

Supporting Information

Bio-Carbon Quantum Dots Modified TiO₂ Nanocrystals for Photocatalytic Degradation of PLA and PET microplastics

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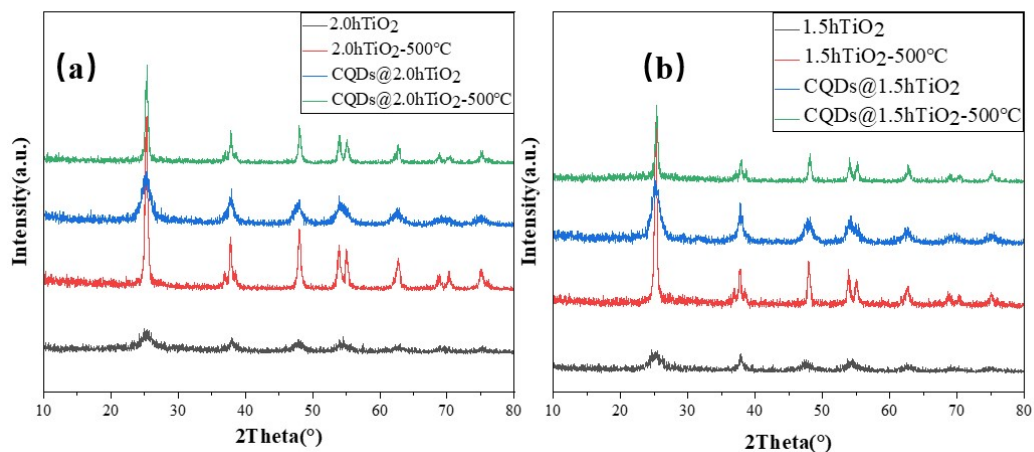


Fig S1. XRD patterns: (a) photocatalyst based on 1.5h TiO₂, (b) photocatalyst based on 2hTiO₂.

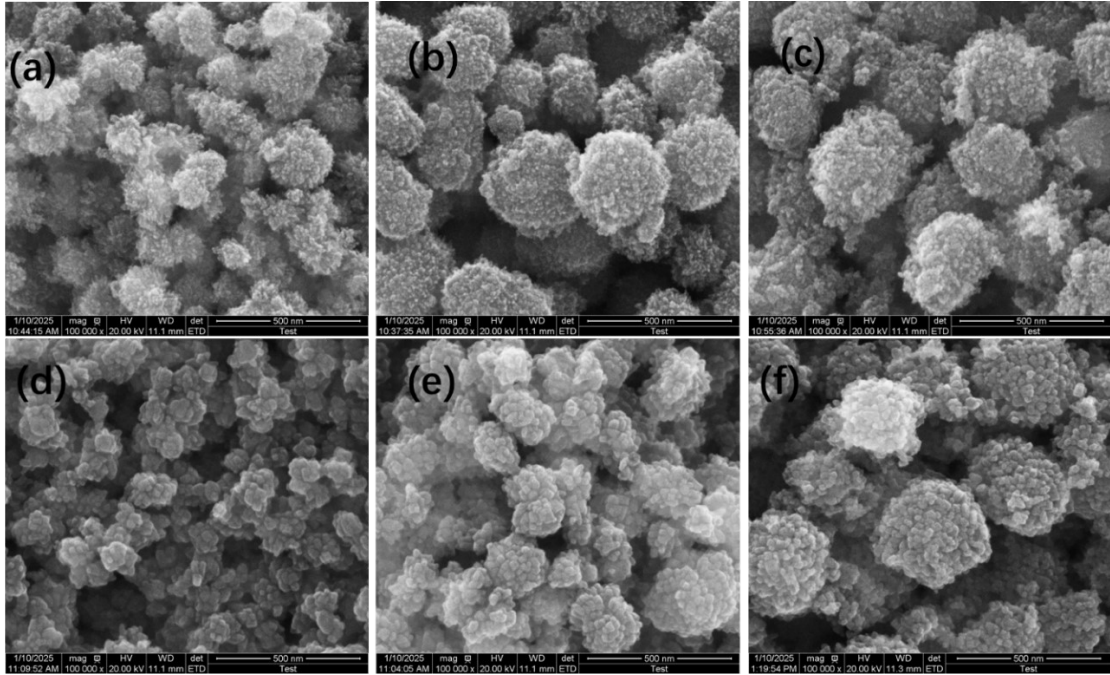


Fig S2. SEM images of TiO_2 nanocrystals : (a) 1hTiO_2 ; (b) 1.5hTiO_2 ; (c) 2hTiO_2 ; (d) $1\text{hTiO}_2\text{-}500^\circ\text{C}$; (e) $1.5\text{hTiO}_2\text{-}500^\circ\text{C}$; (f) $2\text{hTiO}_2\text{-}500^\circ\text{C}$.

