A comparative survey of nanostructured surfaces generated by wet chemistry and LIPSS for NELIBS detection of trace metals in liquids

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Nanoparticle-Enhanced Laser Induced Breakdown Spectroscopy (NELIBS) has experienced significant advancements in the last few years, particularly in the analysis of liquid samples. This technique has shown remarkable sensitivity improvements with respect to standard LIBS, with signal enhancements up to two orders of magnitude. The most common nanostructures used for NELIBS are based on Au and Ag nanoparticles.

This study presents a preliminary comparison of NELIBS effects using noble metal nanoparticles generated and deposited through wet chemistry and an accurately controlled drop-casting method. Additionally, it examines how the spectroscopic signals of deposited liquid samples are affected by Laser Induced Periodic Surface Structures (LIPSS) manufactured on various substrates (metals, semiconductors, and insulators).

To elucidate the relationship between NELIBS enhancements and the mechanisms involved in both types of nanostructured materials, their chemical and physical features are analysed using μ-Raman, Atomic Force Microscopy (AFM), and Scanning Electron Microscopy-Energy Dispersive X-Ray Spectroscopy (SEM-EDS) techniques.

The ultimate aim is to use nanoparticle-enhanced and LIPSS-enhanced LIBS, and their improved sensitivity for trace element analysis in biological fluids, for the early diagnosis of neurological conditions such as Autism Spectrum Disorders (ASD).

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