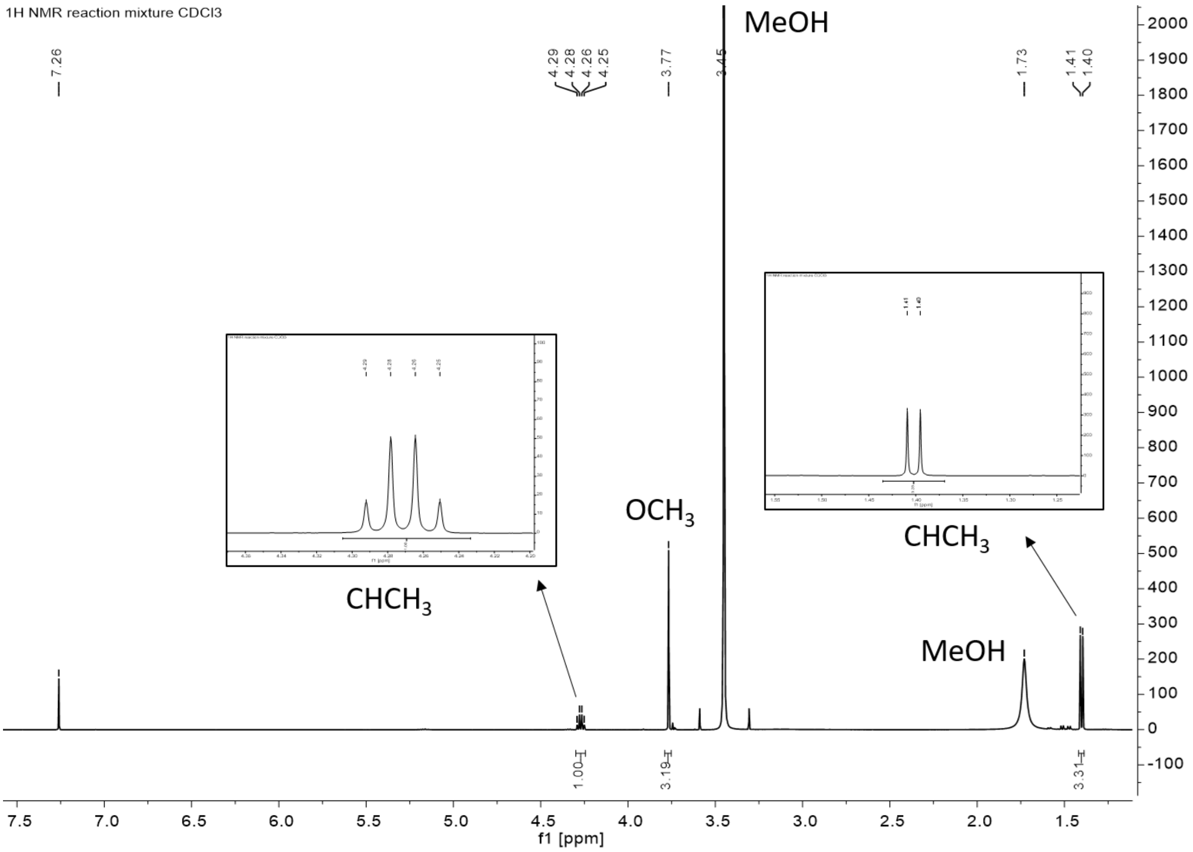
General: All chemicals were used as received without further manipulations. ^{1}H and $^{13}C\{^{1}H\}$ NMR spectra were recorded on a *Fourier 300 MHz* (^{1}H: 300 MHz, ^{13}C: 75 MHz), *Avance I-400* (^{1}H: 400 MHz, ^{13}C: 101 MHz) or *Avance I 500* (^{1}H: 500 MHz, ^{13}C: 126 MHz) by Bruker, using the proton signals of the deuterated solvents as reference or external standards. Mass spectrometry was performed using a *Thermo ISQ LT EI* by Thermo Fisher Scientific. For microwave heating experiments a Microwave Synthesis Reactor Monowave 400 (Anton Paar GmbH) was used. For scale-up experiments a CEM Mars 6 microwave reactor was used. GC-MS was measured with Agilent Technologies 5977B GC/MSD. SEC analysis was performed using a “mixed bed” linear SEC-column (5 µm porous styrene-divinylbenzene particles, separation range 200-1000k g/mol) at a flow rate of 1 mL/min in tetrahydrofuran as eluent. Molecular weights refer to a so-called relative calibration based on narrow polystyrene samples supplied by Agilent Technologies. The SEC system was equipped with a Shimadzu LC-10ATvP pump, an AS1000 autosampler from Thermo Separation Products and a RI2012 refractive index detector from Schambeck SFD GmbH. The scale-up reaction was performed in a Parr autoclave (model: 4774).

General procedure for the depolymerization of polylactide (1a) (optimization of the reaction conditions): A mixture of polylactide (**1a**, transparent plastic cup from Prodana GmbH) (583.2 mg, 8.1 mmol based on the repeating unit), methanol (1.5-6.0 g, 47.0-187.1 mmol, 5.8-23.1 equiv. based on the repeating unit of **1a**) and catalytic amounts of $Sn(Oct)_2$ (0-0.25 mol%, 0-0.0203 mmol based on the repeating unit of **1a**) were placed with a stir bar in a vial. In case of <15.4 equiv. of methanol THF was added as solvent (3.0 g). The vial was sealed and subjected to a Microwave Synthesis Reactor Monowave 400. The reaction was performed for 1-20 minutes (hold time) at 100-180 °C and with a stirring of 600 rpm. The reaction temperature was reached within 1-2 minutes (heat as fast as possible). Afterwards the vial was cooled to room temperature. An aliquot of the clear solution was transferred to a NMR tube and was dissolved in $CDCl_3$ (0.5 mL). The sample was subjected to ^{1}H NMR to determine the yield of methyl lactate (**2**) [The yield of **2** was calculated on the basis of the C*H* function of **2** and the leftover signals of the C*H* function of the polymer/oligomers].

Methyl lactate[1] (**2**): ^{1}H NMR (500 MHz, $CDCl_3$, 25 °C): $\delta = 4.26$ (q, $J = 6.91$ Hz, 1H, CH_3CH), 3.77 (s, 3H, CH_3O-), 1.40 (d, $J = 6.91$ Hz, 3H, CH_3CH-) ppm.