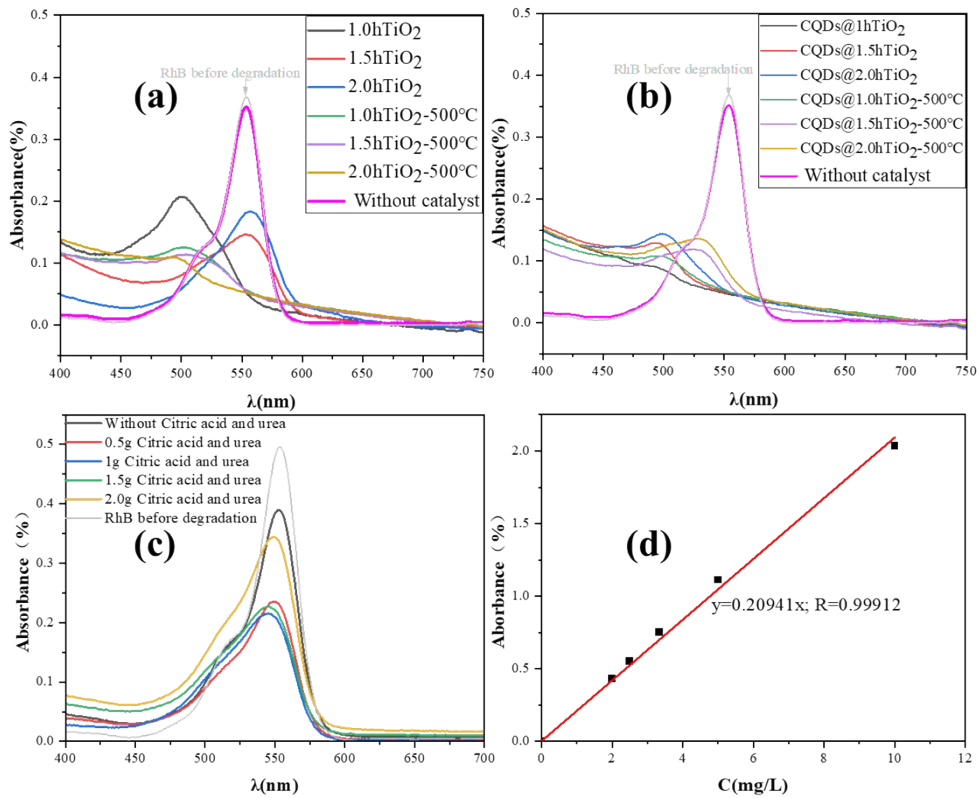


Fig S3 UV-Vis absorption spectra of the RhB solution after degradation 30min: (a) TiO_2 photocatalyst; (b) CQDs@TiO_2 photocatalyst. (c) CQDs@1hTiO_2 prepared from different

concentrations of carbon sources; (d) RhB Absorbance- Concentration curve.

Table S1. Statistical data on the degradation of RhB by different photocatalysts (The value was obtained by calculating the absorbance at 554nm.).

The catalysts	RhB C ₀ (mg/L)	RhB C _{30min} (mg/L)	Degradation rate (%)
1.0hTiO ₂	1.8	0.2435	86.47
1.5hTiO ₂	1.8	0.6974	61.27
2.0hTiO ₂	1.8	0.8644	51.99
1.0hTiO ₂ -500°C	1.8	0.2674	85.14
1.5hTiO ₂ -500°C	1.8	0.2636	85.41
2.0hTiO ₂ -500°C	1.8	0.2483	86.20
CQDs@1.0hTiO ₂	1.8	0.2197	87.80
CQDs@1.5hTiO ₂	1.8	0.2340	87.00
CQDs@2.0hTiO ₂	1.8	0.2388	86.74
CQDs@1.0hTiO ₂ -500°C	1.8	0.2388	86.74
CQDs@1.5hTiO ₂ -500°C	1.8	0.3009	83.29
CQDs@2.0hTiO ₂ -500°C	1.8	0.3868	78.51
Without photocatalyst	1.8	1.6809	6.62

Table S2. Statistical data on the degradation of RhB by CQDs@1hTiO₂ prepared from different concentrations of carbon sources.

