Electronic Supplementary Information

Combined Toxicity of Nanoplastics and Pyriproxyfen to *Daphnia magna*

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Reference to previous work on the synthesis of $NaLuF_4$: 20%Yb, 2%Er@$NaLuF_4$ [1,2].

Synthesis of $NaLuF_4$: 20% Yb, 2% Er@$NaLuF_4$@SiO_2: 1.0g of CO-520 was weighed and added to a three-necked round bottom flask. Subsequently, 0.1mmol of $NaLuF_4$: 20%Yb, 2%Er@$NaLuF_4$ was added and dissolved in 10mL of cyclohexane. Next, 80 μL of ammonia solution was added and the mixture was stirred for 3 hours. Then, 40 μL of tetraethyl orthosilicate was added to the flask, and the mixture was stirred for 24 hours. After that, 20 μL of 3-Methacryloxypropyltrimethoxysilane was added, and the reaction was continued for 24 hours. To separate the mixture, 10mL of ethanol was added, and the mixture was centrifuged at 12000 rpm for 15 minutes. It was washed multiple times with a large amount of ethanol and water and finally dispersed in pure water for storage.

Synthesis of $NaLuF_4$: 20% Yb, 2% Er@$NaLuF_4$@SiO_2@PS: All the above reagents were added to a three-necked round bottom flask, followed by the addition of 25 mL of ethanol and 15 mL of pure water. The mixture was stirred for 3 hours, and then 150 μL of styrene monomer was added. The system was bubbled with Ar for half an hour to remove oxygen. Subsequently, the reaction system was heated to 75 ℃. Once the temperature stabilized, 500 mL of Potassium persulfate aqueous solution (20 mg/mL) was added, and the reaction was allowed to proceed for 1 hour in an Ar atmosphere. Another 150 μL of styrene monomer, 1mL ethanol solution containing 20% acrylic acid and 8% divinylbenzene were then added, and the reaction was continued for 3 hours. After the reaction was complete, it was cooled naturally to room temperature, centrifuged at 13500 rpm for 20 minutes, and washed multiple times with a large amount of water and ethanol before finally being stored in pure water.

The dimensions of the nanoparticles (NPs) were observed with a transmission electron

microscope (TEM, Hitachi H-7650B, 80 kV). The steady-state upconversion luminescence spectrum, which refers to the emission spectrum of the NPs under a specific excitation wavelength, was determined by a fluorescence spectrophotometer (FLS 980, Edinburgh Instruments) under excitation by a continuous beam of 980 nm laser from Changchun New Industries Optoelectronics Technology Co., Ltd.

