

Capacitively coupled microplasma for metals and metalloids determination and speciation

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Capacitively coupled microplasma optical emission spectrometry (μ CCP-OES), as a smaller distant cousin of the well-known inductively coupled plasma optical emission spectrometry (ICP-OES), is a highly sensitive technique for the determination of metals and metalloids. While its low power (10–15 W) and low Ar consumption (100–200 mL min⁻¹) is a great advantage, enabling miniaturization and portability, it is not without limitations, such as intolerance to water vapor. As a result, electrothermal vaporization (ETV) or chemical vapor generation (CVG) techniques must be employed, with or without additional preconcentration.

In Cluj-Napoca, Romania, our Optical Spectrometry research group at the Faculty of Chemistry and Chemical Engineering, has developed several white and green μ CCP-OES-based methods for metals (Cd, Pb, Cu, Zn, Hg, etc.) and metalloids (As, Sb, Se, Te) determination and speciation in a wide range of matrices. For metals determination, sample introduction *via* ETV from a small Rh-coiled filament proved to be highly efficient, achieving limits of detection (LODs) for certain elements that surpass those obtained with ICP-OES. However, these LODs in case of water, fruit or vegetables samples were still not good enough. Thus, preconcentration using diffusive gradients in thin films were tested and validated, significantly improving LODs to the ng L⁻¹ order of magnitude. Furthermore, DGT sampling also enabled the determination of labile metal fractions in water and soil samples, in addition to total metal content. For As, Sb and Hg determination, methods based on CVG have also been developed, using either classical NaBH₄/SnCl₂ reduction, or, in the case of Hg, eco-friendly approaches, such as sono-induced or UV-Vis photo-induced cold vapor generation in dilute formic acid medium. Furthermore, UV-Vis photochemical vapor generation has also enabled the speciation of Hg as Hg²⁺ and CH₃Hg⁺, even at very low concentration when coupled with preconcentration on a gold coiled filament.