The catalysts	RhB C ₀ (mg/L)	RhB C _{30min} (mg/L)	Degradation rate (%)
1.0hTiO ₂ (without Citric acid)	2.4	1.853	22.80
CQDs@1.0hTiO ₂ (0.5g Citric acid and urea)	2.4	1.323	44.88
CQDs@1.0hTiO ₂ (1.0g Citric acid and urea)	2.4	0.9312	61.20
CQDs@1.0hTiO ₂ (1.5g Citric acid and urea)	2.4	0.9837	59.01
CQDs@1.0hTiO ₂ (2.0g Citric acid and urea)	2.4	1.581	34.14

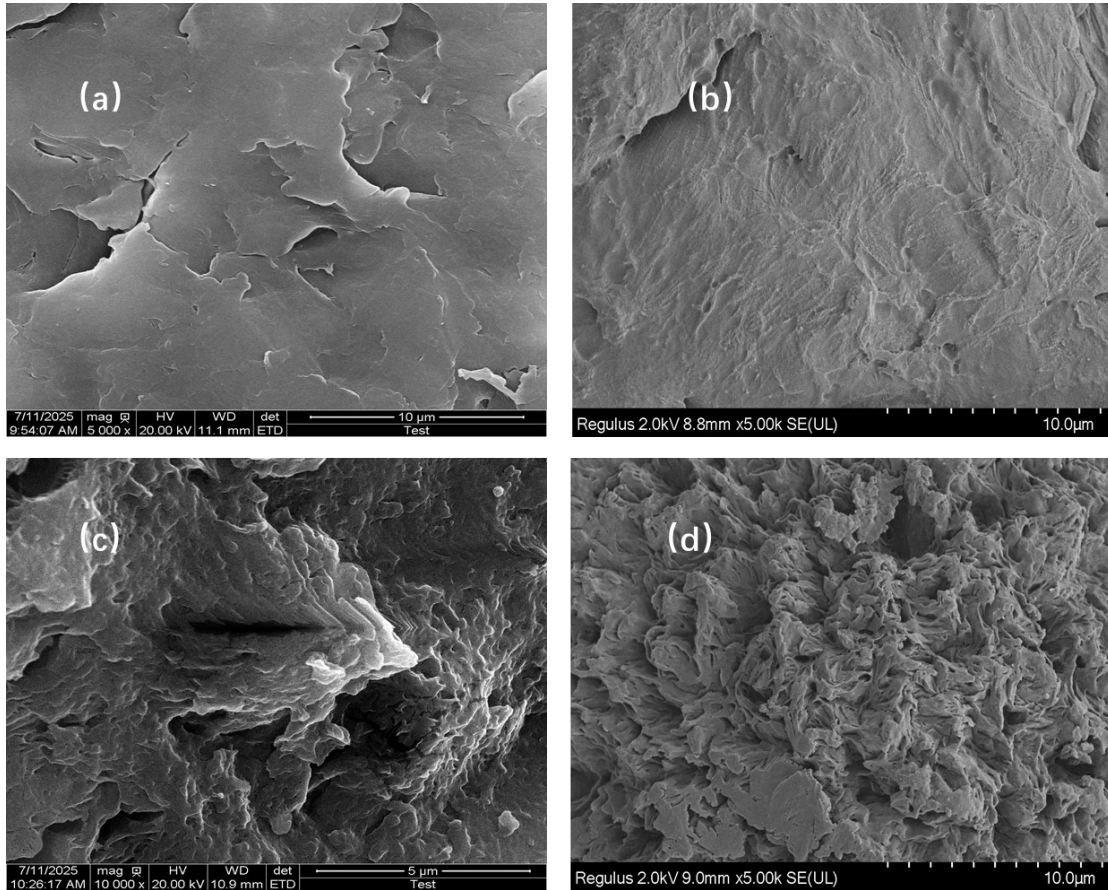


Fig S4. SEM images of microplastic surfaces: (a) untreated PET; (b) alkali-treated PET; (c) untreated PLA; (d) alkali-treated PLA.

