What do phytoplankton tell us about environmental implications of nanotechnology?

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Improved understanding on the interactions of engineered nanomaterials (ENMs) with living organisms is central for predicting their behavior and effects in the environment, for grouping and categorizing of nanomaterials and for designing safe nanomaterials. The present talk focusses on the interactions of metal-containing ENMs with phytoplankton to explore what happens when aquatic organisms are inadvertently exposed to metal-containing nanoparticles. Phytoplankton are some of Earth's most critical organisms making life possible. They produce almost half of the oxygen on our planet and act as a sink of the CO_2, they form the basis of the aquatic food-webs, supporting production of higher trophic levels. Among different ENMs we choose to study metal-containing engineered nanomaterials (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 responces 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.

Since phytoplankton species could affect the ENMs behavior in the aquatic systems, we have also studied the effects of the phytoplankton-produced extracellular polymeric substances (EPS) on the behavior of the ENPs and demonstrated a significant effect of the EPS on the agglomeration and dissolution of metal-containing NPs.

Overall, not only NMs could affect the phytoplankton, but the phytoplankton could alter the NMs behavior. Such knowledge on the interactions of the phytoplankton with ENMs could guide the informed decision about the possible environmental consequences of the nanotechnology and selection of the materials tailored for environmental applications.