Hyphenated mass spectrometry for characterization and quantification of airborne nanoparticles

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The advances in the field of nanotechnologies (NTs) led to an increased amount and variety of nanomaterials (NMs) employed in industrial and commercial sectors. The rapid growth of NTs market represent an emerging risk of exposure for workers involved, as the toxicological effects of many NMs are not yet clear due to the wide range of properties that they can exhibit.

In this framework, occupational exposure risk assessment requires the characterization of the physicochemical properties of airborne nanoparticles (NPs) in specific workplace scenarios. Recently, hyphenated mass spectrometric techniques like Asymmetric Flow Field-Flow Fractionation (AF4) combined with inductively coupled plasma mass spectrometry (ICP/MS) have been proposed for NPs characterization in biological and environmental aqueous matrices.

AF4 is considered to be a suitable method in separating NPs while the single particle mode of ICP-/MS is able to measure number concentration (particles/mL), mass concentration (μg/mL), and size distribution with high sensitivity (ISO/TS 19590:2017, OECD TG No.125 2023).

In this study we present the optimization of an AF4 separation system combined with sp-ICP/MS method for metal and metal oxides NPs analysis, using two different size reference materials of silver NPs (40 and 100 nm); the method was applied to trial samples collected by simulating the handling of SiO_2 and TiO_2 nanopowders inside a glove-box chamber isolated from external environment.