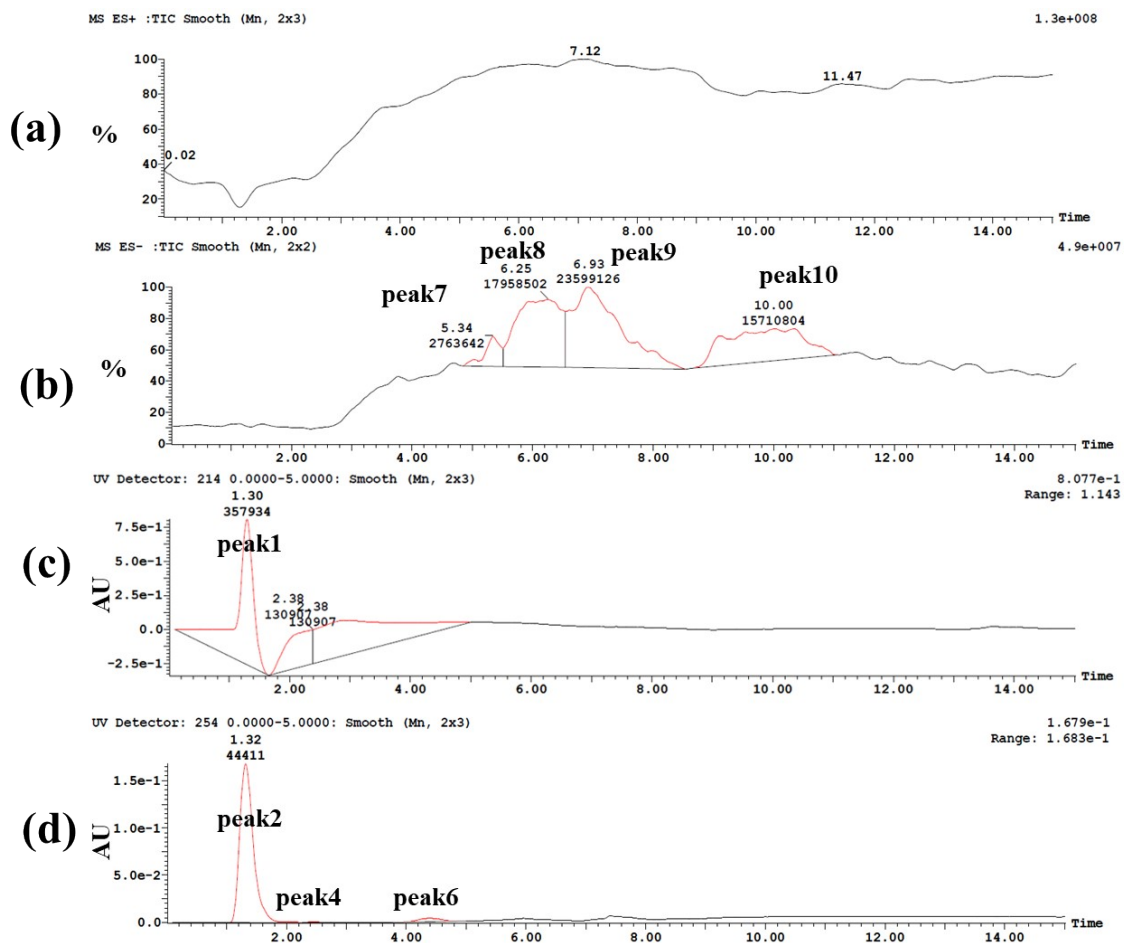


Fig S5. LC-MS and UV analysis of the PET: (a) Total ion chromatogram (TIC) obtained in MS ES⁺; (b) TIC of MS ES⁻; (c) UV absorbance chromatogram detected at 214 nm; (d) UV absorbance chromatogram detected at 254 nm.

