

# Supporting Information

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## Supporting information

Pages: 7

Text:4

Tables: 5

Figures: 3

### **Text S1. Statistical method of particle size distribution.**

The data processing is as follows: Dimensional measurement is done by evenly spreading the plastic particles onto a glass slide, observing them with a Nikon corporation Kanagawa Japan microscope (Ts2-FL) at a magnification of  $\times 4$ , capturing images, and measuring the size of each microplastic with the help of the measurement tools in ImageView.

### **Text S2. PY-GC/MS data analysis methods.**

Method identification: pyrolysis products of temperature gradients were identified using AMDIS32 at 300°C, 350°C, and 400°C, respectively. The steps

are as follows: 1. Import the generated .d data file 2. Instrument:Agilent ChemStation(\*) 3. Analyze-Analysis Settings:identif.-80 Minimum match factor(Libr.: NISTEP.A.MSL). This method is suitable for batch analysis of the component structures of pyrolysis products, but the accuracy is not high, so a high match factor needs to be set.

Main product identification method: analyzed using Qualitative Analysis 10.0 in combination with the Nist database. The analyzed peaks were selected and integrated, followed by the deduction of background to obtain the mass spectral peaks. Next, the mass spectral peaks were sent to the Nist database for matching analysis to obtain Name, CAS, RT, and formula.

GC/MS Information:

Instrument control parameters: 8890+5977

Control information:

Injection port: GC; Injection method: Manual; Mass Spectrometer: Enabled; Run time 41 min Post-run time 2 min; Column: Temp.Setpoint On;(initial value) 40 °C; Holding time 5 min; Post-run 300 °C; Programme: #1 Rate 10 °C/min;#1 Value 300 °C;#1 Hold time 10 min; Equilibration time 0.5 min; Maximum temperature 350 °C; Maximum temperature override Disable; Low speed fan Disable; Front SS inlet He; Mode Shunt; Heater On 300 °C; Pressure On 7.0699 psi; Total Flow On 154 mL/min; Cushion Purge Flow On 3 mL/min; Pre-run Flow Test Off Carrier Gas Saving On 20 after 2 min mL/min; Shunt Ratio 150:1; Diverter Flow 150 mL/min.

#### MS Information:

Acquisition mode: Scanning; Solvent delay (min): 0; EM setting mode Gain: 1.000000; Standard or fast scan: Standard scan; Ion detection: Off; Runtime (if MS only): 10 min; Scan Parameters: Start time: 0; Low mass: 29; High quality: 500; Threshold: 0; MS Ion Source: 230 C maximum 250 C; MS Quadrupole: 150 C maximum 200 C.

#### **Text S3. Set up information.**

The additional information of the device is as follows: 1, the internal space of the experimental closed box is 70cm in length, 53cm in width, and 32cm in height. 2. The length of the UV lamp is 589.8±2.0mm, and the diameter is 25.0±2.0mm. The vertical distance of the UV lamp source from the sample is about 28cm; the material of the lamp is quartz glass; the rated voltage is 220V; the model number is: FLS20T8E/D; G13 lamp head. 3. FLS20T8E/D; G13 lamp head. 3. The design of the experimental closed box is a pull-out finishing box modification, we ensure that the size of the finishing is suitable for placing a sufficient number of samples at the same time to facilitate the processing of the samples to add water and other operations, in addition, in addition, in the inner wall of the finishing box is covered with aluminium foil and fixed with wire, to prevent the finishing box because of the release of additives and other interfering factors in the aging process.

#### **Text S4. The details of Ethyl hydrogen succinate**

Name: Ethyl hydrogen succinate

Formula: C<sub>6</sub>H<sub>10</sub>O<sub>4</sub>

MW: 146 Exact Mass: 146.057909 CAS#: 1070-34-4 NIST#: 133368 ID#: 74395 DB:

mainlib

Other DBs: Fine, TSCA, EINECS

Contributor: NIST Mass Spectrometry Data Center, 1994

InChIKey: LOLKAJARZKDJTD-UHFFFAOYSA-N Non-stereo

10 largest peaks:

101 999 | 73 262 | 29 243 | 55 216 | 128 207 |

45 172 | 27 154 | 74 110 | 28 109 | 56 89 |

Synonyms:

1. Butanedioic acid, monoethyl ester

2. 4-Ethoxy-4-oxobutanoic acid #

3. Monoethyl butanedioate

4. Monoethyl succinate

5. Succinic acid monoethyl ester

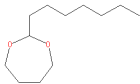
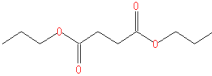
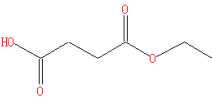

