Concentration of Ions in Water Samples for Human Consumption measured by Femtosecond Laser Induced Breakdown Spectroscopy

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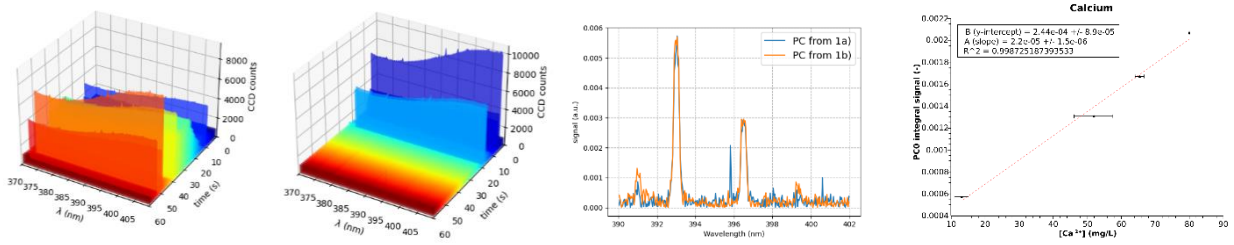
Real-time detection of ions in water for Human Consumption is crucial for a variety of purposes such as monitoring water potability, preventing pipe corrosion or scaling in domestic equipment. However, there is often an incompressible time delay between water sampling and lab analysis due to transportation, preparation and testing procedures in the laboratory.

Laser Induced Breakdown Spectroscopy (LIBS) has been identified as a good strategy for identifying ions in water, since according peak intensities are proportional to their concentrations [1, 2]. Though, preparation (e.g. vaporization) is necessary. In this work, we developed an experimental setup based on a femtosecond laser source (1030 nm, 300 fs) which target is a simple water drop. LIBS generation is performed at air/water interface and several spectra are sequentially acquired over time (10 min). Even though overall gathered spectra differ (Figure 1 (a) and (b)), a fast analysis procedure based on Principal Component Analysis enables to obtain reproducible LIBS spectral features (Figure 1 (c)). The whole process is applied on Solution with known concentrations for calibration. The developed methodology was successfully applied to the determination of Ca and Na in bottled waters. (Figure 1 (d)). Robustness of the calibration permits to perform concentration measurements on tap water. Perspectives of this work range from miniaturization to automation for real-time diagnostics.



(a) (b) (c) (d)

Figure 1. Experimental results : (a) and (b) Two different sets of acquired spectra retaining LIBS information of Ca^{2+} at 393.4 and 396.8 nm ; (c) Principal Components resulting from analysis of (a) and (b). (d) Calibration results of [Ca^{2+}].

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2. I. Goncharova, D. Duichaoua, S. Taboukhat, A. Tarbi, T. Chtouki, H. Erguig, B. Sahraoui, Laser-induced breakdown spectroscopy application for heavy metals detection in water: A review, Spectrochimica Acta Part B: Atomic Spectroscopy, 217, 106943 (2024)

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