

## **Microplastics and nanoplastics disturb the biomineralization of manganese**

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Microplastics (MPs, 1 $\mu$ m-5mm) and nanoplastics (NPs, <1 $\mu$ m) are both discharged directly or from the fragmentation of large plastics into the environment. Then MPs and NPs can interact with microbes. Due to their own nature and load toxicity effect, MPs and NPs can show negative effects on the growth and function of microorganisms. However, these studies are still in their infancy, little attention has been paid to the effect of MPs and NPs on biomineralization.

In this study, we used the Mn oxidizing fungi, which can oxidize Mn(II) to poorly crystalline Mn oxide, to investigate the effect and mechanism of different size of plastic debris (4mm, 2mm, 500 $\mu$ m, 100nm) on biomineralization.

Through direct and optical microscope observation, the Mn oxides decreased with the decrease of particle size, indicated that smaller particle size had stronger inhibitory effect on the Mn oxidation capacity of Mn oxidizing fungi. The surface of MPs (4mm, 2mm, 500 $\mu$ m) were covered with layered black Mn oxides, and the MPs were connected by Mn oxides and hyphae. Transmission electron microscopy (TEM) showed that for MPs, Mn oxides were formed on the hyphae, which was consistent with previous studies. However, for NPs, only a small amount of Mn oxides existed on the hyphae, which was the same with the results of direct and optical microscope observation. Instead, a lot of NPs were attached to the hyphae, which may be the main reason for the inhibition of the Mn oxidation capacity of Mn oxidizing fungi.