Supplementary Information

Freezing-induced microplastic degradation in anoxic Fe(II)-containing solution: the key role of Fe(IV) and •OH

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Figures S1 to S10.

Table S1.

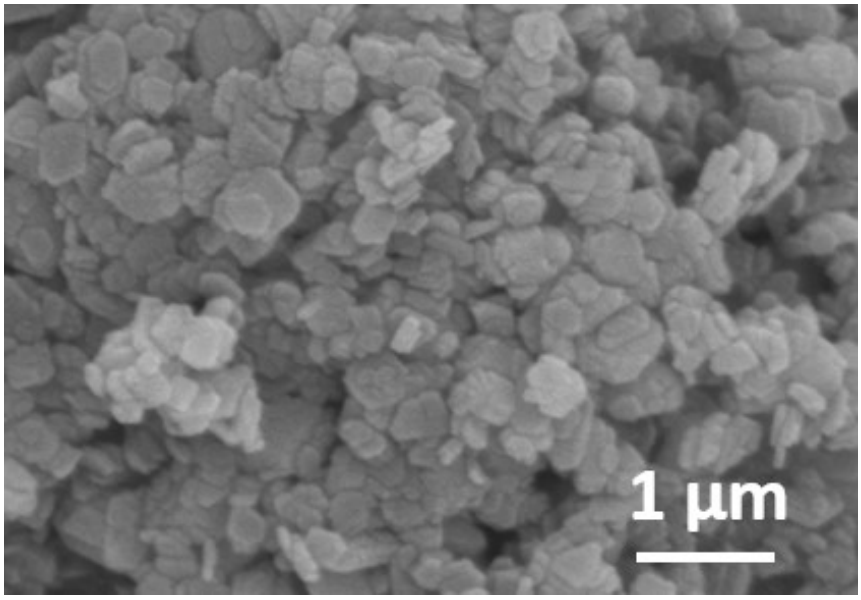

Fig. S1 SEM image of PS-Fe(II)-I after 12d of reaction.

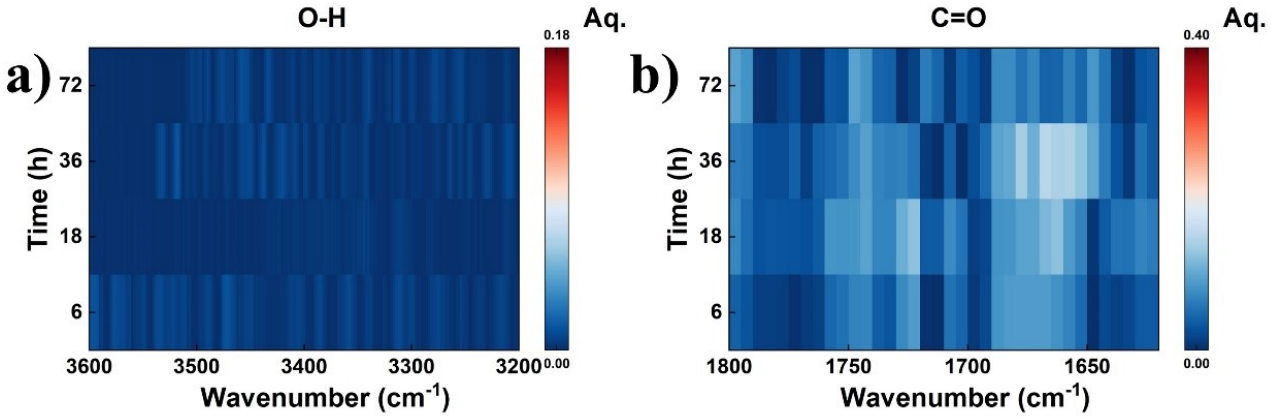

Fig. S2 Heat mappings of a) -OH and b) C=O functional group analyzed by FT-IR for PS-Fe-I after reaction of 6 h, 18 h, 36 h and 72 h.