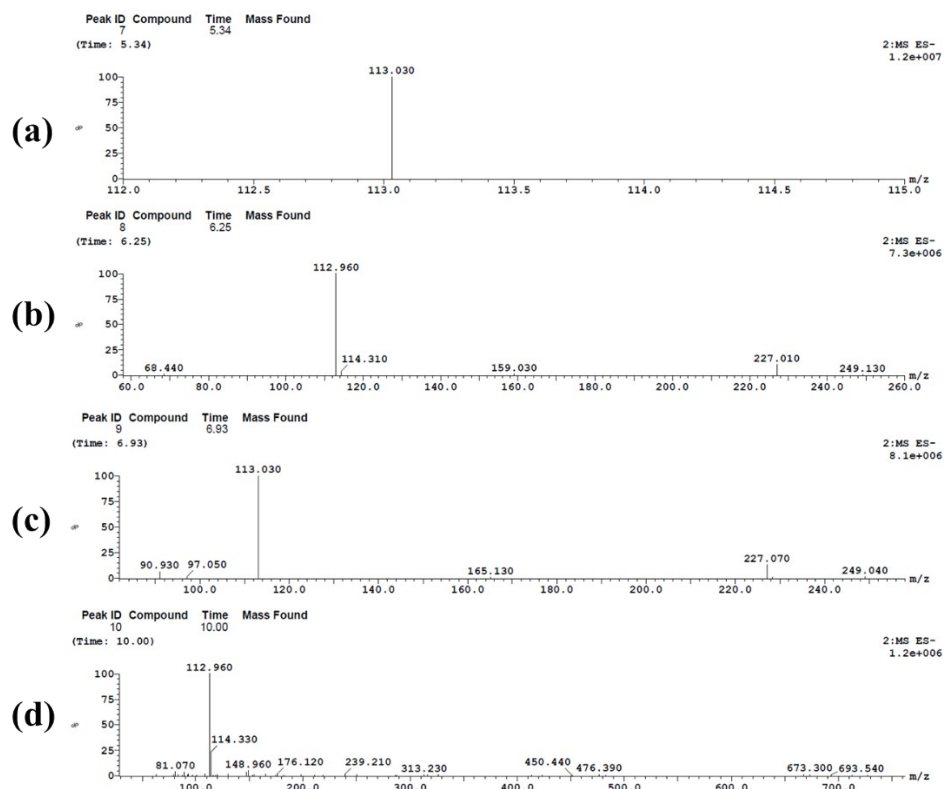


Fig S6 Negative-ion mode MS/MS spectra obtained by LC-MS of the main target compounds in PET degradation solution.

Table S3 LC-MS Data for PET Degradation Products.

Peak No.	Retention Time (min)	Main Detection Module	AreaAbs	Area %Total	m/z	Possible Substance
1	1.3	UV214 MS ES- MS ES+	357934	40.66	143.000,284.910, 125.010,164.970	Monomethyl terephthalate (TPM)+ Ethylene glycol oligomers
2	1.32	UV254 MS ES- MS ES+	44411	95.26	142.990,165.070, 125.010,164.960	terephthalic acid (TPA)+ Monomethyl terephthalate isomer
7	5.34	MS ES-	2763642	4.60	113.030	Terephthalate ion
8	6.25	MS ES-	17958502	29.91	68.440, 112.960, 227.010	TPA-EG-TPA
9	6.93	MS ES-	23599126	39.31	112.960,114.330, 239.210	PET dimer isomer + propylene glycol terephthalate oligomer
10	10	MS ES-	15710804	26.17	90.930,113.030, 227.070	ethylene glycol terephthalate trimer and tis fragments

