DNA Cleavage and Chemical Transformation of Nano-plastics Mediated by Surface Ligand and Size

Chemical Communications

Supporting Information

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Materials and Methods

Materials. Nano-plastic nanoparticles (PS-NH_2, 40, 80, 100, 200 nm and PS-COOH, 40, 80, 100, 200 nm) were purchased from Huge Biotechnology, Shanghai, China. pBR322 DNA was obtained from Thermo Fisher Scientific, Shanghai, China. All other chemicals were purchased from Sigma-Aldrich (MO, USA) and used as obtained. A milli-Q water purification system (Millipore, Billerica, MA, US) was used for generating deionized (DI) water and chemicals were dissolved in DI water.

Characterization. All nanoplastic nanoparticles (PS-NH_2, 40, 80, 100, 200 nm and PS-COOH, 40, 80, 100, 200 nm, 50 mg/L), with or without 2-hour sunlight irradiation, was dropped on clean silicon slice for SEM measurement.

ROS measurement by EPR

All nanoplastic nanoparticles (PS-NH_2, 40, 80, 100, 200 nm and PS-COOH, 40, 80, 100, 200 nm) were freeze-dried in a freeze drier. In order to measure superoxide anion radical, the nanoplastics were re-dispersed in methanol. To measure hydroxyl radical and singlet oxygen, solvent was water. After re-dispersion, the mixtures were sonicated for 5 mins. Then 200 uL solution was taken out to mix with 200 uL DMPO or TEMP (100 mM). Then the capillary tube was used to place the solution for testing under solar irradiation.

DNA Assay

Mixture containing pBR322 DNA (0.015g/L) and different kinds of nanoplastics (PS-NH_2, 40, 80, 100, 200 nm and PS-COOH, 40, 80, 100, 200 nm, 100 mg/L) was irradiated under a solar simulator for 2 hours. The intensity of the solar simulator is 1 sun. The temperature does not change under 1 sun for 2 h to exclude the effects of temperature. After irradiation, DNA loading dye was added into the mixture. DNA gel-electrophoresis was conducted in 1% agarose gel under 100V for 30 minutes by a PowerPac Basic Power Supply (Bio-Rad, New Brunswick, NJ, USA). The gel images were taken by ChemiDoc MP Imaging System (Bio-Rad, CA, USA).

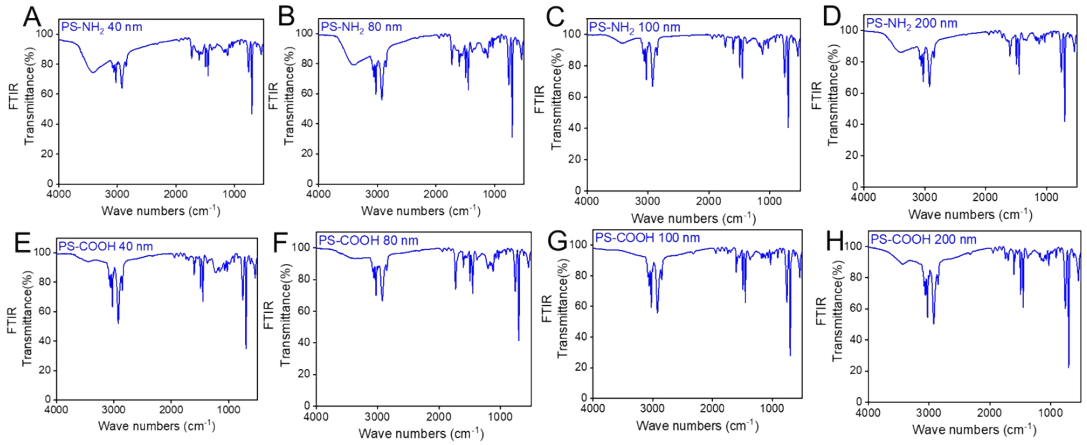

Figure SI-1. FTIR measurement. (A) 40 nm-PS-NH_2, (B) 80 nm-PS-NH_2, (C) 100 nm-PS-NH_2, (D) 200 nm-PS-NH_2, (E) 40 nm-PS-COOH, (F) 80 nm-PS-COOH, (G) 100 nm-PS-COOH, (H) 200 nm-PS-COOH.

Table SI-1. The zeta potentials of nanoplastic particles before and after irradiation.

