PERFORMANCE COMPARISON OF TWO SUBSTRATE-BASED APPROACHES FOR LIQUID LIBS ANALYSIS: NANOPOROUS GLASS vs. Si-WAFER

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Laser-induced breakdown spectroscopy (LIBS) is a powerful and increasingly popular analytical technique in the field of atomic spectroscopy due to its straight-forward, yet versatile operation. In principle, LIBS is capable of analyzing gas, liquid and solid samples, as well as aerosols. In practice, however, the analysis of bulk liquid samples is rather challenging due to their mechanical, thermal, and optical properties which result in unreliable laser coupling, problematic light collection, and the of formation cold, faint plasmas. To bypass these issues, several methodologies have been proposed in the literature. Some of them – among many – involve transforming the bulk liquid sample into different shapes such as liquid jets, aerosols, while others rely on liquid-to-solid transformation e.g. freezing or drying [1].

One of the simplest and widely used techniques is when a small droplet of the aqueous sample is dried onto a chemically pure, nonporous, plane substrate (e.g. Si-wafer), creating a solid residue on the surface which then serves as the target for the LIBS measurements. This approach is low-cost, easy to execute and facilitates a highly sensitive detection, resulting in ppb-level LODs. However, it has a few drawbacks as well, such as the high sensitivity to matrix effects, limited dynamic range, and low reproducibility due to the random distribution of residue caused by the coffee-ring effect [2]. Recently, our group has proposed a simple and effective alternative to tackle the very same problem, relying on the use of nanoporous glass (NPG) substrates. In this approach, a small droplet of the sample solution is placed on a piece of NPG that rapidly absorbs the sample, creating a homogeneous analyte distribution inside the pores near the top surface of the glass. The NPG is then dried and serves as the laser target [3].

In this study, we compare the analytical performance of the two approaches in several regards such as precision, reproducibility, dynamic range, sensitivity (LOD), compatibility, and practicality.

Acknowledgements
This work was partially funded by the National Research, Development and Innovation Office (NKFIH) of Hungary through projects OTKA K 146733 and GINOP-2.3.3-15-2016-00040 and the University Research Fellowship Programme (EKÖP-24-3-SZTE-515). The authors also thankfully acknowledge the support received from the Austrian Research Promotion Agency (FFG) in the frame of the Important Project of Common European Interest (IPCEI) on Microelectronics and Communication Technologies.

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