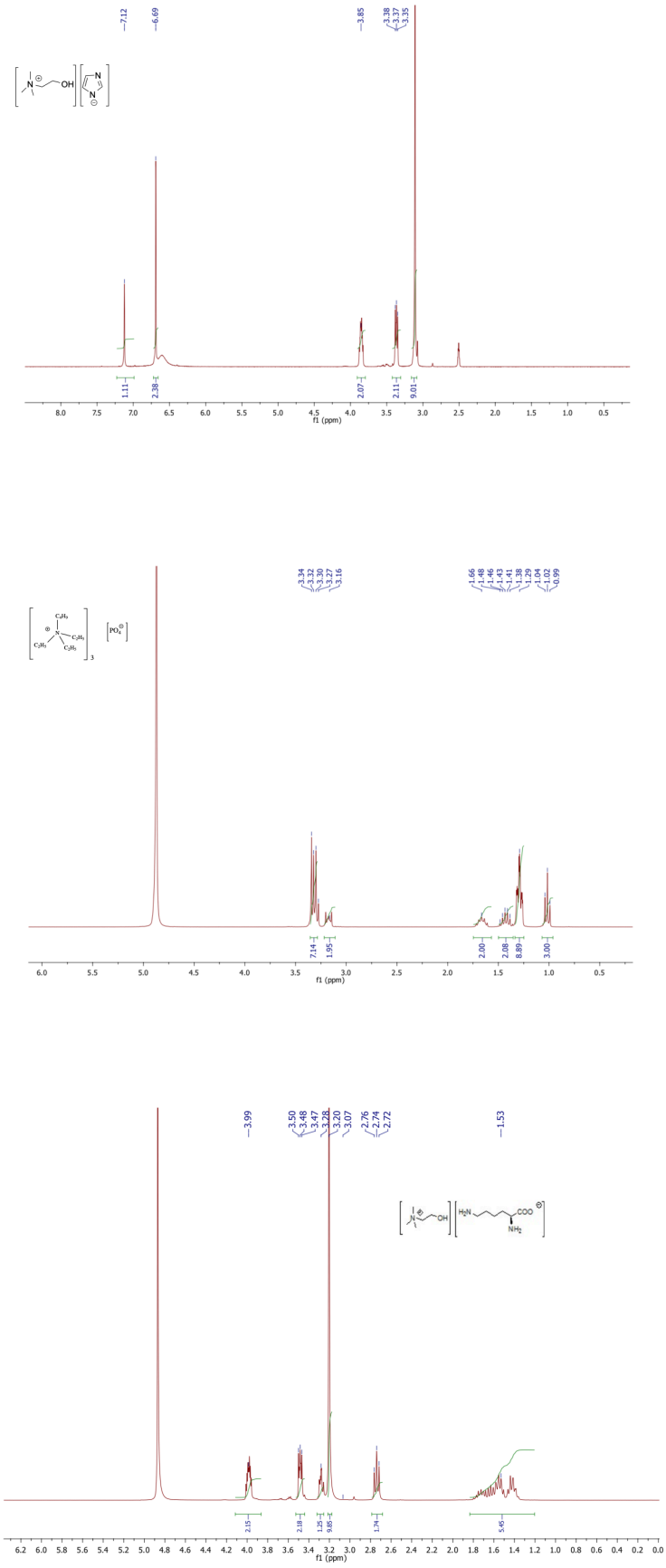

Figure S7. ^{1}H NMR spectra of the IL catalysts.

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