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Tutorial

Introduction of organic/hydro-organic matrices in inductively coupled plasma optical emission spectrometry and mass spectrometry: A tutorial review. Part I. Theoretical considerations

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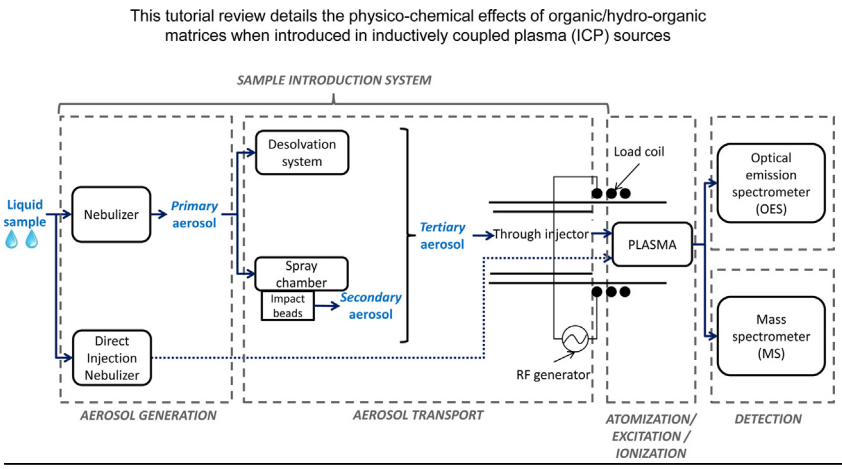
HIGHLIGHTS

- Tutorial review addressed to beginners or more experienced analysts.
- Theoretical background of effects caused by organic matrices on ICP techniques.
- Spatial distribution of carbon species and analytes in plasma.
- Carbon spectroscopic and non-spectroscopic interferences in ICP.

GRAPHICAL ABSTRACT



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ABSTRACT

Due to their outstanding analytical performances, inductively coupled plasma optical emission spectrometry (ICP-OES) and mass spectrometry (ICP-MS) are widely used for multi-elemental measurements and also for isotopic characterization in the case of ICP-MS. While most studies are carried out in aqueous matrices, applications involving organic/hydro-organic matrices become increasingly widespread. This kind of matrices is introduced in ICP based instruments when classical "matrix removal" approaches such as acid digestion or extraction procedures cannot be implemented. Due to the physico-chemical properties of organic/hydro-organic matrices and their associated effects on instrumentation and analytical performances, their introduction into ICP sources is particularly challenging and has become a full topic. In this framework, numerous theoretical and phenomenological studies of these effects have been performed in the past, mainly by ICP-OES, while recent literature is more focused on applications and associated instrumental developments. This tutorial review, divided in two parts, explores the rich literature related to the introduction of organic/hydro-organic matrices in ICP-OES and ICP-MS. The present Part I, provides theoretical considerations in connection with the

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physico-chemical properties of organic/hydro-organic matrices, in order to better understand the induced phenomena. This focal point is divided in four chapters highlighting: (i) the impact of organic/hydro-organic matrices from aerosol generation to atomization/excitation/ionization processes; (ii) the production of carbon molecular constituents and their spatial distribution in the plasma with respect to analytes repartition; (iii) the subsequent modifications of plasma fundamental properties; and (iv) the resulting spectroscopic and non spectroscopic interferences. This first part of this tutorial review is addressed either to beginners or to more experienced scientists who are interested in the analysis of organic/hydro-organic matrices by ICP sources and would like to consider the theoretical background of effects induced by such matrices.

The second part of this tutorial review will be dedicated to more practical consideration on instrumentation, such as adapted introductions devices, as well as instrumental and operating parameters optimization. The analytical strategies for elemental quantification in such matrices will also be addressed.

Contents

Amélie Leclercq received her Engineering and Master's degrees in Chemistry from the University of Rouen (France) in 2009, and her Ph.D. in Chemistry from the University of Nice-Sophia Antipolis (France) in 2013. She was working on the behavior and transfers of anthropogenic radionuclides in environmental compartments. In 2013, she joined the Laboratory of Nuclear, Isotopic and Elemental Analytical development (LANIE) of the French Alternative Energies and Atomic Energy Commission (CEA, France) as a postdoctoral researcher, where she is focusing on the introduction of high-content organic matrices in ICP-MS.

Anthony Nonell obtained his Ph.D. in Isotope Geochemistry from the Paul Sabatier University (Toulouse III, France) in 2005. Since 2006, he has been a researcher in the Nuclear Energy Division of the French Alternative Energies and Atomic Energy Commission (CEA). Within the Laboratory of Nuclear, Isotopic and Elemental Analytical development (LANIE), he is conducting research on state of the art analytical developments for isotopic and elemental measurements on radioactive samples by mass spectrometric techniques such as MC-ICP-MS and TIMS.