INTERACTIONS BETWEEN TERRESTRIAL PLANTS AND RARE EARTH OXIDE NANOPARTICLES

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Introduction

Rare earth oxide (REO) NPs generally have magnetic, catalytic, and optic properties and have been widely used in paint coating, polishing powder, automobile exhaust catalysts, etc. REO NPs could be released into the environment from various application routes, but their effects on the ecosystem are still unknown (Gottschalk, et al., 2013). In this study, phytotoxicity of 3 REO NPs, nano-CeO_2, nano-La_2O_3, and nano-Yb_2O_3 on 7 terrestrial plant species (radish, rape, tomato, lettuce, wheat, cabbage, and cucumber) were investigated and the toxic mechanisms were explored.

Methods

Phytotoxicity of REO NPs on plants was assessed by means of seed germination and root elongation tests. Distribution and biotransformation of REO NPs in plant roots were investigated *in situ* by TEM, EDS, as well as synchrotron radiation based scanning transmission X-ray microscopy (STXM).

Results

A suspension of 2000 mg L^{-1} nano-CeO_2 only had negative effect on the root elongation of lettuce. On the contrary, 2000 mg L^{-1} suspensions of nano-La_2O_3 and nano-Yb_2O_3 severely inhibited the root elongation of all the 7 species. Most of nano-La_2O_3 and Yb_2O_3 were transformed into $REPO_4$ in plant roots. Phytotoxicity of trivalent NPs was probably attributed to the dissolution of NPs on the root surface induced by the organic acids excreted from root cells. Nano-CeO_2 is generally recognized as stable in biological or environmental systems. We proved for the first time that nano-CeO_2 NPs can be reduced to Ce(III) in hydroponic plants. The high sensitivity of Lactuca plants to the released Ce^{3+} ions caused the species-specific phytotoxicity of nano-CeO_2 (Zhang, et al., 2015).

Conclusion

Biotransformation of REO NPs is pivotal for their ecotoxicology research.

References

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