SciAps ApNotes
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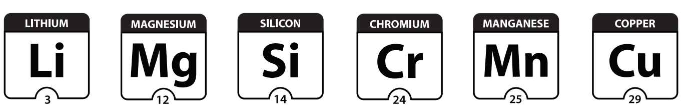
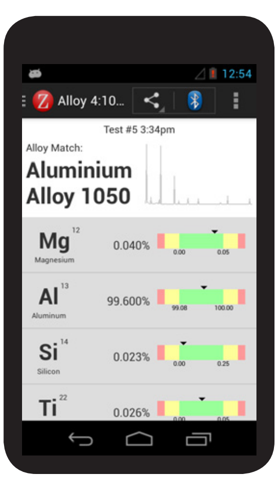
The Z: Handheld LIBS Analysis for Lithium and other Critical Elements in Aluminum Alloys

Laser-induced Breakdown Spectroscopy (LIBS) offers an alternative technique to both handheld XRF and spark OES for the analysis of a broad range of elements and sample types. In the LIBS process, a plasma is created at the material surface, as in spark optical emission spectroscopy (OES). Spectral lines from the various elements present are measured as the plasma cools. The wavelength of specific lines reveals the elements present, and the intensity of the light at a given wavelength is related to the concentration of each element.

SciAps is pleased to introduce the Z, a handheld analyzer featuring our LIBZ technology. The Z delivers the low atomic number performance of mobile OES, while maintaining the portability of handheld XRF. Key features of the Z include a) a pulsed, 5 mJ eye-safe, Class 1 rated laser, b) a high resolution (< 80 pm) spectrometer*, and c) Opti-Purge™ * for measurements in the deep UV (< 200 nm) and overall improved limits of detection (LODs).



The wide elemental range and high sensitivity of mobile OES units, plus the portability and ease of use of handheld XRF analyzers.



Aluminum Alloy Analysis:

The Z offers a fast, accurate and highly portable technique for aluminum alloy ID and chemistry. Critical elements to identify many common grades include Mg, Si, Cr, Mn and Cu among others. For example, the ability to analyze low concentrations of Mg, Cr and Cu are critical to confidently identify several common wrought grades such as 6063, 1100, 5083/5086, and 2014, 2018 and 2024.

The latter three are mainly different in Mg concentrations, and require precise analysis to 0.2% Mg or lower. A second example is the common alloys 1100, 6063 and 6061. 1100 and 6061 are uniquely identified by measuring > 0.04% Cr and 0.8 - 1.2% Mg. Distinguishing 6063 and 1100 require measuring 0.4% Mg. An example with foundry alloys is 356 and 357, which can only be identified by the difference in Mg concentrations, 0.2%-0.45% for 356, and 0.45%-0.6% for 357. All of these analysis can be made with the Z in a few seconds.

*Patent Pending

Table 1 demonstrates the speed and performance of the LIBZ system. Detection limits for 2, 5 and 10 s test times, for Mg, Si, Cr, Mn and Cu are shown in Table 1. A LIBZ spectra from a high-purity 1050 certified reference material (CRM) containing 0.027% Mg is shown in Fig. 2. In a two second test, two prominent Mg lines at 279.57 nm and 285.23 nm are measurable in excess of a 99.7% confidence level, the criteria for detection. The visible lines, even at 0.027% Mg concentration after 2 sec, demonstrates that LIBZ technology provides the performance needed for confident aluminum alloy analysis.

Element	2 sec	5 sec	10 sec
Mg	0.025	0.02	0.015
Cr	0.04	0.03	0.02
Mn	0.11	0.08	0.08
Cu	0.02	0.015	0.015
Si	0.25	0.10	0.08

Table 1: Limits of detection (%) for 2, 5 and 10 s tests of several key alloying elements in Al grades. The analyzer measures more elements than shown in the table.

A major advantage of SciAps LIBZ technology is that it analyzes all elements in Aluminum alloys with low detection limits, including the low atomic number elements such as Mg, Li, Be and Si. This means that the above alloys can be separated in just a few second, as opposed to the 30+ seconds of many handheld XRF units.