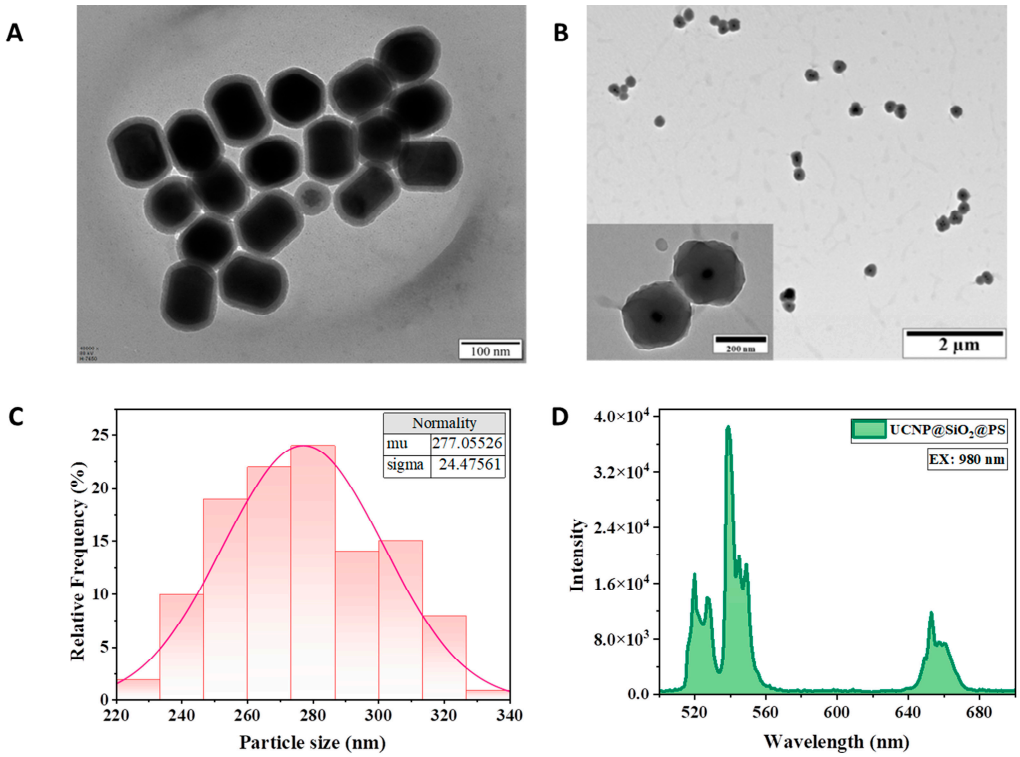

Figure S1. (A) TEM image of $NaLuF_4$: 20% Yb, 2% Er@$NaLuF_4$@SiO_2; (B) TEM images of $NaLuF_4$: 20% Yb, 2% Er@$NaLuF_4$@SiO_2@PS; (C) diameter distribution of PS-NPs based on the result of TEM images; (D) luminescence spectrum of PS-NPs at the excitation wavelength of 980 nm (2 W/cm^2).

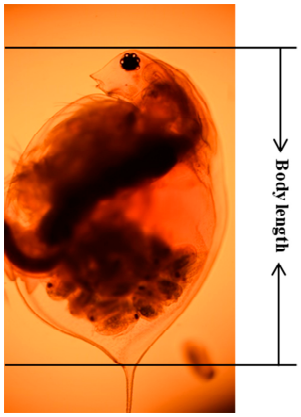

Figure S2. Measurement of body length of *D. magna*.

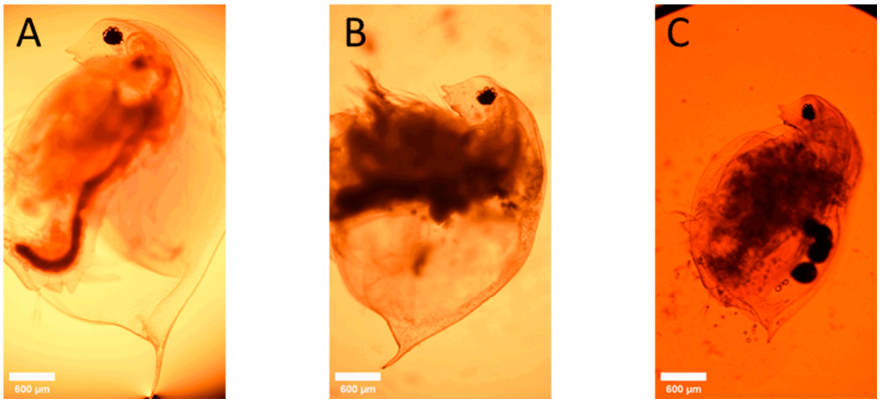

Figure S3. Digital camera images of *D. magna* after 21 days of chronic experiment. (A) 0 ng/L pyriproxyfen; (B) 100 ng/L pyriproxyfen; (C) 200 ng/L pyriproxyfen.

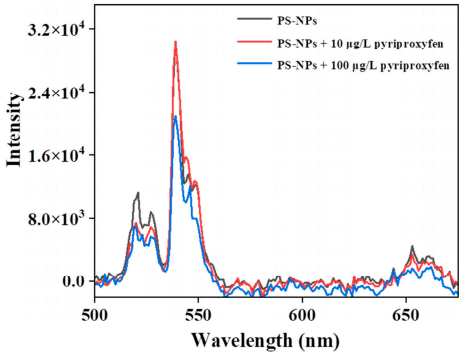

Figure S4. Luminescence spectrum of 1 mg/L PS-NPs at the excitation wavelength of 980 nm (2 W/cm^2).

Table S1. Select the concentration of pyriproxyfen.

The concentration of pyriproxyfen (mg/L)

0 mg/L PS-NPs	1 mg/L PS-NPs	5 mg/L PS-NPs	10 mg/L PS-NPs
0.10	0.13	0.16	0.20
0.13	0.16	0.24	0.40
0.20	0.20	0.35	0.80
0.25	0.25	0.50	1.60
0.32	0.32	0.80	3.20
0.4	0.40	1.60	6.40

Reference

1. Wang, Z.-J.; Zhang, Y.-H.; Gao, R.-Y.; Jia, H.-B.; Liu, X.-J.; Hu, Y.-W.; Shao, Q.-Q.; Fu, L.-M.; Zhang, J.-P. Polystyrene Nanoparticle Uptake and Deposition in Silkworm and Influence on Growth. Sustainability 2023, 15, 7090, doi:10.3390/su15097090.
2. Zhang, Y.-H.; Gao, R.-Y.; Wang, Z.-J.; Shao, Q.-Q.; Hu, Y.-W.; Jia, H.-B.; Liu, X.-J.; Dong, F.-Q.; Fu, L.-M.; Zhang, J.-P., Daphnia magna uptake and excretion of luminescence-labelled polystyrene nanoparticle as visualized by high sensitivity real-time optical imaging. Chemosphere 2023, 326, 138341, doi:10.1016/j.chemosphere.2023.138341.