	Before Irradiation		After Irradiation	
	Average zeta	STD	Average zeta	STD
PS-NH_2 40 nm	28.16	0.32	35.40	1.35
PS-NH_2 80 nm	28.33	0.33	28.90	2.64
PS-NH_2 100 nm	45.60	1.42	45.83	0.36
PS-NH_2 200 nm	49.13	0.70	49.86	0.26
PS-COOH 40 nm	-38.50	3.90	-41.13	0.71
PS-COOH 80 nm	-47.76	0.82	-45.03	3.10
PS-COOH 100 nm	-47.26	0.26	-44.33	1.03
PS-COOH 200 nm	-44.43	0.37	-40.93	0.78

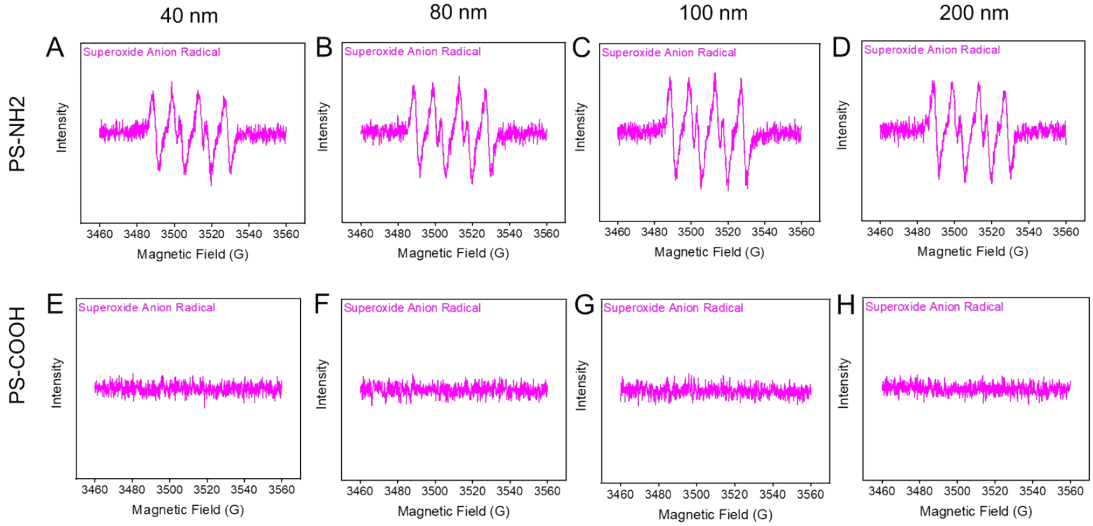

Figure SI-2. Detection of superoxide anion radical. The production of superoxide anion radical

with (A) 40 nm-PS-NH_2, (B) 80 nm-PS-NH_2, (C) 100 nm-PS-NH_2 and (D) 200 nm-PS-NH_2 under solar irradiation. No generation of superoxide anion radical with (E) 40 nm-PS-COOH, (F) 80 nm-PS-COOH, (G) 100 nm-PS- COOH and (H) 200 nm-PS- COOH under solar irradiation.

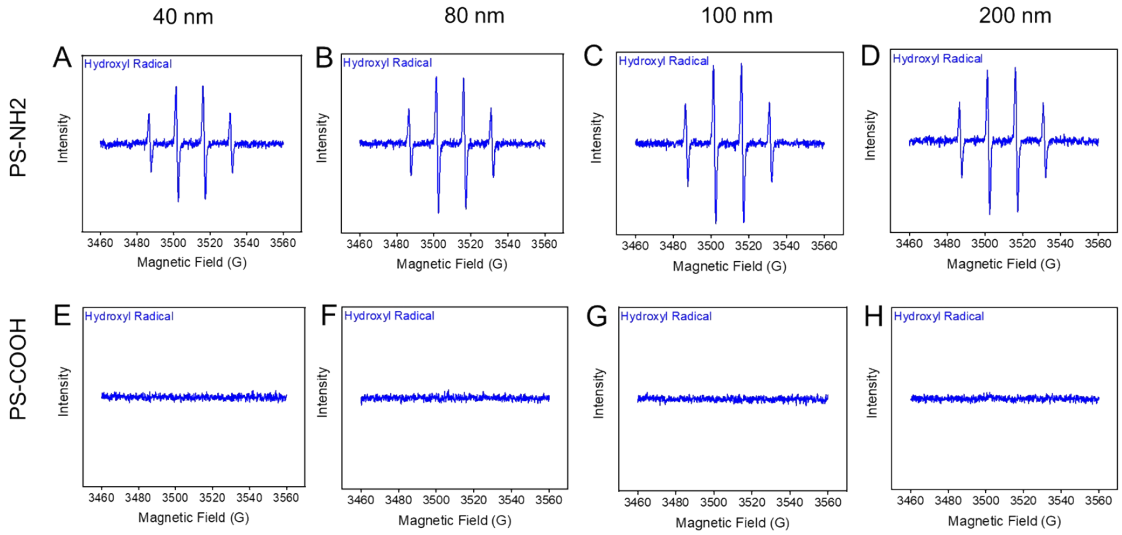

Figure SI-3. Detection of hydroxyl radical. The production of hydroxyl radical with (A) 40 nm-PS-NH_2, (B) 80 nm-PS-NH_2, (C) 100 nm-PS- NH_2 and (D) 200 nm-PS-NH_2 under solar irradiation. No generation of hydroxyl radical with (E) 40 nm-PS-COOH, (F) 80 nm-PS-COOH, (G) 100 nm-PS- COOH and (H) 200 nm-PS- COOH under solar irradiation.