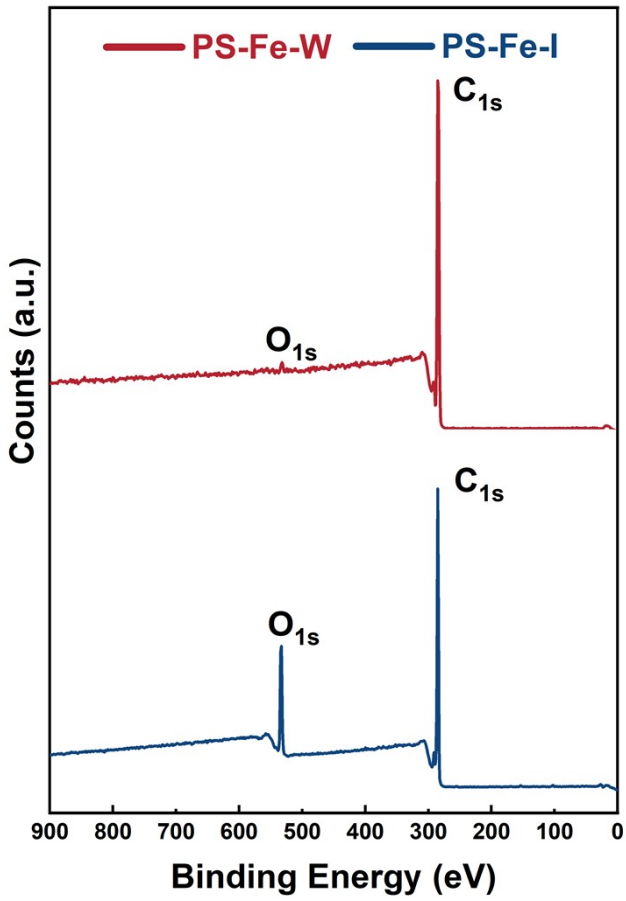

Fig. S3 XPS spectra of PS-Fe-W and PS-Fe-I after the degradation reaction for 36 h.

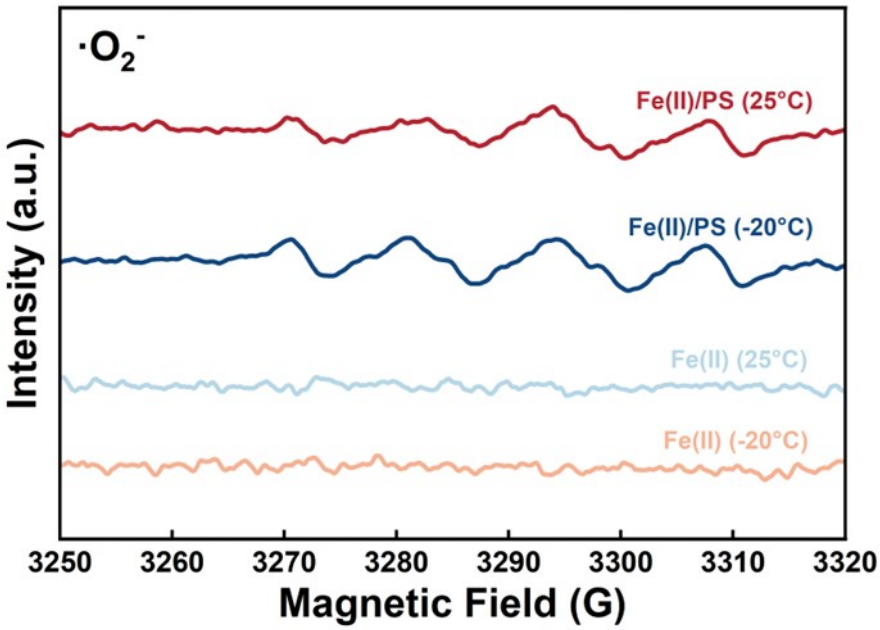

Fig. S4 EPR spectra of $\bullet O_2^-$ in PS frozen (-20 °C, Fz.) and aqueous (25 °C, Aq.) Fe (II) solutions after 36 h. Fe(II) = 100 μmol/L, [PS] = 25 mg/L.