Figure S1. Spectrum of a reaction mixture (0.25 mol% $Sn(Oct)_2$, 23.4 equiv. MeOH, 160 °C, 10 min) (^1H NMR (500 MHz, $CDCl_3$, 25 °C)).



General procedure for the depolymerization of polylactide (1): A polylactide-good (**1**) (583.2 mg, 8.1 mmol based on the repeating unit, for simplification we insinuate that the PLA-product is composed of 100% of PLA), methanol (6.0 g, 187.2 mmol, 23.1 equiv. based on the repeating unit of **1**), and catalytic amounts of $Sn(Oct)_2$ (0.25 mol%, 0.0203 mmol based on the repeating unit of **1**) were placed with a stirring bar in a vial. The vial was sealed and subjected to a Microwave Synthesis Reactor Monowave 400. The reaction was performed for 10 minutes (hold time) at 160 °C and stirring with 600 rpm. The reaction temperature was reached within 1-2 minutes (heat as fast as possible). Afterwards the vial was cooled to room temperature. The reaction mixture was transferred into a 50 mL flask. The flask was attached to distillation equipment. The receiving flask (50 mL) was cooled with liquid nitrogen. The volatile compounds (methanol, methyl lactate) were removed in vacuum and were collected in the receiving flask. Afterwards the receiving flask was attached to a rotary evaporator and the methanol was carefully removed in vacuum. The amount of the liquid residue was determined and an aliquot was transferred to a NMR tube and was dissolved in $CDCl_3$ (0.5 mL). The mass of isolated **2** was related to the mass of the starting

PLA-product. The amount of substance of **2** was related to the amount of substance of the starting PLA-product insinuating that the PLA-product is composed of 100% of PLA.

The NMR spectra are in accordance to the NMR spectra obtained for depolymerization of **1a** (*vide supra*).

Methyl lactate (**2**): ^{1}H NMR (400 MHz, $CDCl_3$, 25 °C): δ = 4.27 (dq, *J* = 6.91 Hz, *J* = 5.20 Hz 1H, CH_3CH-), 3.77 (s, 3H, CH_3O-), 2.83 (d, *J* = 5.20 Hz, 1H, -CHO*H*), 1.40 (d, *J* = 6.91 Hz, 3H, CH_3CH-) ppm. $^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$, 25 °C): δ = 176.1, 66.7, 52.6, 20.4 ppm.

Figure S2. Spectrum of **2** (^{1}H NMR (400 MHz, $CDCl_3$, 25 °C)).

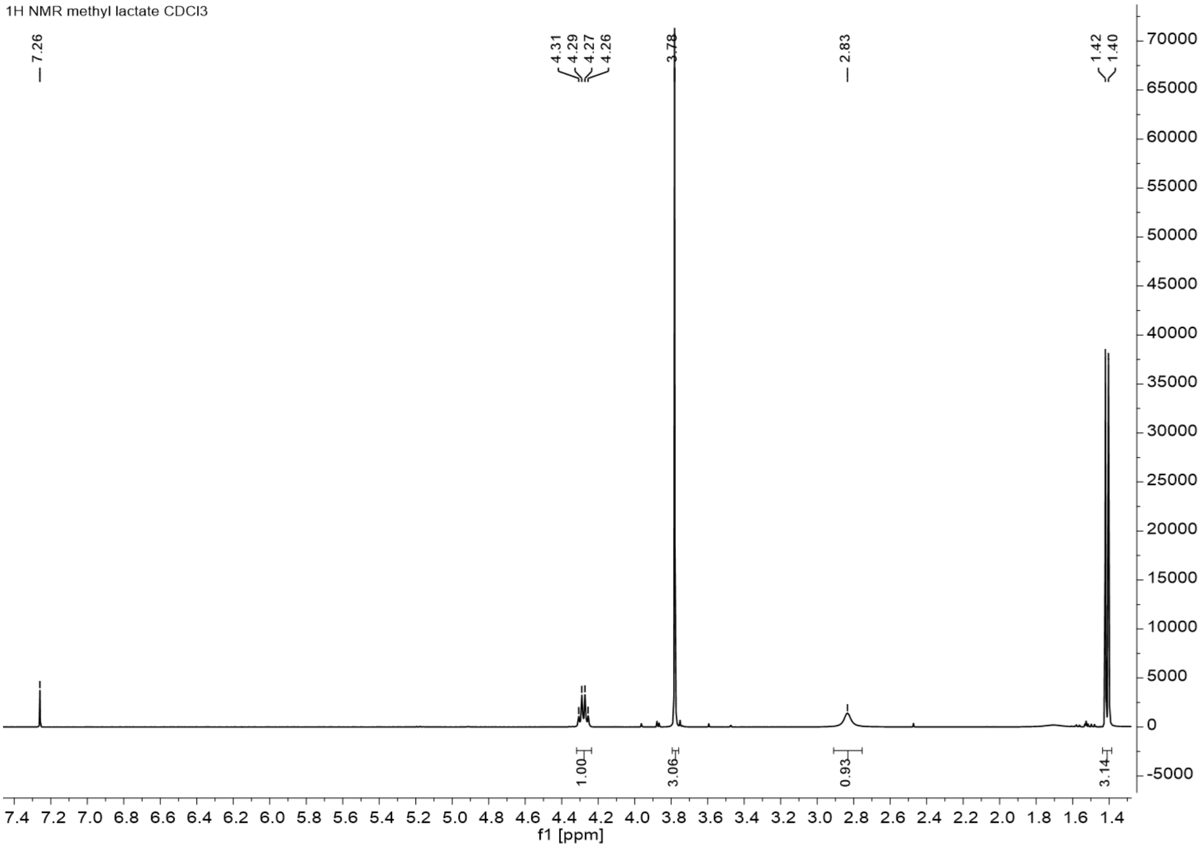


Figure S3. Spectrum of **2** ($^{13}C\{^1H\}$ NMR (101 MHz, $CDCl_3$, 25 °C)).