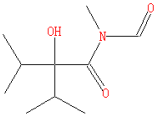
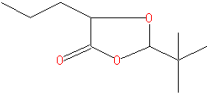
6. Butanedioic acid, 1-ethyl ester

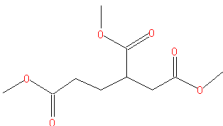
**Table S1. Information on plastic products**

Product Information	LDPE-50200	PLA-3033D
Density (g/cm <sup>3</sup> )	0.92	1.20-1.30

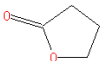
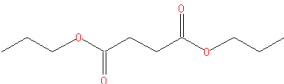
Melting point (°C)	105	155-185
Purity	99.99%	99.9%
CAS	9002-88-4	26100-51-6

**Table S2. Pyrolysis products produced after PLA aging at 300°C.**

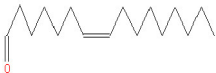

Name	CAS	RT	Formula
1,3-dioxepane, 2-heptyl-	61732-92-1	14.019	
Butanedioic acid, dipropyl ester	925-15-5	15.248	
Ethyl hydrogen succinate	1070-34-4	19.115	
1,3-dioxepane, 2-pentadecyl-	41563-29-5	19.489	
Butanamide, n-formyl-2-hydroxy-n,3-dimethyl-2-(1-methylethyl)-	56440-44-9	20.076	
2-t-butyl-5-propyl-[1,3]dioxolan-4-one	157733-17-0	20.878	

1,2,4-butanetricarboxylic acid, trimethyl ester	4339-27-9	21.957	
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**Table S3. Pyrolysis products produced after PLA aging at 600°C.**

Name	CAS	RT	Formula
Butyrolactone	96-48-0	4.351	
Butanedioic acid, dipropyl ester	925-15-5	15.237	

**Table S4. Pyrolysis products produced after PE aging at 300°C.**

Name	CAS	RT	Formula
7-Hexadecenal, (Z)-	56797-40-1	0.142	
Octadecane, 1,1'-[1,3- propanediylbis(oxy)]bis-	17367-38-3	26.850	

Succinic acid, heptadecyl 2-

methyllallyl ester

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22.875

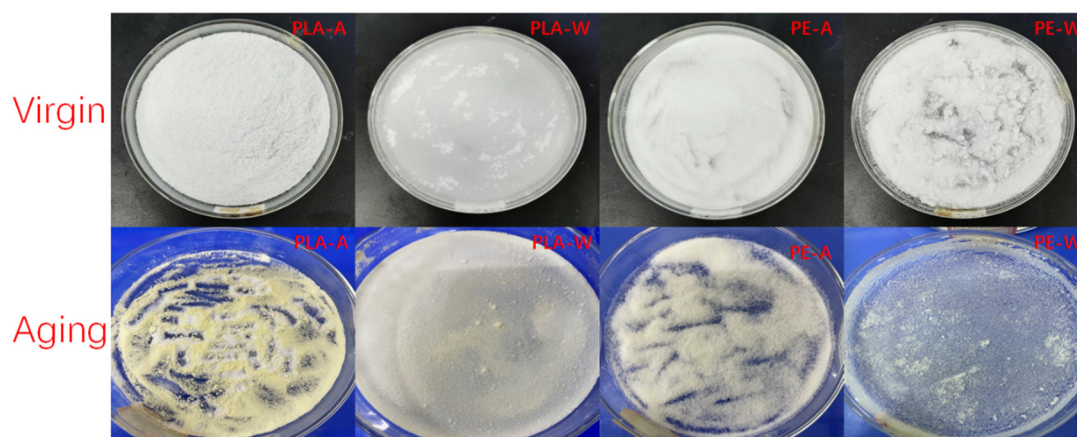
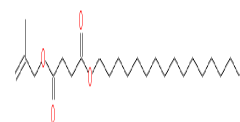


Figure S1 Plastic pellets before and after aging pictures. W represents photoaging in water, A represents photoaging under anhydrous conditions