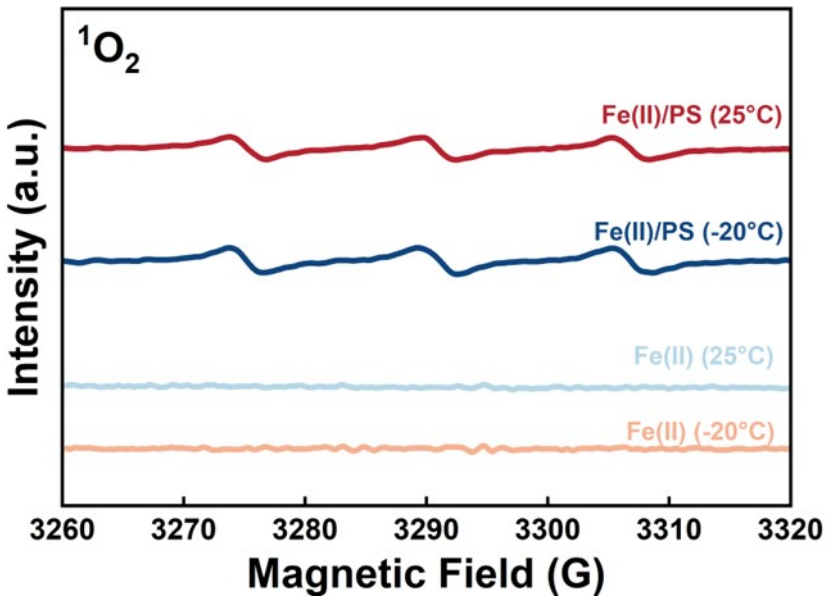

Fig. S5 EPR spectra of $^1O_2$ in PS frozen (-20 °C, Fz.) and aqueous (25 °C, Aq.) Fe(II)-containing solution after 36 h. Fe(II) = 100 μmol/L, [PS] = 25 mg/L.

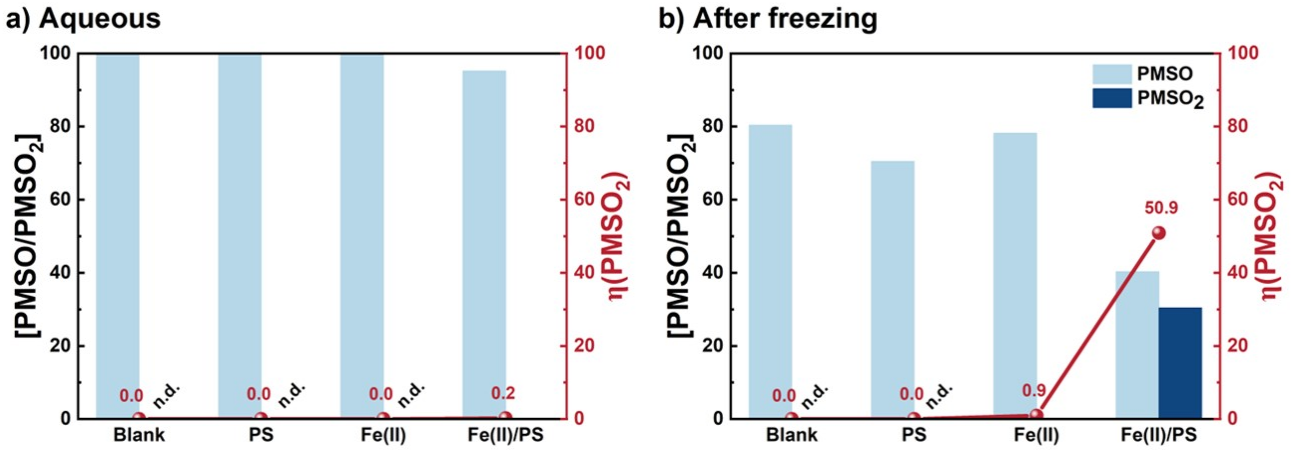

Fig. S6 PMSO degradation, $PMSO_2$ formation and $\eta(PMSO_2)$ a)before freezing and b)after freezing in a blank, PS solution, Fe(II) solution, Fe(II) and PS solution. $[Fe(II)]_0 = [PMSO]_0 = 100$ μmol/L, [PS] = 2.5 mg/L, freezing temperature = -20°C, freezing time = 36h.

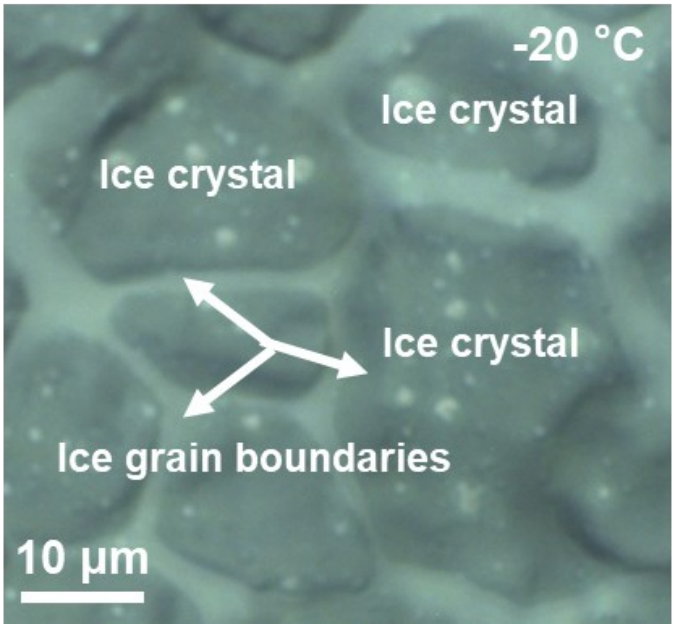

Fig. S7 Confocal Raman microscopy test of PS-Fe-I at -20°C.