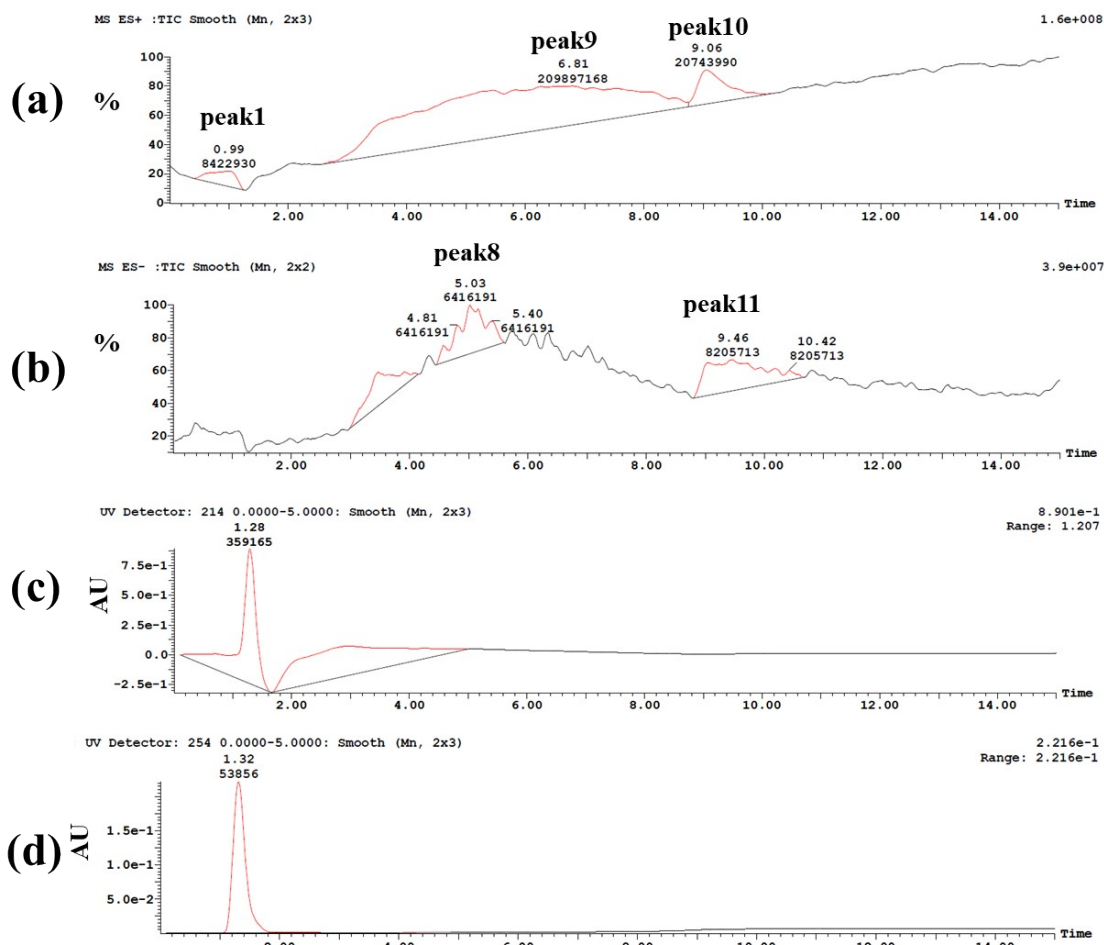


Fig S7. LC-MS and UV analysis of the PLA degradation solution: (a) Total ion chromatogram (TIC) obtained in MS ES⁺; (b) TIC of MS ES⁻; (c) UV absorbance chromatogram detected at 214 nm; (d) UV absorbance chromatogram detected at 254 nm.

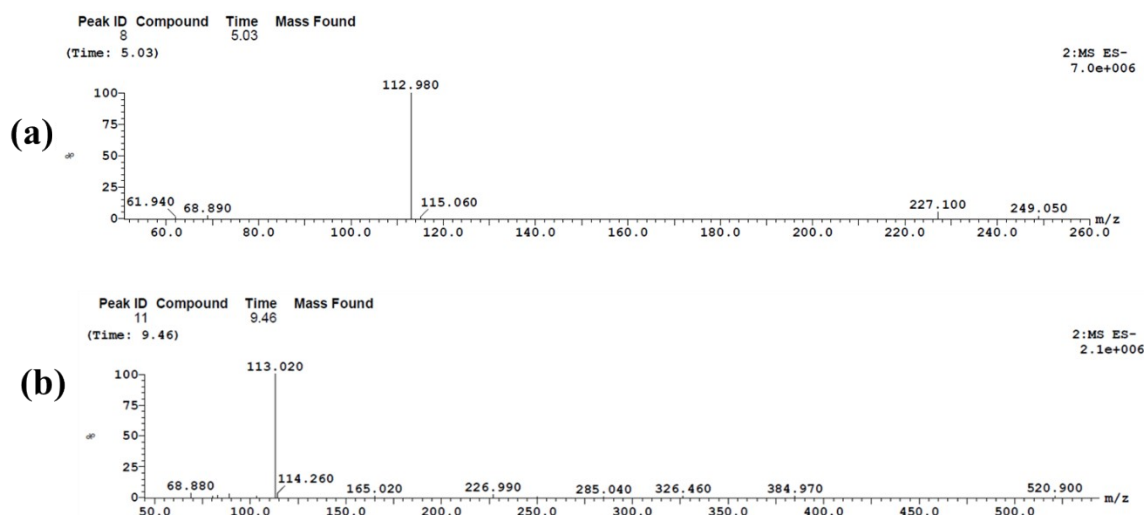


Fig S8 Negative-ion mode MS/MS spectra of the main target compounds in PLA degradation solution.

