PHYTOTOXICITY OF RARE EARTH OXIDE NANOPARTICLES

ZHANG Zhiyong, MA Yuhui, ZHANG Peng, HE Xiao, LI Yuanyuan, ZHAO Yuliang

Institute of High Energy Physics, Chinese Academy of Sciences, Beijing, China

Abstract

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, and so on. REO NPs could be released into the environment from various application routes, but their effects on the ecosystem are still unknown.We assessed phytotoxicity of 3 rare earth oxide nanoparticles, nano-CeO_2, nano-La_2O_3, and nano-Yb_2O_3 on seven higher plant species (radish, rape, tomato, lettuce, wheat, cabbage, and cucumber). 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. To explore the phytotoxicity mechanism of REO NPs, distribution and biotransformation of the three materials in plant roots were investigated in situ by TEM, EDS, as well as synchrotron radiation based method STXM. The results showed that most of nano-La_2O_3 and Yb_2O_3 were transformed into REPO4 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.

Keywords: Biotransformation, Phytotoxicity, Rare earth oxide nanoparticles

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