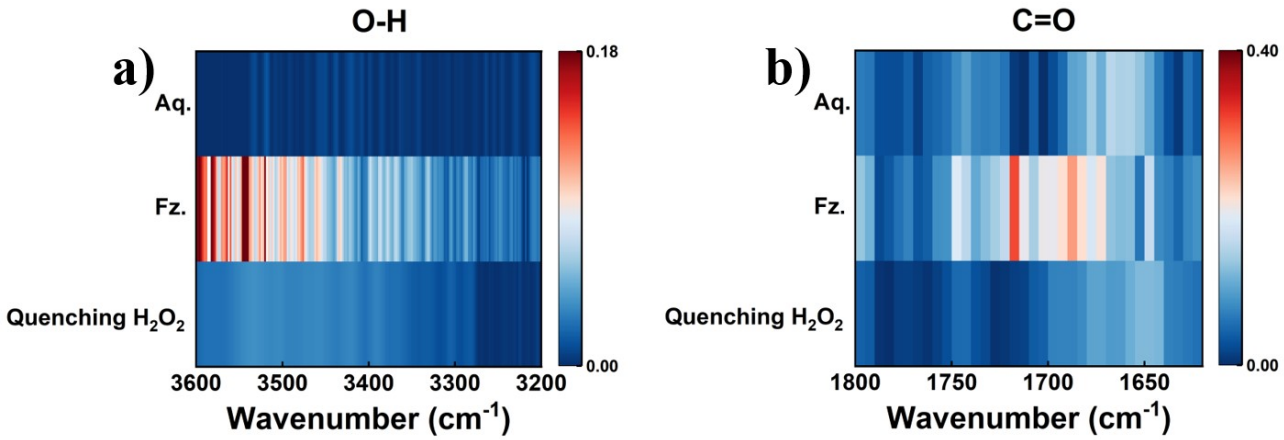

Fig. S8 Heat mappings of a) −OH and b) C=O regions in FT-IR spectra by quenching H_2O_2 after 36 h degradation in water and frozen ice.