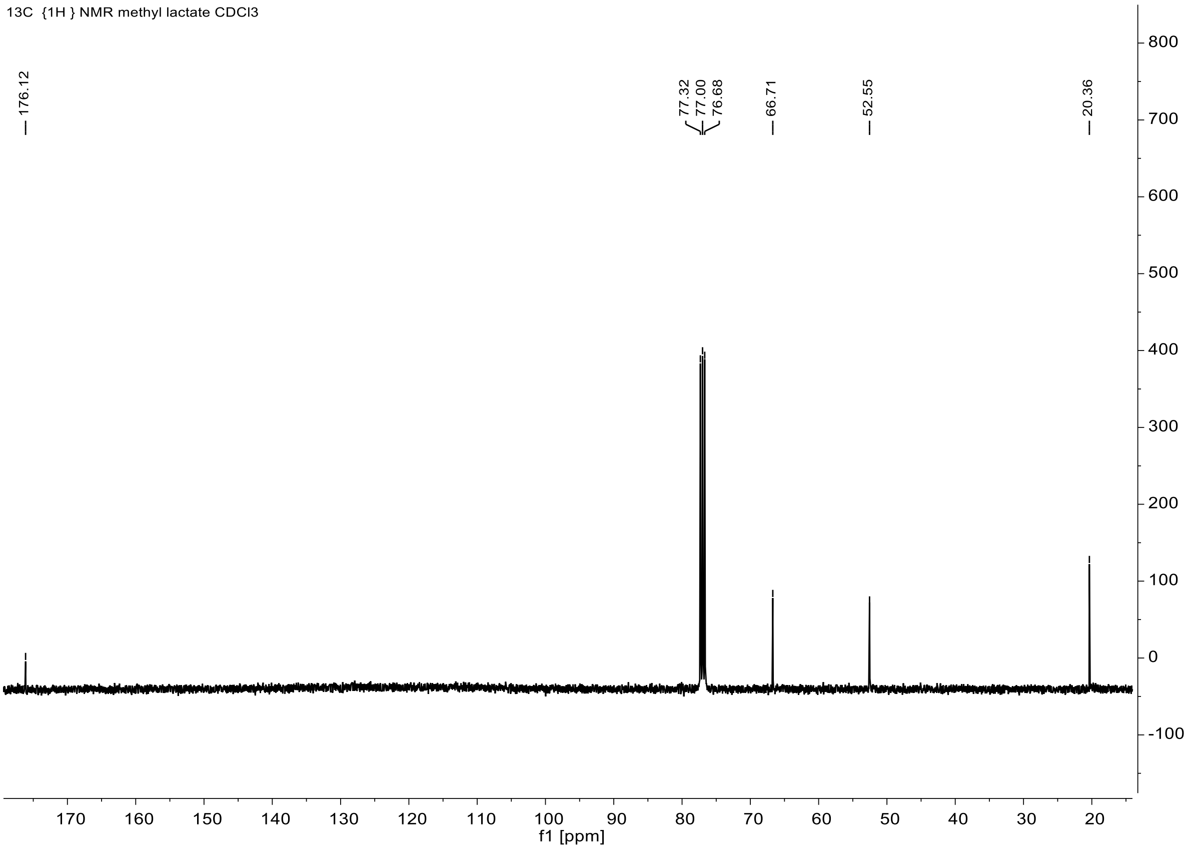


Figure S4. GC-MS spectrum of **2**.

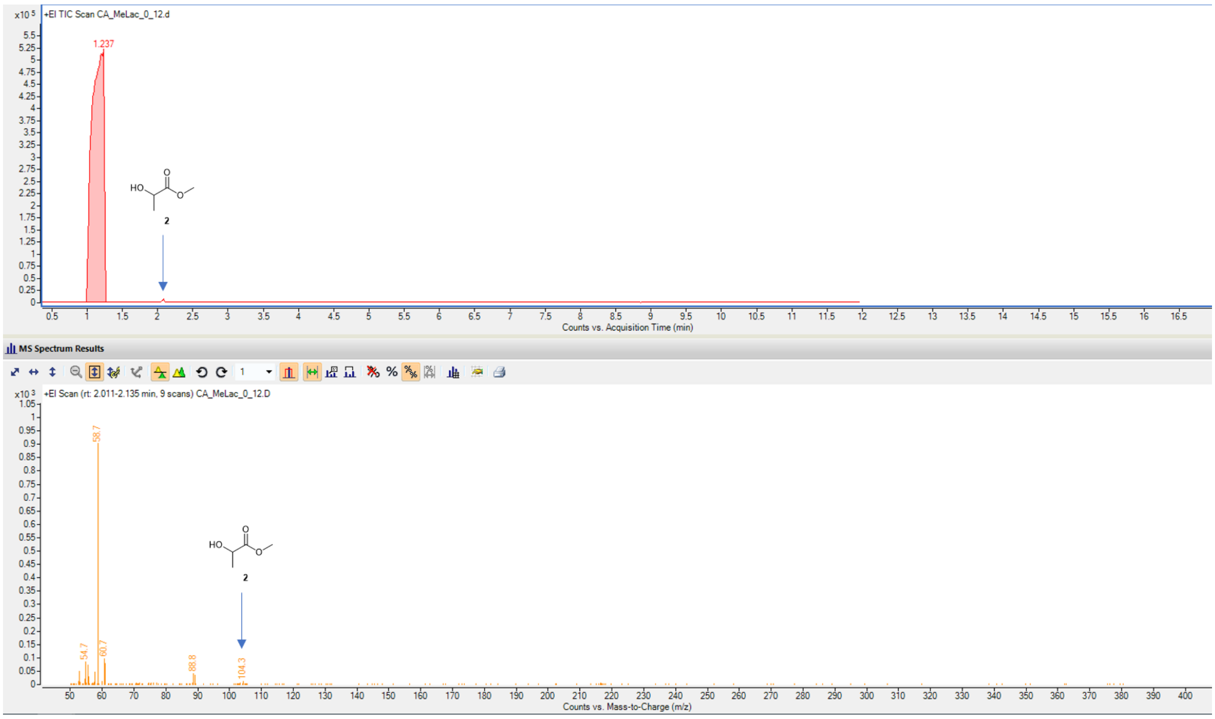
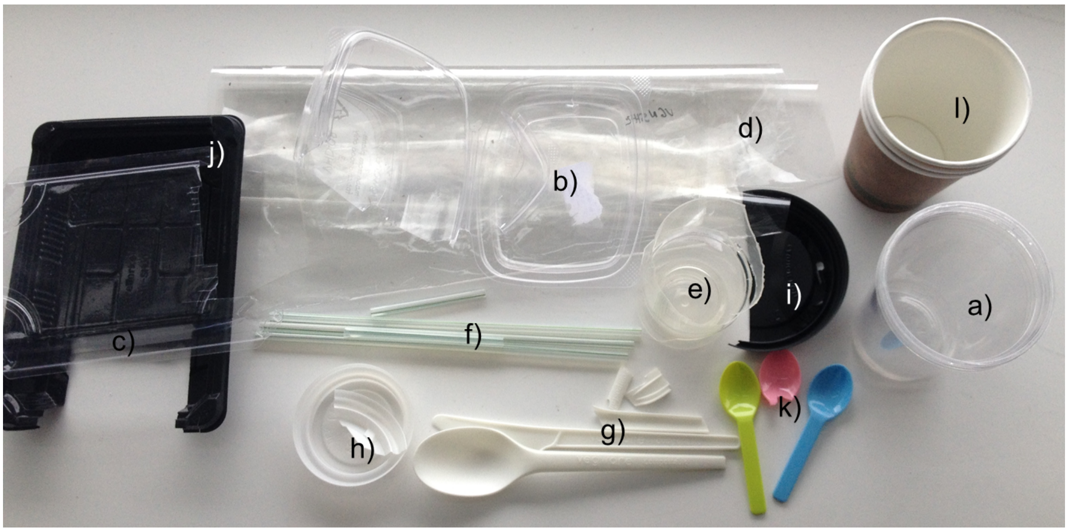


