Extraction and Single-Particles-ICP-MS characterization of Nanoparticles from the environment

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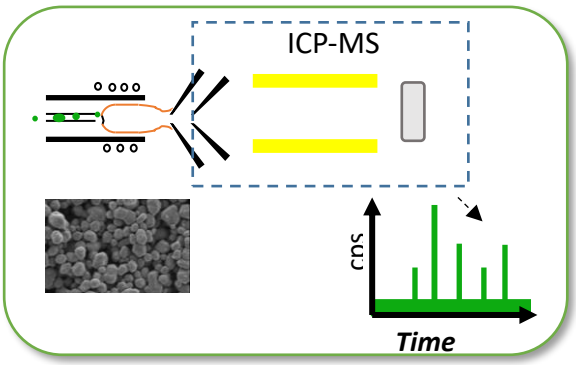
The fast growth in the production and use of engineered nanoparticles (NPs) increases also exposure of the natural environment to these compounds. Single-particle analysis is therefore a growing research field. Nano materials, due to their unique properties are employed in many applications. In medicine, nanocarriers have provided a novel platform for target-specific delivery of therapeutic agents. Gold nanoparticles have emerged as a promising scaffold for drug delivery. Nano particles are also introduced in cosmetics or as antimicrobial additives in paints. For example, TiO2 and ZnO in nanoform are extensively used in current sunscreens and their wide use spreads the nano-particles in the environment.

With the increased incorporation into everyday products, release of NPs into the environment is growing, while, the environmental and ecological risk associated with these materials is still not well understood. Furthermore, elements occuring at trace levels in the environment are now increasingly present as incorporated in engineered nano-materials such as rare earth elements (Ce, Gd) or precious metals (Ag or Au).

Single-particle ICP-MS (spICP-MS) harnesses the specificity and sensitivity of ICP-MS to detect and characterize NPs at low-ppt concentrations. Utilizing time-resolved analysis with short dwell times, a discrete pulse of intensity originating from each particle vaporization and ionization in the inductively coupled plasma can be detected. The frequency of the recorded spikes is proportional to the particle number concentration.



The ICP-MS application to NPs determination has received much attention in the past decades and we propose to develop research to be able to detect and characterize particles directly from the environment. The study may be separated in three essential and complementary objectives.

-Develop a new extraction procedure, to be able to transfer the particles from a real world environment (surface and waste waters) without modification of the nature and particle distribution.

-Improve selectivity of the spICP-MS method toward small <10nm particles. In this field, recent instrumentations allow to drastically reduce dwell times and consequently improve detection of smaller particles. A consequent work on mass spectrometric parameters will be done in our work.

-The method will then be applied to complex environmental matrices where the particles are from various origins (organics, purely metallic NPs and mixed oxides).

Keywords: environment, spectrometry, ICP-MS, nanomaterials

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