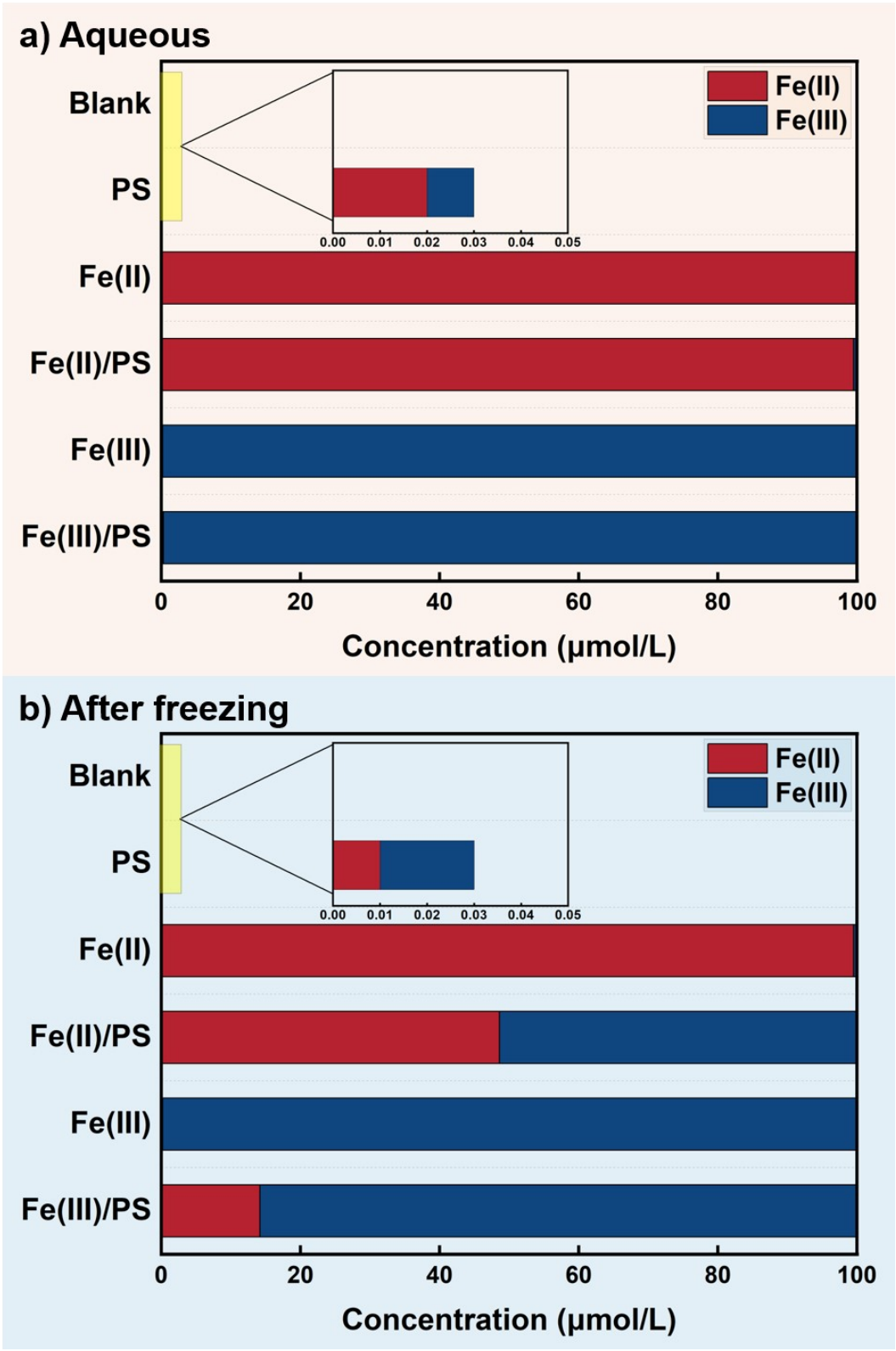

Fig. S9 The concentration of Fe(II) and Fe(III) a)before freezing and b)after freezing in a blank, PS solution, Fe(II) solution, Fe(II) and PS solution, Fe(III) solution, Fe(III) and PS. [Fe(II)] = [Fe(II)] = 100 μmol/L, [PS] = 2.5 mg/L, freezing temperature = -20°C, freezing time = 36h.

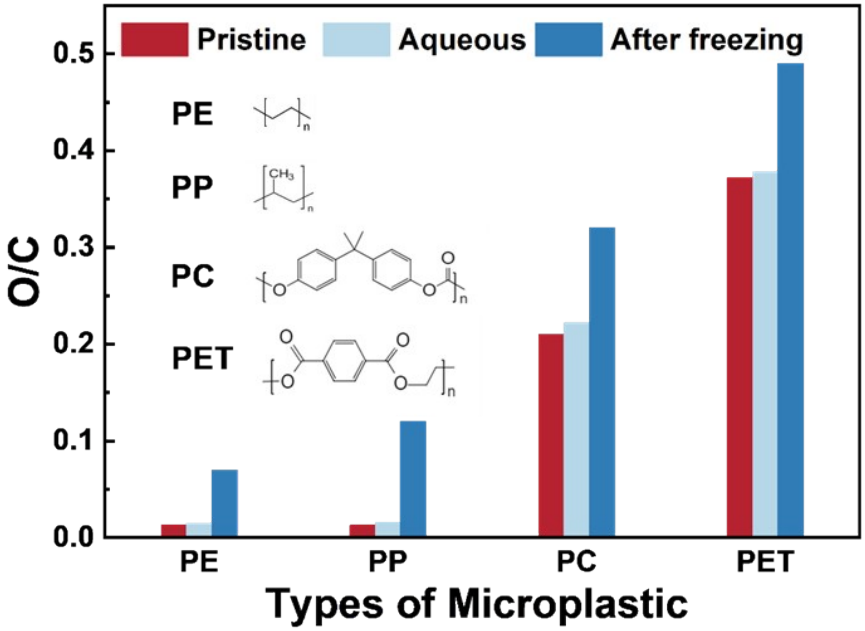

Fig. S10 Enhanced degradation of freezing polypropylene (PP), Poly ethylene (PE), polycarbonate (PC) and polyethylene terephthalate (PET).

Table S1 Determination parameters of PMSO and $PMSO_2$.

Organic Contaminant	Mobile Phase		Detection Wavelength (nm)	Flow Rate (mL/min)
	Water (%)	Acetonitrile (%)		
PMSO	72	28	230	0.13
$PMSO_2$	72	28	230	0.13