Table S1. Polylactide products (the PLA-products were obtained from Prodana GmbH and were used as received).



Entry	PLA-Product	Item number
1	transparent plastic cup (**1a**)	Huhtamaki
2	transparent disposable food box (**1b**)	VHD08-Mu
3	transparent cover of a disposable Sushi box (**1c**)	VSU02-Mu
4	transparent plastic sheet (**1d**)	VGNSH2-Mu
5	transparent bottle (**1e**)	NAFL250-Mu
6	drinking straw with green strips (**1f**)	VSS05GS-Mu
7	disposable fork with talcum powder (**1g**)	VWKFSWN-Mu
8	lid for espresso mugs with talcum powder (~20-30%) (**1h**)	VLID62A1-Mu
9	black lid for coffee mugs (**1i**)	VLID89SB-Mu
10	black base of a disposable Sushi box (**1j**)	VSU02-Mu
11	pink ice cream spoon (**1k**)	VSP3C-Mu
12	coffee mug with PLA coating on the inside (**1l**)	VKV08-Mu

Table S2. Appearance after depolymerzation reaction.

Entry	Product
1	transparent plastic cup (**1a**) (M_n = 57500 g/mol, M_w = 240800 g/mol, D = 4.2)
2	transparent disposable food box (**1b**) (M_n = 43600 g/mol, M_w = 236000 g/mol, D = 5.4)
3	transparent cover of a disposable Sushi box (**1c**) (M_n = 54700 g/mol, M_w = 212700 g/mol, D = 3.9)
4	transparent plastic sheet (**1d**) (M_n = 150400 g/mol, M_w = 262000 g/mol, D = 1.7)
5	transparent bottle (**1e**) (M_n = 99100 g/mol, M_w = 254900 g/mol, D = 2.6)
6	drinking straw with green strips (**1f**) (M_n = 112100 g/mol, M_w = 239900 g/mol, D = 2.1)
7	disposable fork with talcum powder (**1g**) (M_n = 59000 g/mol, M_w = 124100 g/mol, D = 2.1)
8	lid for espresso mugs with talcum powder (~20-30%) (**1h**) (M_n = 56100 g/mol, M_w = 177500 g/mol, D = 3.2)
9	black lid for coffee mugs (**1i**) (M_n = 75400 g/mol, M_w = 241100 g/mol, D = 3.2)
10	black base of a disposable Sushi box (**1j**) (M_n = 80300 g/mol, M_w = 148400 g/mol, D = 1.8)
11	pink ice cream spoon (**1k**) (M_n = 57600 g/mol, M_w = 133000 g/mol, D = 2.3)
12	coffee mug with PLA coating on the inside (**1l**) (M_n = 86400 g/mol, M_w = 221000 g/mol, D = 2.6)

Table S3. Appearance after depolymerzation reaction.

Entry	PLA-Product	Appearance
1	transparent plastic cup (**1a**)	Clear colorless solution
2	transparent disposable food box (**1b**)	Clear colorless solution
3	transparent cover of a disposable Sushi box (**1c**)	Clear colorless solution
4	transparent plastic sheet (**1d**)	Clear colorless solution
5	transparent bottle (**1e**)	Clear colorless solution
6	drinking straw with green strips (**1f**)	Green solution with precipitate
7	disposable fork with talcum powder (**1g**)	Clear colorless solution with colorless precipitate
8	lid for espresso mugs with talcum powder (~20-30%) (**1h**)	Colorless solution with colorless precipitate
9	black lid for coffee mugs (**1i**)	Clear colorless solution with black precipitate
10	black base of a disposable Sushi box (**1j**)	Clear colorless solution with black precipitate
11	pink ice cream spoon (**1k**)	Clear colorless solution with pink precipitate
12	coffee mug with PLA coating on the inside (**1l**)	Clear yellow solution and pieces of paper (shape unchanged). The inside surface of the pieces of paper changed from plain (before depolymerization) to rough (after depolymerization)

Table S4. Appearance after depolymerzation reaction – used PLA-products.

