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Nanotechnology: Industrial revolution or "Pandora's box" an ecotoxicology perspective

Sustinută de către

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Abstract. Nanotechnology is considered as the "sixth truly revolutionary technology" introduced in the modern world. The central question how to benefit by this powerful technology, while maximizing and avoiding possible risks represents a challenge for regulatory agencies and an important area of scientific research.

With examples from our own research we will illustrate what happens when aquatic microorganisms are inadvertently exposed to metal-containing nanoparticles that are increasingly released into the environment from nano-enabled materials. We highlight the complexity of the nano-sized material behavior in the aquatic environment and discuss the importance of various transformations and organism ingestion patterns for the assessment of the environmental implications of these materials. Among different ENMs we choose to study metal-containing engineered nanomaterials (ENMs) such as nanoAg, nanoCuO, nanoTiO_2 etc.) which are often used as biocides, but also shown to have significant effect on non-targeted species. We compared the ENMs-induced responses in two representative phytoplankton species: presumably "particle-proof" green alga *Chlamydomonas reinhardtii* and "particle-ingesting" microalgal predator flagellate *Poterioochromonas malhamensis*. Generation of the highly reactive oxygen species (ROS), disturbing the cellular pro- and antioxidant equilibrium was followed. The results revealed significant increase of the cellular ROS upon exposure to ENMs, but the intensity of the effects was dependent on the nature and concentration of the ENMs, the exposure duration and the feeding pattern of the species. Liquid chromatography - based targeted metabolomics revealed that in all cases the abundance of metabolites involved in various pathways corresponding to amino acid, nucleotides, fatty acids, tricarboxylic acid cycle (TCA), and antioxidant metabolism was altered in various treatments. The metabolomics results correlate well with the physiological results and confirmed that (i) oxidative stress is a major toxicity mechanism for nanoTiO_2 exposure; (ii) dissolved Ag released by nanoAg seems to be a major toxicity driver, even though nanoAg is internalized in the food vacuoles of *P. malhamansis*. However, nanoAg play an important role in the perturbation of amino acid metabolism, TCA cycle and oxidative stress. These results demonstrate the value of metabolomics as a tool for understanding the molecular basis for these metabolic and physiological changes, and to detect early on metabolic changes that can later express themselves physiologically.

Speaker bio

Dr. Slaveykova is a Full Professor in Environmental Biogeochemistry and Ecotoxicology at the Department for Environmental and Aquatic Sciences (DEFSE), University of Geneva, Switzerland, and a President of the School of Earth and Environmental Sciences. Her research focus is on the improvement of the basic knowledge of the key processes governing the behavior and possible effects of inorganic contaminants such as toxic metals, engineered nanoparticles and nanoplastics in aquatic ecosystems, from their input to the site of biological action. Dr. Slaveykova serves as a Specialty Chief Editor of Section Biogeochemistry Dynamics of the Frontiers in Environmental Science and is member of the National Research Council of Swiss national Science Foundation.