Electronic Supplementary Material (ESI) for Environmental Science: Processes & Impacts.

Supporting Information

Photo-aging of brominated epoxy microplastics in water under simulated solar irradiation

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Text S1 Information of BER-MP

Brominated epoxy resins are classified according to their terminal group structures into EP types and EC types. EP types have excellent weather resistance, while EC types have good thermal performance and fluidity. The BER-MP used in this article belongs to the EP type of brominated epoxy resin, which is a white powdery sample with a color index less than 90. It has a bromine content of 52%, an average molecular weight between 10,000 and 13,000, a decomposition temperature of 350°C, and good thermal stability.

Currently, research and production of brominated epoxy resins are mainly focused on low molar mass and low bromine content. These resins are primarily used in the printed circuit board (PCB) industry.[1] The PCB is mainly composed of metal, glass fiber, and thermosetting resin,[2, 3] with thermosetting resin (plastic) accounting for approximately 30% of the composition.[4]

Research shows that by 2021, there will be over 19.67 billion scrapped electronic and electrical devices, and the production and waste treatment processes of electronic and electrical equipment will generate approximately 1.297-13.43 million tons of PCB resin waste. Waste air conditioners, televisions, and washing machines are the main contributors to PCB resin waste. By 2035, at least 568.27 thousand tons of PCB resin waste will be generated.[5]

Text S2 Characterization of BER-MP

Scanning electron microscope samples were prepared on conductive adhesive and treated with gold spray. Ultraviolet-visible Spectroscopy used barium sulfate as the substrate, with a scanning range of 200-800 nm and an interval of 0.5 nm. Attenuated total reflection-fourier transform infrared spectroscopy, with the spectral range set from 3500 to 400 cm^{-1}, 32 scans at a spectral resolution of 4 cm^{-1}. Gel Permeation Chromatography measures the relative molecular weight, with the eluent used being dimethylformamide (DMF) at room temperature. Electron paramagnetic resonance testing scanned within a range of 200 nm, repeated 5 times. The fluorescence EEM was obtained using a fluorescence spectrometer by scanning emission wavelengths (Em) from 250 to 650 nm and excitation wavelengths (Ex) from 250 to 600 nm both with 5 nm intervals equipped with a 1 cm path-length quartz cuvette. The nuclear magnetic resonance spectrometer is used to record the ^{1}H NMR (128 scans) and ^{13}C NMR (5000 scans) spectra of the leachate of BER-MP photoaged for 1000 h.

Table S1 GPC analysis of original BER and dark reaction BER

	Mw (g/mol)	Mn (g/mol)	Mp (g/mol)	Mz (g/mol)	Mz+1 (g/mol)	PDI
BER-MP0	41001	23798	42325	62176	83647	1.722876
BER-MP4	43173	26203	43977	63829	84577	1.647636
BER-MP4 (Leachate)	43237	26435	43977	63799	84673	1.635597

Table S2 EDS analysis of BER-MP with different photoaging times

	C	O	Br	O/C
BER-MP0	61.40	11.95	26.65	0.19
BER-MP1	66.27	8.51	25.23	0.12
BER-MP2	68.96	12.49	18.56	0.18

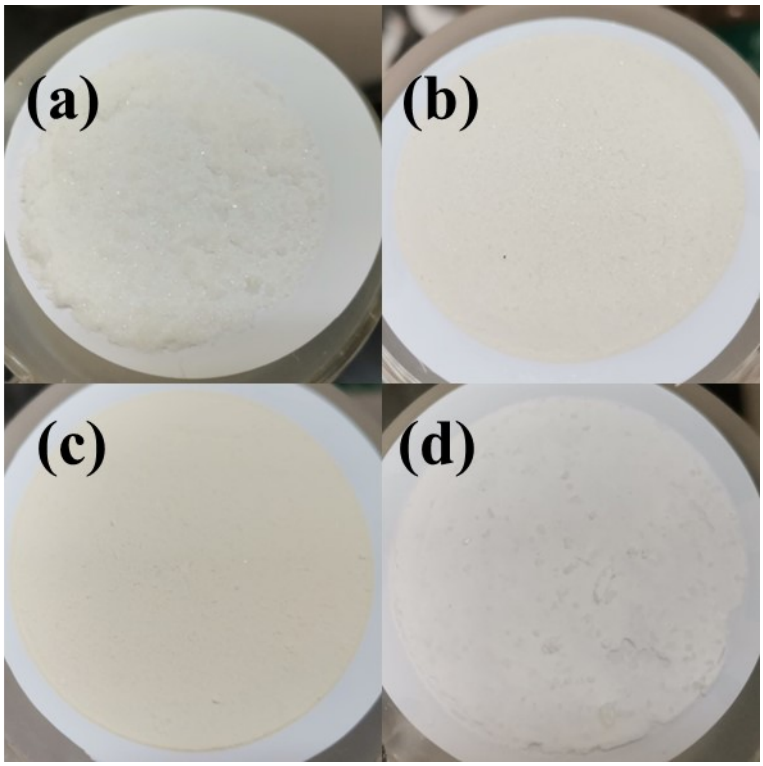

Fig. S1 Phenomenon diagrams before and after BER-MP aging, (a) BER-MP0, (b) BER-MP1, (c) BER-MP2, (d) BER-MP4