Entry	PLA-Product	Appearance
1	Yellow ice cream spoon (**1e**). Used for stirring a mixture of coffee, sugar and milk. The PLA-product was not cleaned before depolymerization.	Clear colorless solution with yellow precipitate
2	Black lid for coffee mugs (**1f**). Used with coffee, milk and sugar. The PLA-product was not cleaned before depolymerization.	Clear colorless solution with black precipitate

Procedure for the depolymerization of polylactide (1m) – scale-up (autoclave): Used PLA-cups were washed with water and dried in air. PLA cups (**1m**, NatureWorks) (5.832 g, 81 mmol based on the repeating unit, for simplification we insinuate that the PLA-product is composed of 100% of PLA), methanol (40 g, 1.2 mol, 15.4 equiv. based on the repeating unit of **1**), and catalytic amounts of $Sn(Oct)_2$ (0.25 mol%, 0.203 mmol based on the repeating unit of **1**) were placed with a stirring bar in an autoclave. The autoclave was sealed and heated to 140 °C (a pressure of 18.1 bar was noticed). The temperature was hold for 2 hours, while stirring the solution. Afterwards the vial was cooled to room temperature. The reaction mixture (clear solution) was transferred into a 250 mL flask. The flask was attached to distillation equipment. The receiving flask (100 mL) was cooled with liquid nitrogen. The volatile compounds (methanol, methyl lactate) were removed in vacuum and were collected in the receiving flask. Afterwards the receiving flask was attached to a rotary evaporator and the methanol was carefully removed in vacuum. The amount of the liquid residue was determined and an aliquot was transferred to a NMR tube and was dissolved in $CDCl_3$ (0.5 mL). The mass of isolated **2** was related to the mass of the starting PLA-product. The amount of substance of **2** was related to the amount of substance of the starting PLA-product insinuating that the PLA-product is composed of 100% of PLA.

The NMR spectra are in accordance to the NMR spectra obtained for depolymerization of **1a** (*vide supra*).

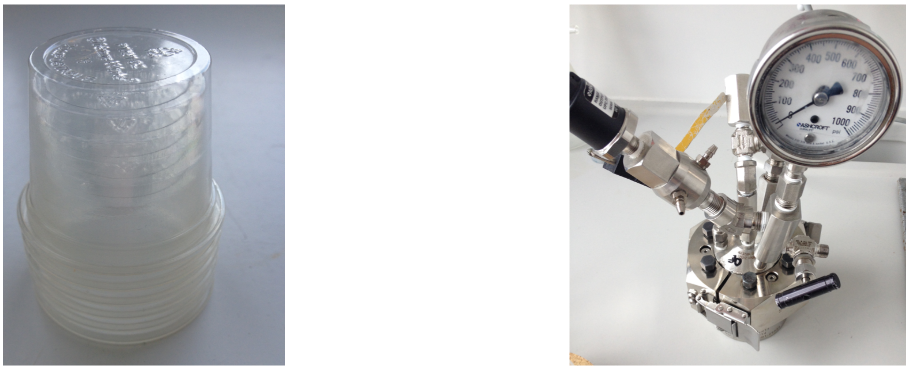
Figure S5. Scale-up experiment (autoclave)

a) PLA-cups after use

b) PLA-cups after washing

c) Applied cups for scale-up experiment

d) Autoclave (160 mL) charged with reagents



e) Isolated methyl lactate

Procedure for the depolymerization of polylactide (1m) – scale-up (autoclave): Used PLA-cups were washed with water and dried in air. PLA cups (**1m**, NatureWorks) (50.8732 g, 705.98 mmol based on the repeating unit, for simplification we insinuate that the PLA-product is composed of 100% of PLA), methanol (277 g, 8.3 mol, 11.8 equiv. based on the repeating unit of **1**), and catalytic amounts of Sn(Oct)$_2$ (0.25 mol%, 1.406 mmol based on the repeating unit of **1**) were placed with a stirring bar in an autoclave. The autoclave was sealed and heated to 140 °C (a pressure of 10.5 bar was noticed). The temperature was hold for 2 hours, while stirring the solution. Afterwards the autoclave was cooled to room temperature. The reaction mixture (clear solution) was transferred into a 500 mL flask. The flask was attached to distillation equipment. The receiving flask (500 mL) was cooled with liquid nitrogen. The volatile compounds (methanol, methyl lactate) were removed in vacuum and were collected in the receiving flask. Afterwards the receiving flask was attached to a rotary evaporator and the methanol was carefully removed in vacuum. The amount of the liquid residue was determined and an aliquot was transferred to a NMR tube and was dissolved in CDCl$_3$ (0.5 mL). The mass of isolated **2** was related to the mass of the starting PLA-product. The amount of substance of **2** was related to the amount of substance of the starting PLA-product insinuating that the PLA-product is composed of 100% of PLA.

The NMR spectra are in accordance to the NMR spectra obtained for depolymerization of **1a** (*vide supra*).

Procedure for the depolymerization of polylactide (1m) – scale-up (microwave): Used PLA-cups were washed with water and dried in air. The following reactions were performed in eight microwave reactor vials (each 100 mL volume), which were treated with microwave irradiation at the same time. PLA cups (**1m**, NatureWorks, ~33 exemplars) (8x5.00 g = 40 g, 8x69.5 mmol = 556.0 mmol based on the repeating unit, for simplification we insinuate that the PLA-product is composed of 100% of PLA), methanol (8x35 g = 280 g, 8x1.05 mol = 8.4 mol, 15.1 equiv. based on the repeating unit of **1**), and catalytic amounts of Sn(Oct)$_2$ (8x0.25 mol%, 8x70.0 mg = 560 mg, 8x0.17 mmol = 1.38 mmol based on the repeating unit of **1**) were placed with a stirring bar in Teflon microwave vials (8x100 mL). The vials were sealed and heated to 140 °C in a microwave reactor. The temperature was hold for 20 min, while stirring the solution. Afterwards the vial was cooled to ambient temperature. The reaction mixtures (clear solutions) were filtered over a paper filter and combined into a 500 mL flask. The flask was attached to distillation equipment. The receiving flask (500 mL) was cooled with liquid nitrogen. The volatile compounds (methanol, methyl lactate) were removed in vacuum and were collected in the receiving flask. Afterwards the receiving flask was attached to a rotary evaporator and the methanol was partially removed in vacuum. The flask containing the liquid residue was attached to distillation equipment and the methanol and the methyl lactate was removed in vacuum and was collected in a flask cooled with liquid nitrogen. Afterwards the collecting flask was attached to a rotary evaporator and the methanol was removed in vacuum. The amount of the remaining liquid was determined and an aliquot was transferred to a NMR tube and dissolved in $CDCl_3$ (0.5 mL). The mass of isolated **2** was related to the mass of the starting PLA-product. The amount of substance of **2** was related to the amount of substance of the starting PLA-product insinuating that the PLA-product is composed of 100% of PLA.