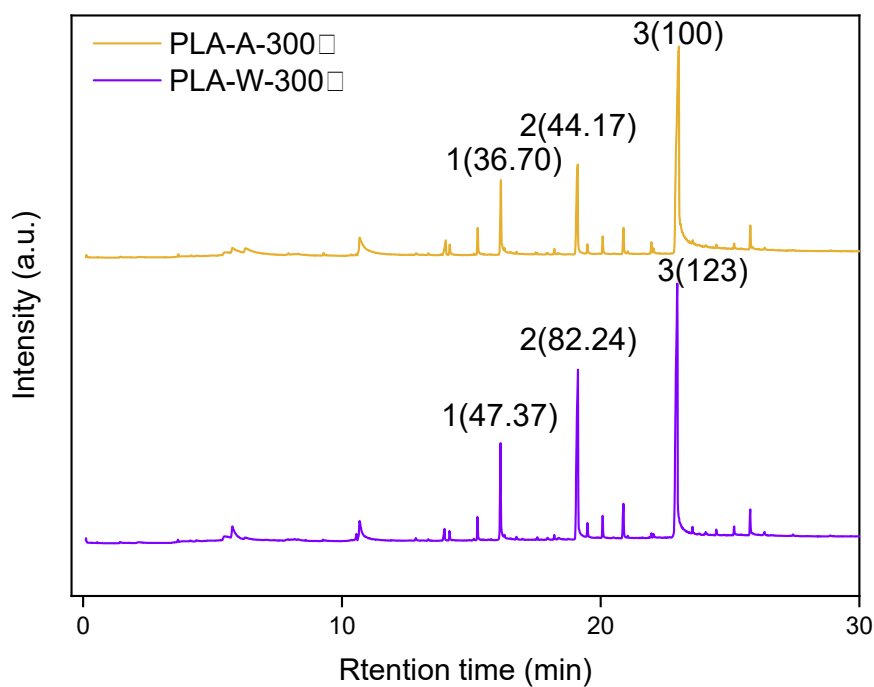
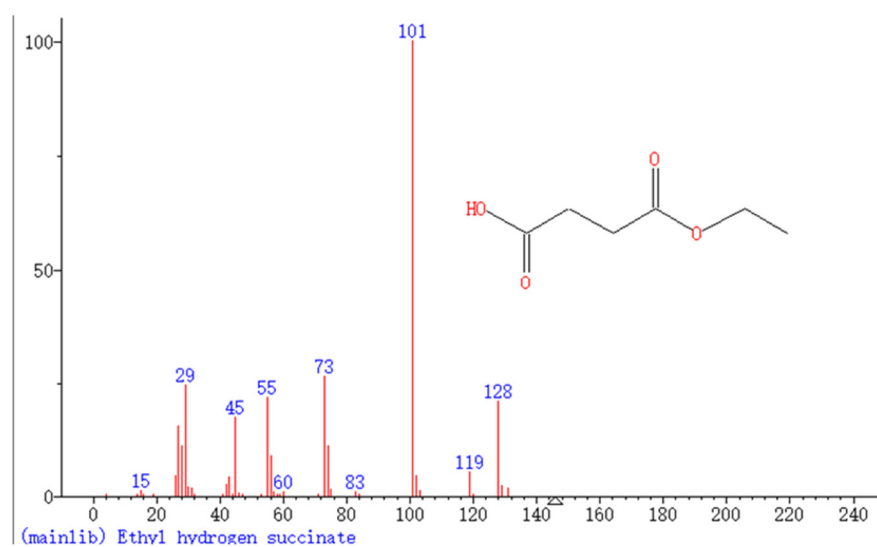


Figure S2. Chromatograms of the main pyrolysis products involved in photoaging at 300°C with and without water



**Figure S3. Mass spectra of Ethyl hydrogen succinate**



**Table S5 particle size distributions**

Sample	0-100 $\mu\text{m}$		101-200 $\mu\text{m}$		201-300 $\mu\text{m}$		301-400 $\mu\text{m}$		401-500 $\mu\text{m}$		501-600 $\mu\text{m}$	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
PLA-V	11.37	16.07	49.37	7.33	23.10	13.38	12.69	5.08	2.33	3.29	1.17	1.65
PLA-A	45.08	19.55	32.72	7.98	9.02	10.82	9.02	10.82	4.17	5.89	0	0
PLA-W	69.80	5.15	23.99	7.41	5.42	1.03	3.12	2.23	0	0	0	0
PE-V	8.41	3.82	24.01	6.46	35.20	1.28	19.72	0.40	7.07	2.13	5.60	3.87
PE-A	8.47	0.50	39.265	5.6215	27.98	6.29	15.7	6.92	2.82	0.17	5.76	4.33
PE-W	13.22	6.57	27.86	11.11	26.43	7.07	13.93	4.55	12.50	2.53	6.07	3.54