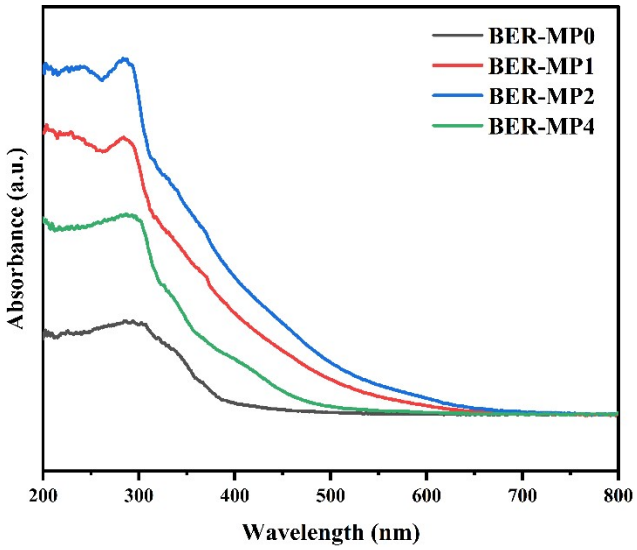

Fig. S2 UV-VIS of before and after BER-MP aging

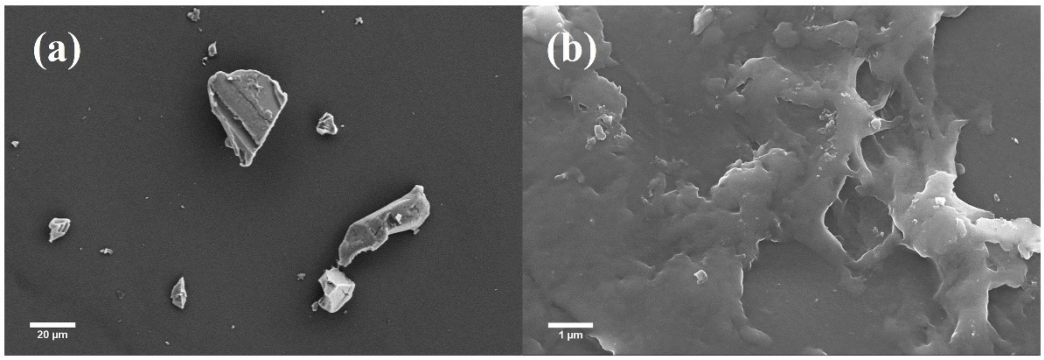

Fig. S3 SEM images of BER-MP4.

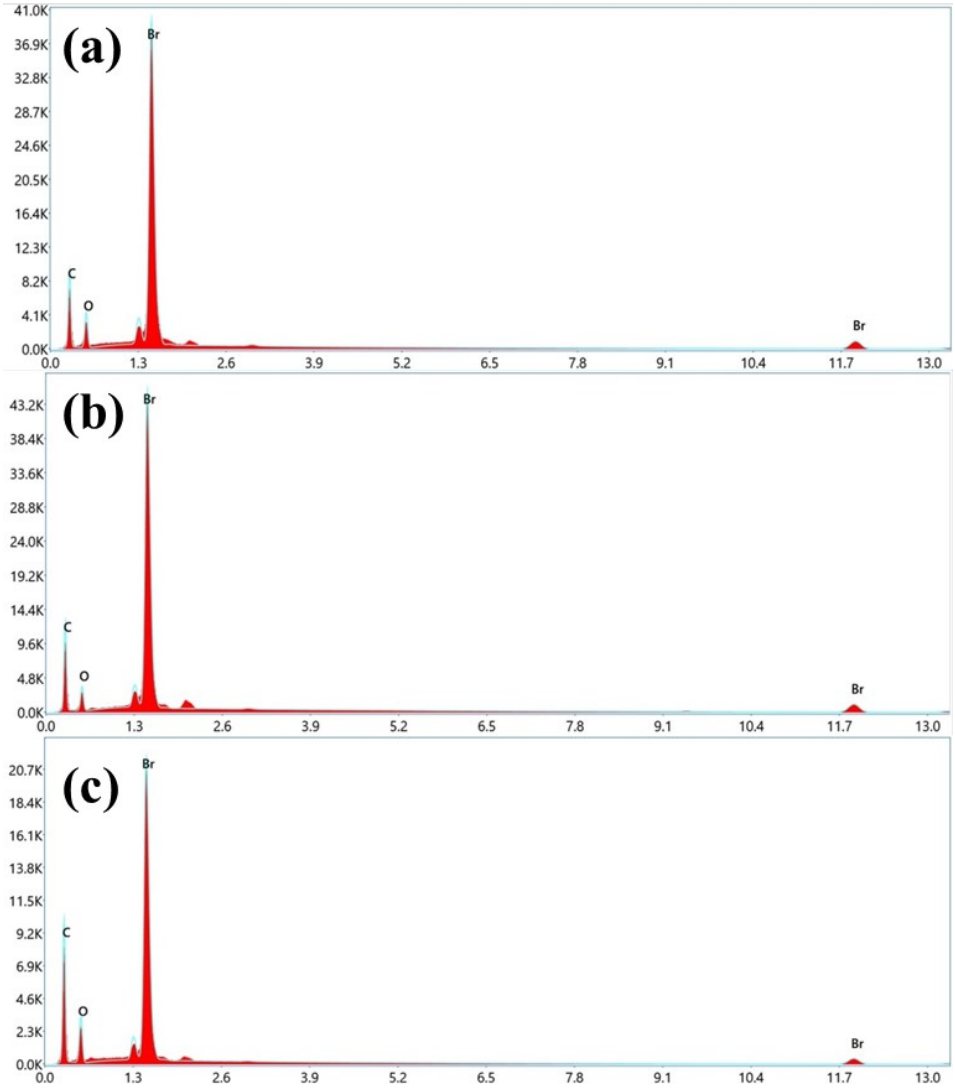

Figure S4 EDS spectra of BER-MP (a: BER-MP0. b: BER-MP1. c: BER-MP2)

References

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