The NMR spectra are in accordance to the NMR spectra obtained for depolymerization of **1a** (*vide supra*).

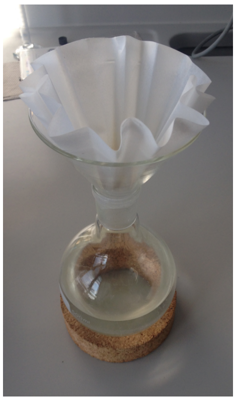
Figure S6. Scale-up experiment (microwave)

a) Applied cups for scale-up experiment

b) Sealed microwave reactor vial

c) Microwave reactor with samples.

d) Filtration of the reaction mixture



e) Methyl lactate

Procedure for the depolymerization of poly(lactide) (1a), poly(bisphenol A carbonate) (3) and poly(ethylene terephthalate) (4): A mixture of poly(lactide) (**1a**, transparent plastic cup from Prodana GmbH) (194.5 mg, 2.7 mmol based on the repeating unit), poly(bisphenol A carbonate) (**3**) (689 mg, 2.7 mmol based on the repeating unit, obtained from a DVD[2]), poly(ethylene terephthalate) (**4**, transparent water bottle) (518.5 mg, 2.7 mmol based on the repeating unit), methanol (6.0 g, 187.3 mmol, 69.4 equiv. with respect to the repeating unit of **1a**, **3** and **4**) and catalytic amounts of $Sn(Oct)_2$ (17.2 mg, 0.042 mmol, 1.5 mol% with respect to the repeating unit of **1a**, **3** and **4**) were placed with a stir bar in a vial. The vial was sealed and subjected to a Microwave Synthesis Reactor Monowave 400. The reaction was performed for 20 minutes (hold time) at 160 °C and stirring with 600 rpm. The reaction temperature was reached within 1-2 minutes (heat as fast as possible). Afterwards the vial was cooled to room temperature. The suspension was filtered to remove the unreacted PET. An aliquot of the clear solution was transferred to a NMR tube and was dissolved in $CDCl_3$ (0.5 mL). The sample was subjected to ^{1}H NMR to determine the yield/conversion of the polymers. A NMR yield of >99% of **2** was detected, since no PLA leftover was observed. A NMR yield of >99% of 5 was detected, since no PC leftover was observed. A NMR yield of >99% of **5** and **6** was detected, since no PC leftover was observed. For PET only traces of the polymer were observed in the $CDCl_3$ by NMR.

For isolation of the monomers the solution was transferred to a flask, which was attached to distillation equipment. All volatiles (methanol, dimethyl carbonate, methyl lactate) were removed in vacuum and were collected in the collecting flask, which was cooled with liquid nitrogen. The collecting flask was attached to distillation equipment. The methanol and dimethyl carbonate were distilled off by heating the mixture to 110 °C. Due to azeotrope formation of methanol and dimethyl carbonate only the quality was checked by ^{1} HNMR. The leftover in the distillation flask was characterized by NMR, revealing the presence of methyl lactate (the ^{1}H NMR is in accordance as aforementioned). Methyl lactate was isolated in 61% yield (m = 170 mg). The residue of the reaction mixture was dissolved in chloroform and stored in a fridge. Colorless crystals were obtained, which were filtered off and dried in vacuum. Bisphenol A was isolated in 64% yield (m = 394 mg).

Bisphenol A (**2**)[3]: ^{1}H NMR (400 MHz, acetone-d6, 25 °C): δ = 8.09 (s, 2H, -O*H*), 7.03-7.08 (m, 4H, Ar-*H*), 6.72-6.75 (m, 4H, Ar-*H*), 1.59 (s, 6H, $(CH_3)_2C$-) ppm. $^{13}C\{^1H\}$ NMR (126 MHz, acetone-d6, 25 °C): δ = 155.9, 142.8, 128.4, 115.4, 42.1, 31.5 ppm.

Dimethyl carbonate (**3**):[4] ^{1}H NMR (400 MHz, $CDCl_3$, 25 °C): δ = 3.76 (s, 6H, $(CH_3O)_2C=O$) ppm.

Figure S7. Left: PLA transparent cup; 4 isolated from a DVD; PET transparent bottle. Middle: Reaction mixture before microwave heating. Right: Reaction mixture after microwave heating.

Figure S8. Spectrum of the reaction mixture (^{1}H NMR (500 MHz, $CDCl_3$, 25 °C)).