Lithium in Aluminum Alloys:

A growing need, especially in the aluminum re-melting industries, requires the analysis of lithium (Li) in aluminum alloys. Several grades of aluminum alloys manufactured predominantly in Russia for military aircraft, contain between 0.1% and 1.5% lithium. If this scrap is mixed with others for re-melting, there is a possibility of an explosion. Elemental Li analysis is yet another benefit of LIBZ technology, in addition to the wrought and foundry aluminum alloys, plus the coppers, high-temps and low alloy steels. A spectrum from an aluminum alloy with 1.83% Li is shown in Figure 3. The large peaks at 610.3 nm and 670.7 nm result from Li in the sample. The 610nm line is used for quantifying Li down to a lower limit of about 0.05%.

The stronger line at 670.7 nm may be used for lower concentrations. The lithium application also highlights the advanced, proprietary spectrometer technology inherent in the Z. The analyzer measures lines as low as 185 nm including carbon at 193 nm, and extends up to 675 nm in order to measure major Li lines at 610.2 nm and 670.7 nm.

Summary:

The Z is the world's first handheld LIBS-based analyzer. The Z offers the performance of HHXRF on transition and heavy metals, and greatly improved performance for low-atomic number elements and aluminum alloys, all without the regulatory challenges of x-ray devices.

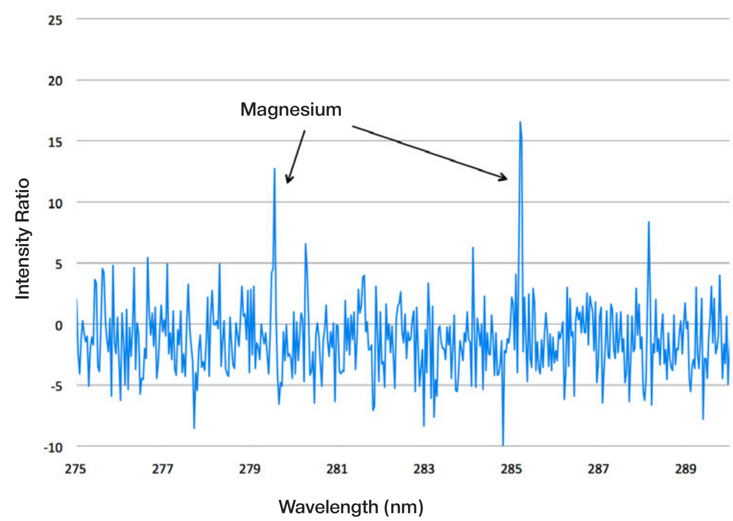


Figure 2: Spectrum for a 2 second test of a 1050 grade aluminum alloy containing 0.027% Mg.

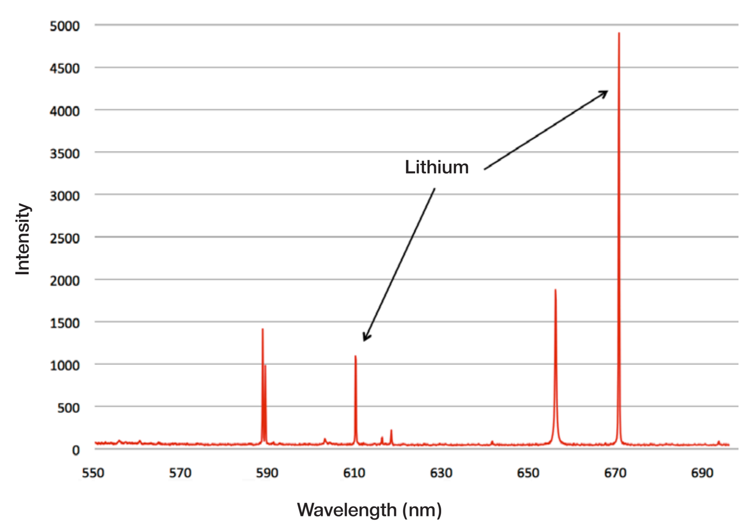


Figure 3: Spectrum from a 2 second test on a Russian manufactured aluminum alloy containing 1.86% lithium.