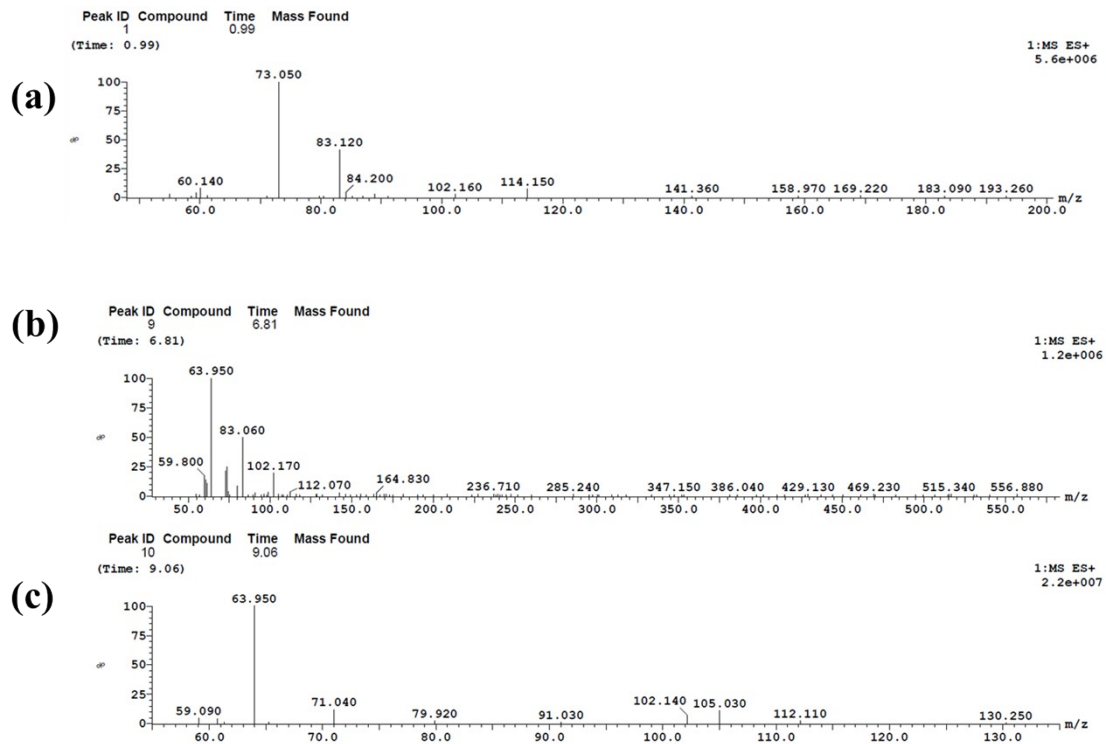


Fig S9 Positive-ion mode MS/MS spectra of the main target compounds in PLA degradation solution.

Table S4 LC-MS Data for PLA degradation solution.

No.	Retention Time (min)	Main Detection Module	AreaAbs	Area %Total	m/z	Possible Substance
1	0.99	MS ES+	8422930	3.52	73.050, 83.120	Lactic acid monomer
8	5.03	MS ES-	6416191	33.74	112.980, 61.940, 68.890, 115.060, 227.100, 249.050	Lactic acid tetramer
9	6.81	MS ES+	20989716 8	87.8	63.950, 83.060, 112.070, 236.710, 285.240, 386.040	Lactic acid dimer
10	9.06	MS ES+	20743990	8.68	63.950, 71.040, 79.920, 91.030, 102.140, 112.110	Lactic acid trimer
11	9.46	MS ES-	8205713	43.14	113.020, 68.880, 114.260, 165.020, 226.990, 285.040, 384.970, 520.900	Lactic acid hexamer