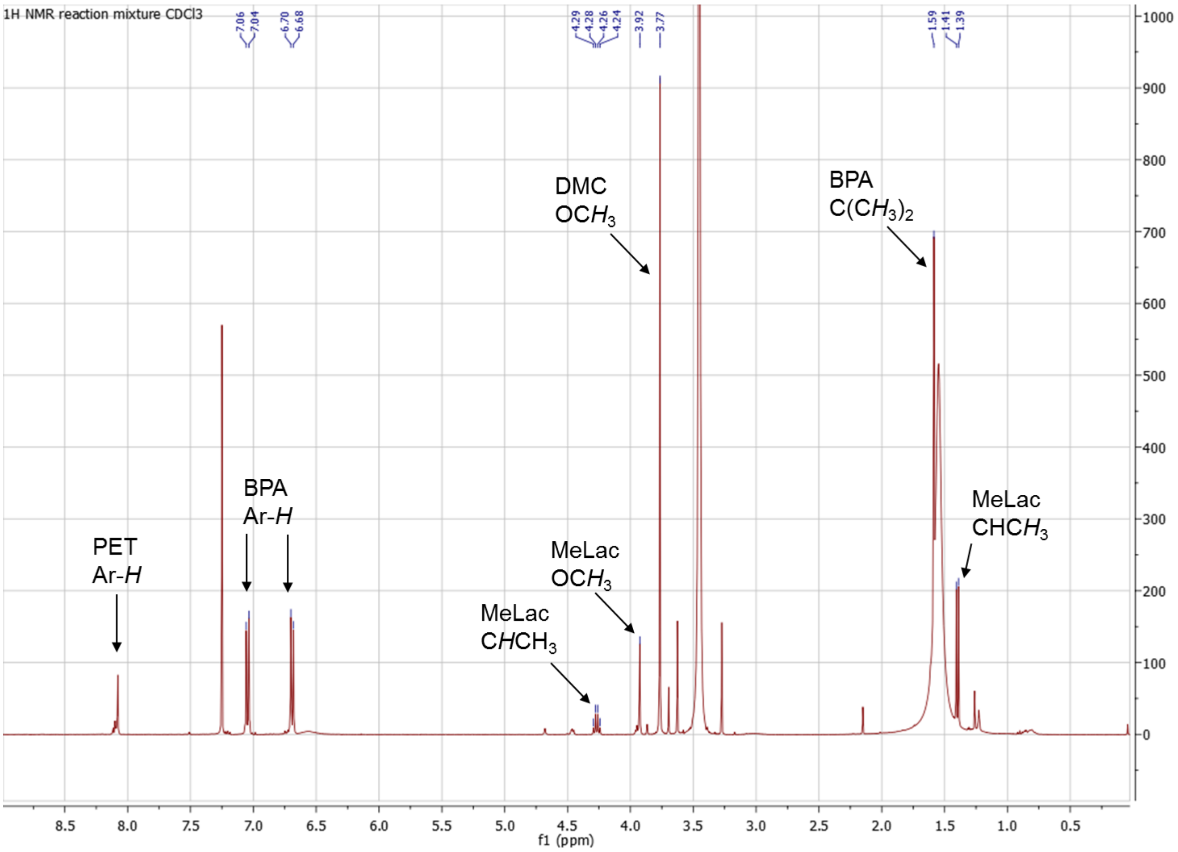


Figure S9. Spectrum of dimethyl carbonate/methanol (^{1}H NMR (500 MHz, $CDCl_3$, 25 °C)).

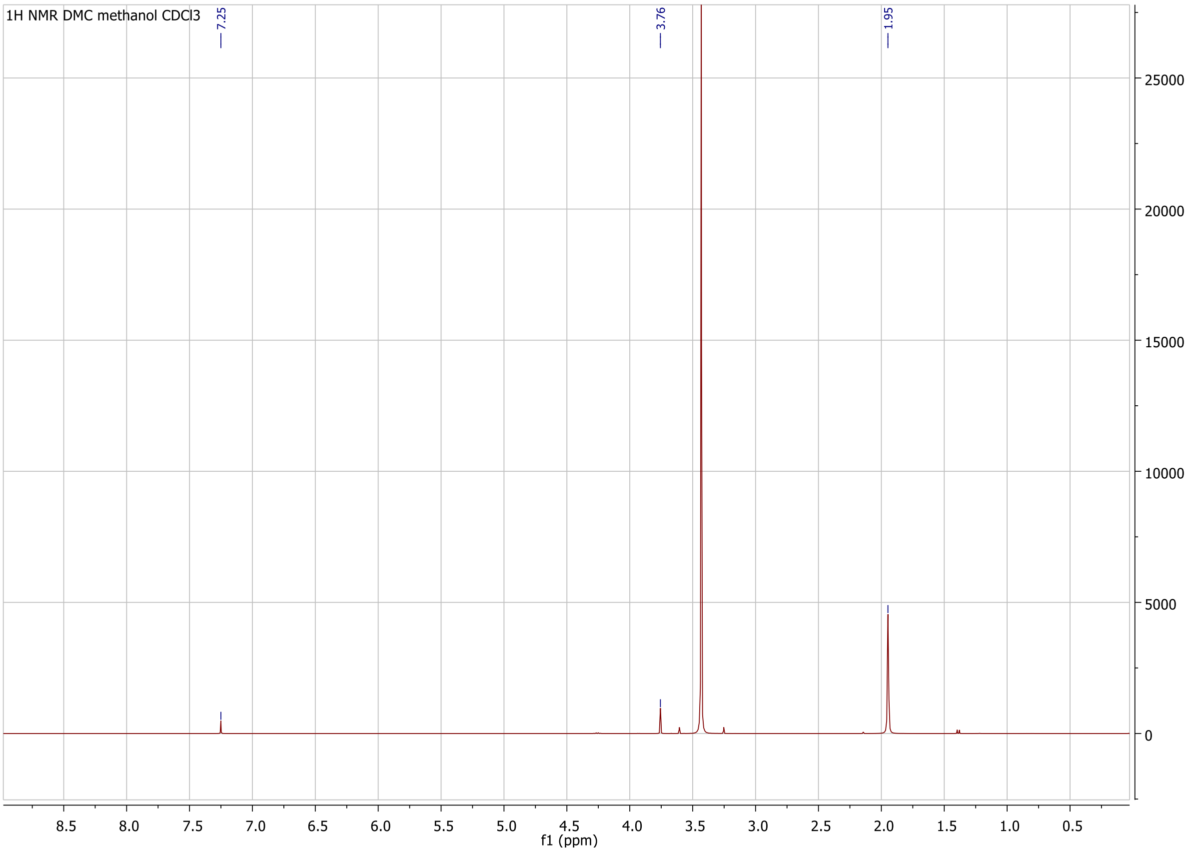


Figure S10. Spectrum of bisphenol A (^{1}H NMR (500 MHz, acetone-d6, 25 °C)).

