

## A Better Insight into Engineered Nanomaterials Life Cycle combining Single Particle and Single Cell ICP-MS

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Recently the production and use of engineered nanomaterials (ENMs) have experienced a drastic increase in manufacturing and use in commercial products. This increase in use results in a significant risk of their release into the environment and their interaction with aquatic species such as algae or fish. The measurement of exposure (amount of contaminant in the water), dose (amount of contaminant taken up by organism) and response has been difficult to quantify due to the limitations of being able to measure the amount of metal within a single cell.

Single cell ICP-MS (SC-ICP-MS) is a new ICP-MS technique based on single particle (SP)-ICP-MS, which allows for the measurement of the metal content of individual single celled organisms. SC-ICP-MS allows for the measurement of exposure and dose to single celled organisms in both environmental and human health studies with minimal sample preparation and at relevant contaminant concentrations. SC-ICP-MS allows for the quantification of both metal concentration within the cell and the number of cells containing that metal. It permits for the measurement of intrinsic metal as well as the uptake of both dissolved and nanoparticulate (NP) metallic contaminants.

Here we examine the uptake and depuration of both dissolved (Au) and NP (Au and Ag) to freshwater algae. The algae were exposed to Au and Ag nanoparticles over a period of four days. The amount of NPs in suspension (exposure) and the amount of metal taken up by the cells (dose) were measured by SC-ICP-MS and the toxicity (biological response) was measured at various time points. We show that the percentage of the cell population containing metal NPs increases with both time and initial exposure concentration. The uptake of multiple NPs into individual cells was observed for higher concentration exposures along with evidence for intercellular interactions with the NPs.