How do nanoparticles impact our environment and us?

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We are seeing an increased availability of nanoparticle-containing products on the market. During production, use and disposal they affect both our environment and us. Sometimes the interactions are remarkable.

In the young nanoecotoxicology field researchers such as Dr. Irina Blinova and colleagues at the National Institute of Chemical Physics and Biophysics in Estonia evaluate nanoparticles' (NPs) interaction with their environment. ZnO NPs can be found in paints and personal care products and CuO NPs is present in photovoltaic cells, gas sensors and other products on the market. This means there is a rising risk that NPs will contaminate natural water. The Estonian researchers found natural water has a surprising potential to reduce CuO NPs' (but not ZnO NPs') toxic effects on crustaceans. The potential was principally dependent on dissolved organic carbon concentration in the water. The toxic effects were primarily due to dissolved metal ions and the toxic effect reduction was up to 140-fold.

Priyanka Gajjar and colleagues at Utah State University also studied CuO and ZnO NPs, but they wanted to find out if these metal-containing NPs and Ag NPs were dangerous to beneficial soil microorganisms. These microorganisms are important in plant growth and pollutant degradation. Both CuO and Ag NPs killed the microorganisms while the ZnO NPs inhibited microorganism growth and reproduction. Bulk material showed no toxicity to microorganisms. That made the researchers assume the NPs toxic effect on microorganisms could be reduced in NP aggregation making them larger.

Ag NPs were also in focus when Dr. Enda Cummins at the UCD institute of Food and Health in Ireland ranked environmental and human health risks from nanomaterials. He concluded, for example, that the exotoxicological risk rankings for Ag and TiO2 NPs posed by their release to surface waters were of moderate to high concern. “We have used a risk ranking approach to facilitate a comparison between different nanomaterials. Due to many uncertainties in current data we cannot give exact predictions on likely environmental concentrations, but we can do a relative comparison among materials. This facilitates a prioritisation of nanomaterials from a toxicological and ecotoxicological basis while identifying critical data gaps. We thought the highest exposure risk would be from possible airborne nanomaterials, but we found the highest rank was from surface water. Our next step is to fill the many data gaps.”

Dr. Anne Kahru from the National Institute of Chemical Physics and Biophysics in Estonia and Henri-Charles Dubourguier from Institut Sup?rieur d'Agriculture in France identified in 2009 the most harmful NPs and most sensitive organism groups though evaluation of existing information on NPs toxicity in different species. The organisms included were bacteria, algae, crustaceans, nematodes, yeasts, fish, and ciliates. They stand for primary food-chain levels. The evaluated NPs were TiO2, CuO, MWCNs, SWCNTs, C60-fullerenes, ZnO and Ag. The two latter were classified as extremely toxic (L(E)C50 provided for information purposes only.