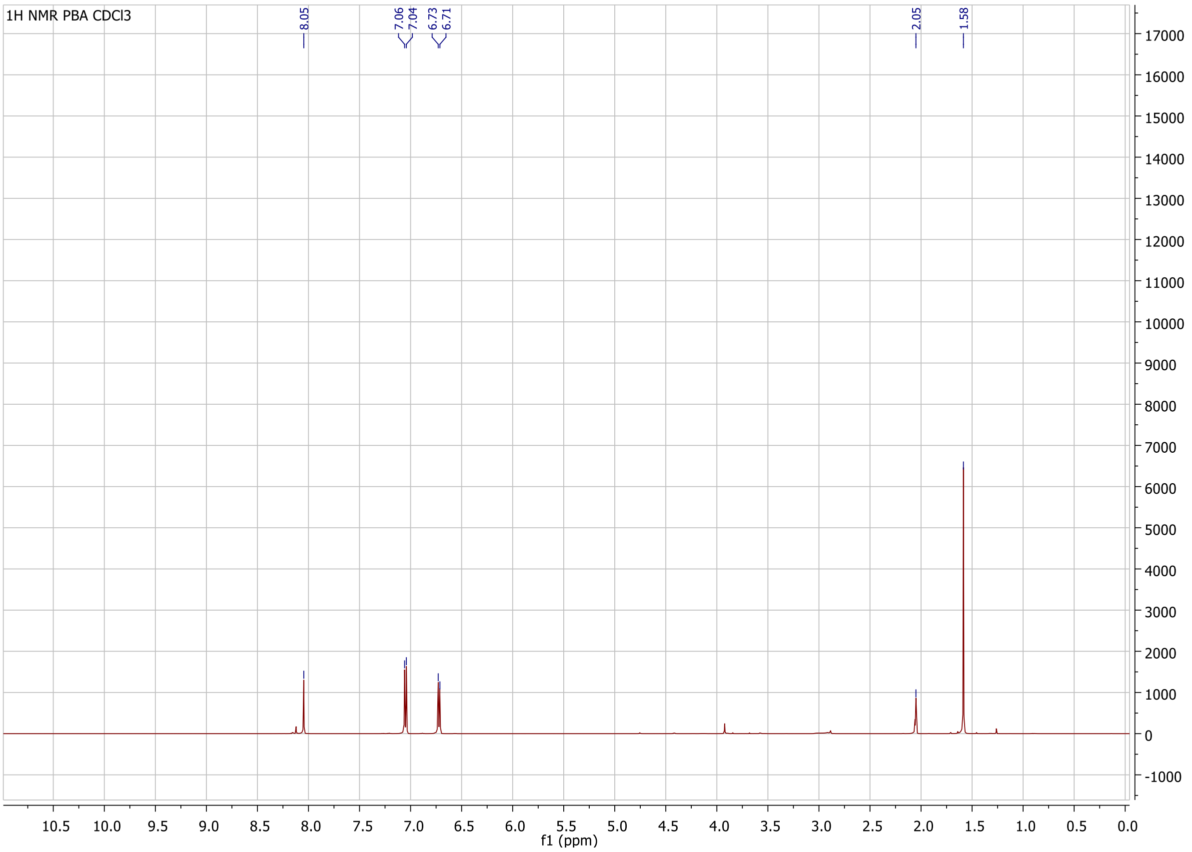
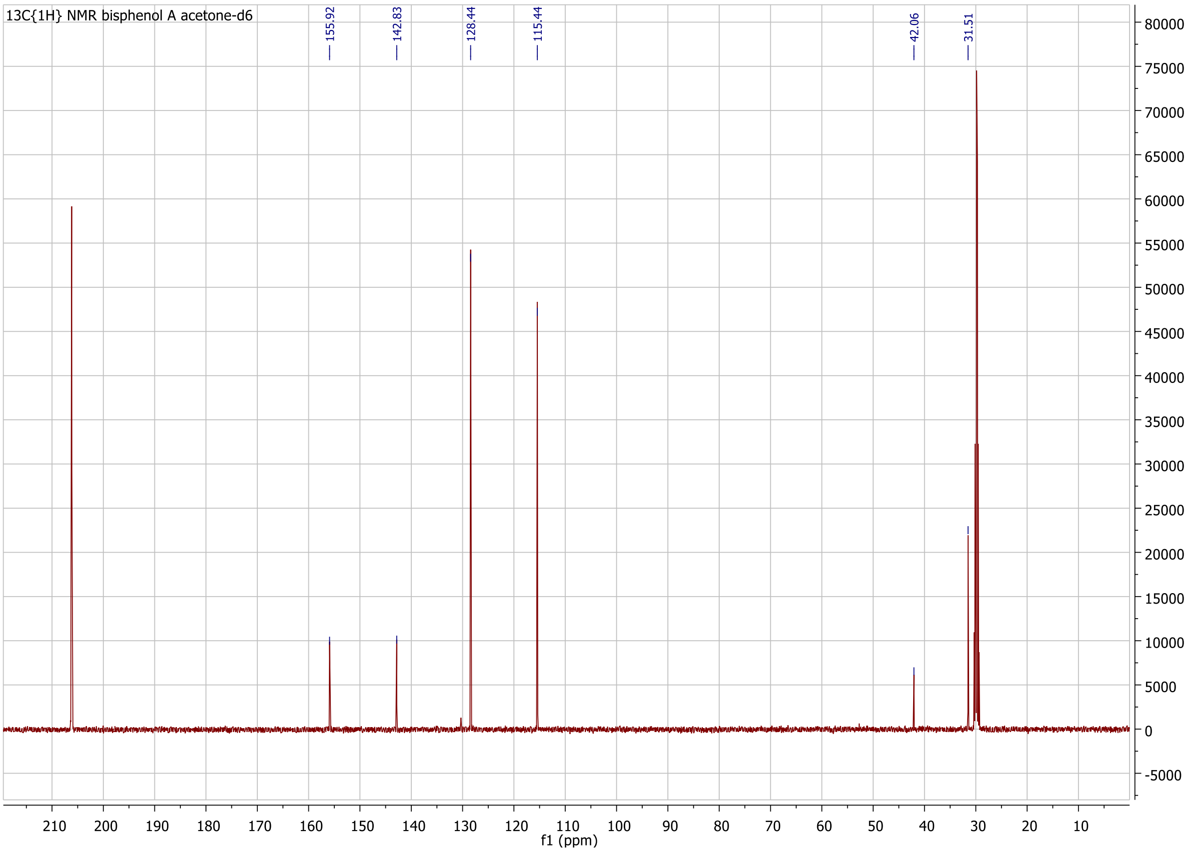


Figure S11. Spectrum of bisphenol A ($^{13}C\{^{1}H\}$ NMR (101 MHz, acetone-d6, 25 °C)).



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[2] For the isolation of poly(bisphenol A carbonate) (**3**) from a DVD see for instance: a) C. Alberti, F. Scheliga, S. Enthaler, *ChemistrySelect* **2019**, *4*, 2639–2643; b) C. Alberti, S. Enthaler, *Asian J. Org. Chem.* **2019**, DOI: 10.1002/ajoc.201900242R1; c) C. Alberti, F. Scheliga, S. Enthaler, *ChemistryOpen* **2019**, DOI: 10.1002/open.201900149.

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