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TRACE ELEMENTS DETECTION AND CF ELEMENTAL ANALYSIS OF WATER BY LIBS FOR ENVIRONMENTAL CONTROL- COMPARISON OF SURFACE ASSISTED, ACOUSTIC LEVITATION AND NE METHODS.

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Elemental analysis of water circulating in nature (e.g., water from springs, lakes, rivers, polluted groundwater near environmental contaminants, and wastewater released from factories) is highly important. Pure natural water primarily contains elements such as C, N, O, H, alkali metals, alkaline earth metals, and other trace elements essential for life. However, pollutants like heavy metals or other elements introduced through industrial environmental pollution may also be present (e.g., Cd, Pb). Monitoring these elements in groundwater is crucial for assessing water quality.
Laser-Induced Breakdown Spectroscopy (LIBS) is a method offering rapid detection and quantification of all elements present in natural water samples, including heavy metal pollutants, which is critically important for environmental protection and public health.
Elemental analysis of water samples using LIBS remains challenging due to issues such as splashing and plasma quenching by water products [1]. Several LIBS-based methods have been developed to address these challenges, such as surface-enhanced (SE) or surface-assisted (SA) LIBS, where liquid droplets are dried on a solid surface [2,3,4], or using absorption in zeolites to capture pollutants from water samples [5].
Acoustic levitation (AL) of isolated droplets, achieved by creating an ultrasonic standing wave in an acoustic resonator, is a sampling technique that enables LIBS analysis of liquids without contact with a solid substrate [6,7]. In this method, controlled evaporation using CW-IR laser radiation leads to the preconcentration of water samples around hundred times. Another method for enhancing the LIBS signal of water-based samples is nanoparticle (NP) enhancement (NE). This technique is often combined with SE or SA LIBS methods. Recently, our group used this approach to compare different beverages (drinking water, wine, beer) by employing varying concentrations of three different types of spherical metal nanoparticles (Au, Ag, Cu) [8]. Additionally, NE-LIBS combined with AL was utilized in our group to analyze heavy metals (Cd, Pb) in water using Ag nanoparticles.
These two liquid LIBS analysis methods (SA LIBS and LIBS AL), both with and without NP enhancement, will be compared for the elemental analysis of various types of water- and alcohol-based liquids using time-resolved, broadband UV-NIR Echelle-based spectroscopy. Recent results regarding the limit of detection (LOD) for boron in water samples using the LIBS AL method will also be presented [9].

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