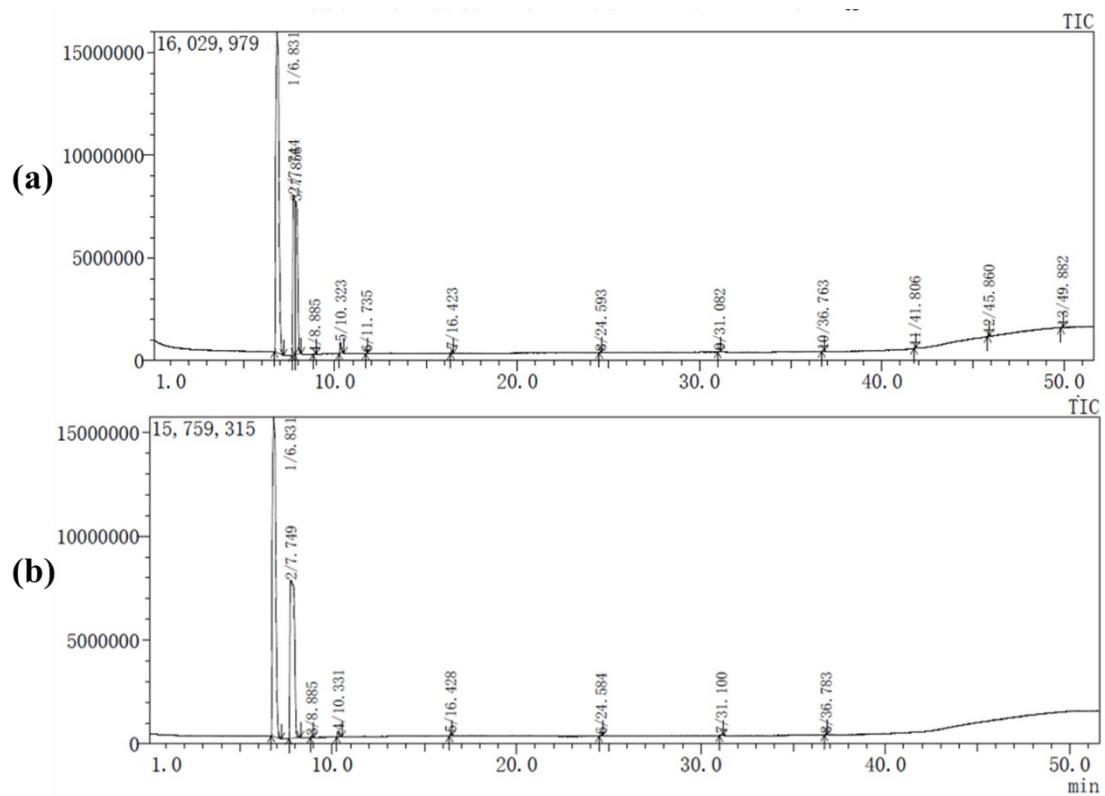


Fig S10. TIC obtained by HS-GC-MS analysis of (a) PET degradation solution and (b) PLA degradation solution.

Table S5 HS-GC-MS Data of PET and PLA degradation solution.

Sample	NO.	Retention Time (min)	Compound Name	Peak Area	Peak Area (%)	m/z	SI
PET	1	6.831	Nitrogen	189281030	58.92	28.1	75
	2	7.744	Water	54687015	17.02	18.1	95
	3	7.856	Water	72580712	22.59	18.1	96
	4	8.885	Acetaldehyde	209371	0.07	29.1	91
	5	10.323	Ethanol	2758732	0.86	31.1	95
	6	11.735	Acetone	52810	0.02	43.05	85
	7	16.423	Ethyl Acetate	591899	0.18	43.05	97
	8	24.593	Cyclotrisiloxane, hexamethyl-	84419	0.03	207	82
	9	31.082	Cyclotetrasiloxane, octamethyl-	180693	0.07	281.1	81
	10	36.763	Cyclopentasiloxane, decamethyl-	138052	0.06	73	78
	11	41.806	Cyclohexasiloxane, dodecamethyl-	234357	0.08	73.05	84
	12	45.86	Hexasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11-dodecamethyl-	262537	0.06	73.05	68
	13	49.882	2,6-Dihydroxybenzoic acid,3TMS derivative	181044	0.04	73.05	63
PLA	1	6.831	Nitrogen	189435352	58.35	28	76
	2	7.749	Water	132321353	40.76	18	95
	3	8.885	Acetaldehyde	351235	0.11	44	92
	4	10.331	Ethanol	1524230	0.47	31	94
	5	16.428	Ethyl Acetate)	502692	0.15	43	94
	6	24.584	Cyclotrisiloxane, hexamethyl-	175690	0.05	207	85
	7	31.1	Cyclotetrasiloxane, octamethyl-	237278	0.07	281	84
	8	36.783	Cyclopentasiloxane, decamethyl-	94386	0.03	355	76