THE MASSBOX MASS SPECTROMETER SIMPLIFIES SOLID SAMPLE ANALYSIS FOR TRACE-LEVEL QUANTITATION

A Laser Ablation Laser Ionization Time of Flight Mass Spectrometer (LALI-TOF-MS) for applications requiring low detection levels

By Ellen Williams, Jon Putman, Jeff Williams

The Massbox is the first commercial Laser Ablation Laser Ionization Time of Flight Mass Spectrometer (LALI-TOF-MS). It combines high detection capabilities with low-cost, uncomplicated operations. Thus, it simplifies solid sample analysis for any application requiring trace-level quantitation

Many commercial techniques exist for solid sample analysis. Compared to tools for simple bulk analysis, instruments with high detection capabilities are typically more expensive to maintain, involve more complicated sample preparation, and require a highly skilled, trained operator. Recent advancements in solid-state lasers, computing power, and software user interfaces have contributed to a new instrument – the Massbox. Combining improved technical capabilities with reduced operational challenges, the Massbox is the first Laser Ablation Laser Ionization Time of Flight Mass Spectrometer (LALI-TOF-MS).

The LALI method uses two lasers to first ablate (or desorb, in the case of organics) material from the solid sample's surface and then ionize that material in a second step. By analyzing solid samples directly, LALI eliminates intricate dissolution/digestion sample preparation procedures that complicate other techniques. The initial ablation (or desorption) process creates both a temporal plasma and a neutral particle cloud, and the second laser ionizes the neutrals. Compared to other plasma-ionizing techniques, targeting neutral particles greatly reduces the matrix effects.

Figure 1 shows color-contoured periodic tables comparing detection limits of LALI-TOF-MS to those of other common methods for solid sample analysis: 1) Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS), 2) X-ray Fluorescence (XRF), and 3) Laser Induced Breakdown Spectroscopy (LIBS). In this graph, the color gradient denotes detection limits with the darker colors representing the lowest levels.

As shown in Figure 1, detection limits for LA-ICP-MS are most comparable to those of the new LALI-TOF-MS – ranging from ~1 to 100 parts per billion. Estimating the total cost of the ICP-MS

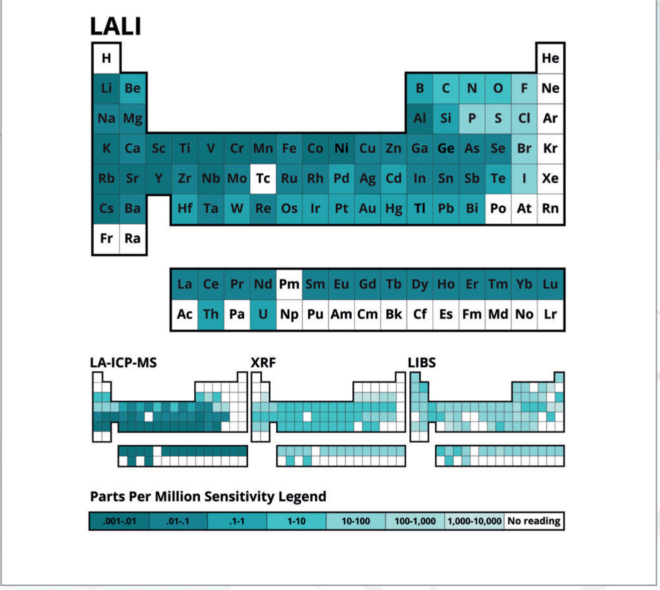

Figure 1: Detection limits for LALI-TOF-MS, LA-ICP-MS, XRF, and LIBS. Each element is colored by its respective limit of detection. Darker colors represent lower detection limits.

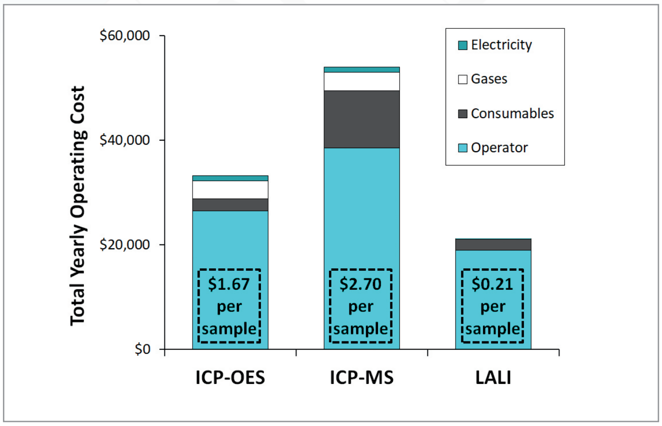

Figure 2: Yearly operating costs for ICP-OES, ICP-MS, and LALI-TOF-MS, assuming instruments run 1,000 hours per year (1).

instrument and the additional ablation chamber for LA-ICP-MS are beyond the scope of this application note. Thus, the authors present the following cost comparison of techniques, which builds upon a previously-published evaluation of ICP-MS, ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometry) and two other systems (1). Because LALI-TOF-MS requires little calibration/training, a technician can operate it. Contrarily, the more complicated operation of ICP-MS involves a Doctor of Philosophy (PhD). Figure 2 compares total yearly operating costs among the three methods. Compared to ICP-OES and ICP-MS, LALI has 35-60 percent lower operating costs, and its cost per sample is approximately 10 times lower. With the intuitive operations of its all-in-one system, the Massbox is the ideal instrument for commercial applications requiring trace-level quantitation.

Reference:

1. *Thomas, R. (2016). Money to Burn: Do you Know What it Costs to Run your Atomic Spectroscopy Instrumentation? Mass Spectrometry & Spectroscopy, 18–19.*