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Mass Spectra 2018: Advances in ICP-MS: Clinical applications and human bio-monitoring- Ciprian Mihai Cirtiu- National Institute of Public Health of Quebec

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Inductively Coupled Plasma Mass Spectrometry (ICP-MS) is now regarded as one of the most powerful analytical techniques for trace and ultra-trace analysis of elements. It finds applications in various fields and applies to different matrices like environmental (air and water quality check, waste water treatment plants), geochemical (soil), drugs and pharmaceutics (quality control), food and beverages, petrochemical as well as biological matrices (clinical, occupational and environmental medicine, human bio-monitoring). ICP-MS coupled to separation techniques (chromatography) is proving an invaluable detection technique to characterize elemental species (toxicology, quantitative proteomics). A more recent way to use ICPMS is in time-resolved mode, which allows analyzing nanoparticles in Single-Particle ICP-MS mode (SP-ICP-MS). At the Centre de Toxicologie du Quebec, a branch of the Institute National de Sante Publique du Quebec (INSPQ, Quebec, Canada) we are aiming at developing ICP-MS-based analytical methods to assess trace and ultra-trace elements in biological matrices. The methods are developed and validated following general guidelines of ISO/IEC 17025. In the present work, an overview of various recent applications of ICP-MS methods will be given, with focus on clinical applications (screening, speciation, toxicology), bio-monitoring (health surveys) and preparation of proficiency testing materials as part of the quality assessment schemes organized by CTQ. Current research and development activities are directed towards the development of new technologies and methodologies for the analysis of emerging products in order to advance knowledge in terms of toxicology and human bio-monitoring.

Inductively coupled plasma mass spectrometry (ICP-MS) represents a major geochemical tool for both elemental and isotope ratio analysis . It allows analyses of elements at concentrations as low as 1 part per trillion (ppt) or even lower depending on instrument and application. This is accomplished by ionizing the sample in an inductively coupled plasma (ICP), followed by ion extraction into a mass spectrometer for separation and quantification of those ions. Different types of mass spectrometers are combined with an ICP source such as quadrupole, sector field mass spectrometry (ICP-SFMS), and multi-collector (MC) ICP-MS instruments. The latter are sector field instruments that feature multiple detectors (normally Faraday cups) for simultaneous detection of ions with different masses. The MC-ICP-MS analyses yield unprecedented precisions for isotope ratio measurements in the parts per million (ppm) range, which are only matched by thermal ionization mass spectrometry.

One of the largest volume uses for ICP-MS is in the medical and forensic field, specifically, toxicology. A physician may order a metal assay for a number of reasons, such as suspicion of heavy metal poisoning, metabolic concerns, and even hepatological issues. Depending on the specific parameters unique to each patient's diagnostic plan, samples collected for analysis can range from whole blood, urine, plasma, serum, to even packed red blood cells. Another primary use for this instrument lies in the environmental field. Such applications include water testing for municipalities or private individuals all the way to soil, water and other material analysis for industrial purposes. In the forensic field, glass ICP-MS is popular for glass analysis. Trace elements on glass can be detected using the LA-ICP-MS. The trace elements from the glass can be used to match a sample found at the crime scene to a suspect.

Biography

Ciprian Mihai Cirtiu has completed his PhD in the Université de Sherbrooke (2007) on the development of functionalized materials for the electro-catalytic hydrogenation reaction. From 2007 to 2008, he has worked as Post-doctorate at UQAM on the fabrication and characterization of semi-conductive nanoparticles for electrochemical solar cell and olivine-type lithium-iron phosphate nanoparticles for Li-ion batteries. In 2008, he joined the group of Professor Audrey Morres in McGill University as Postdoctoral Fellow to work on the development of new hybrid materials for catalytic reactions as well as the synthesis, characterization and application of zero-valent iron nanoparticles for groundwater remediation. He has joined the “Centre de Toxicologie du Québec” at Institut National de Santé Publique de Québec in 2011 as Analytical Development Chemist. In January 2013 he was named Head of Trace Metals Division. His research activities are oriented towards the development of new technologies and methodologies for the analysis of emerging products (nanoparticles, metals, rare earths elements, etc.) in order to advance knowledge in terms of toxicology and human bio-monitoring. He has 23 articles in peer reviewed journals, 2 patents, 38 oral communications and 25 posters to his credit.

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