Bioavailability, Toxicity, and Trophic Transfer of Manufactured ZnO Nanoparticles

Supporting/Contributing Agency/Institution: U.S. EPA (STAR RD832530), with University of Georgia, University of Kentucky

Since 2006, Dr. Paul Bertsch and his collaborators have been investigating the bioavailability, toxicity, and trophic transfer of two different sizes of manufactured zinc oxide nanoparticles (ZnO-np) in terrestrial environments. Decomposers and detritivores are central players to potential ecological risks associated with the release of manufactured nanomaterials to the environment, from the standpoint of both uptake and transformation of the nanomaterials, including transfer from one trophic level to the next, as well as of lethal and sub-lethal toxicity endpoints (Unrine et. al. 2008, 343-364).

Characterization studies have revealed that the acetate used in ZnO-np (<4 nm) synthesis and stabilization can inhibit surface reactivity through the passivation of surface sites. Acetate removal leads to aggregation of the ZnO-np primary particles but promotes greater surface reactivity. ZnO-np exposure experiments to nematodes found that biological responses can be independent of the free ion concentration and that different toxicity mechanisms may be operative (Ma et al. 2008).

Also uptake and distribution of ZnO-np (see *figure*) may sometimes be size dependent but not always and ZnO-np can be effectively distributed among tissues remote from the portal of entry. These results are important to environmental agencies that seek to establish guidelines on potential consequences of nanomaterials released to the environment.

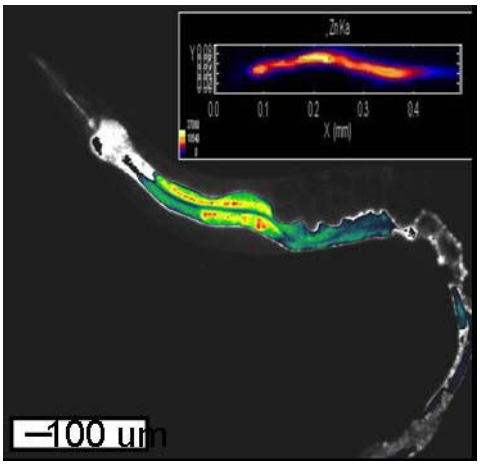

Figure. X-ray fluorescence /epifluorescence maps of Zn distribution in exposed worms.

References/Publications

Ma et al., 2008 (in press). Bioavailability and toxicity of manufactured ZnO nanoparticles in the nematode *Caenorhabditis elegans*. *Environmental Toxicology and Chemistry*.

Unrine, J., P.M Bertsch, and Simona Hunyadi. 2008. “Bioavailability, trophic transfer, and toxicity of manufactured metal and metal oxide nanoparticles in terrestrial environments.” In V.H. Grassian, ed., *Nanoscience and nanotechnology*. Berlin: Wiley-VCH..