



Advanced Aluminum Alloy Analysis with Handheld LIBS

- Low concentrations of contaminant beryllium (Be).
- Low concentration, precise iron measurements for increasing scrap value.
- Trace lithium analysis.
- Rapid magnesium measurements.

Handheld laser-induced breakdown spectroscopy (LIBS) offers a faster, more comprehensive approach to aluminum alloy sorting and chemical analysis compared to x-ray technology. And it offers a handheld form factor not available in spark OES type of technologies. The Z, manufactured by SciAps, offers superior analytical capability compared to any other HH LIBS analyzers. The Z features patented on-board argon purge for 10x improvement in precision, high speed laser shot cleaning to eliminate surface effects, and wide range high resolution spectrometer. The advanced spectrometer is critical as it offers a wider range of elements including Na and Li, and better resolution, compared to the simple sorting LIBS analyzers. The functionality and performance is comparable to benchtop or mobile OES devices, but now in a handheld form factor.

Beryllium (Be)

Beryllium is used in aluminum alloys containing magnesium to reduce oxidation at elevated temperatures.¹ Beryllium is also a significant health hazard especially if fine particles are inhaled, so knowing the presence and concentration of Be is important.

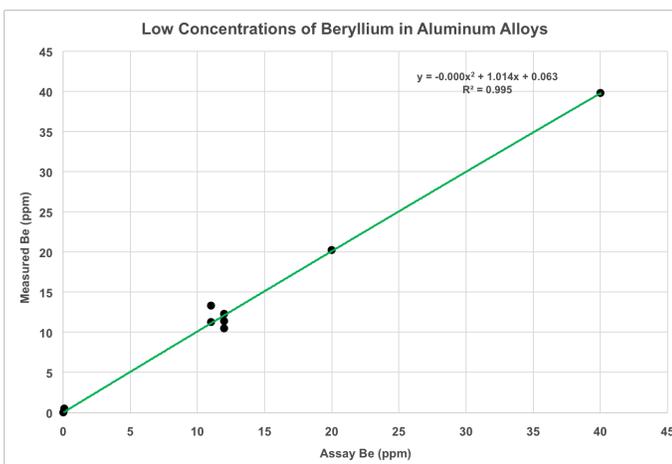


Figure 1: Response curve for low concentrations of Be in various aluminum alloys from < 10 ppm up to 40 ppm.

The **powerful laser, wide range spectrometer and on-board argon purge** in the Z-200 yield OES level analytical performance, in a handheld form factor. From trace Be, Li, Pb as well as precise analysis of Si, Mg, Mn, Fe and Cu, the Z-200 is the ideal analyzer for the aluminum industry.

The response curve for the Z-200 for Be is shown in Fig. 1 for the maximum 3 second test. The 3-sigma detection limit is about 10 ppm. At 20 ppm the relative standard deviation (repeatability) is less than 10% thus 20 +/- 2 ppm. While other HH LIBS units measure beryllium, but only the SciAps Z can measure trace Be as low as 10 ppm due to the argon purge and laser power.

Low % Iron Analysis

For many foundries, incoming Al scrap is more valuable if scrap with < 0.2% iron or better yet < 0.1% iron can be segregated. For some aluminum product, by using low Fe scrap feed, less virgin raw material is needed, thus saving production costs. The Z reliably measures Fe to < 0.1% in aluminum alloys due to the argon purge and rastered laser (there is some evidence that iron clusters, thus making averaging of multiple test locations important). The Z is expected to analyze as low as 0.05% once reference standards in this concentration range can be found and performance verified.

Rapid, Accurate Mg Measurements from 0.02 – 6%

Many aluminum alloys are only distinguished by differences in Mg concentration. Or in terms of sorting, the value of the material is strongly correlated to Mg percentage. Examples include 3003/3005, 2024/2014, 356/357 to name a few. The Z offers very precise and accurate Mg measurements. Moreover, the Z is much faster and more sensitive to Mg measurements than HHXRF and in fact it rivals mobile and benchtop OES in terms of analytical performance on Mg. The Z is factory configured with multiple calibration curves to cover concentration ranges from 0.02-0.5%, 0.5-1.5% and >1.5%. Users have the capability to generate their own curves on proprietary materials if needed.

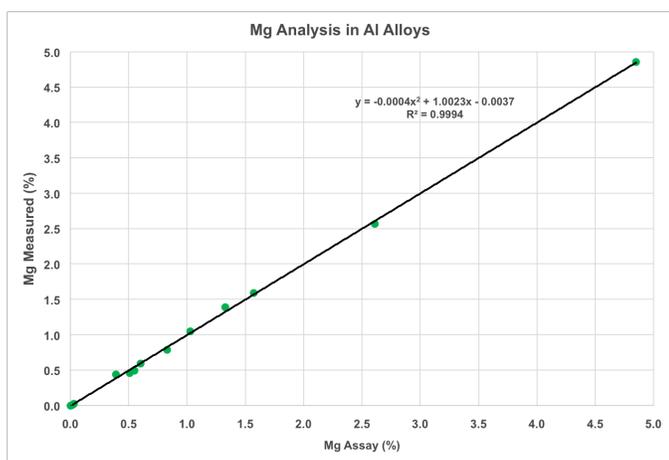


Figure 3: Calibration curve showing the low concentration regime of Mg values. The measured values were generated using multiple Mg calibration curves typically from 0 – 1% and 1-6%.

Trace and Alloying Lithium Analysis

The Z-200's broad spectral range (190 – 615 nm) and argon purge yield excellent results for lithium measurements (lithium line at 610.39 nm). The Z offers fast, precise lithium measurements for the newest aerospace alloys such as 2195. The Z may also be used for more trace level Li analysis. The high intensities achieved provide a lithium detection limit in the 50 – 100 ppm range (0.005 – 0.01%). If detection limits in the 10 ppm limit are required, the Z platform may also be modified with a 3rd spectrometer (Z-300) that extends the range to measure the brighter 670.8 nm line. Any Z-200 may be upgraded to the Z-300 at any time.

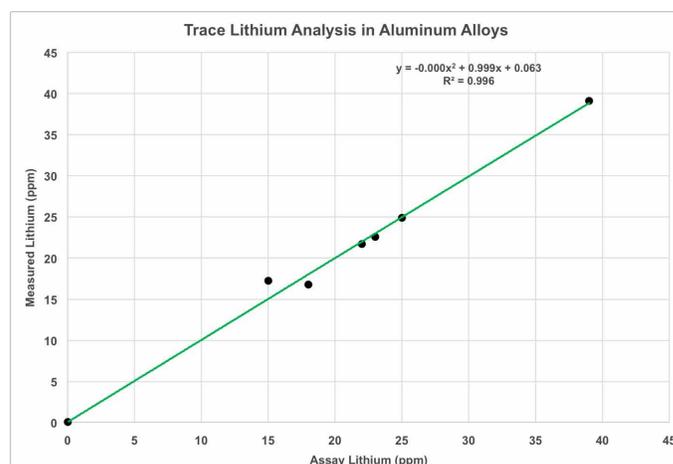


Figure 4: Trace level lithium analysis with the Z-200.



Summary

The LIBZ Z-200 fills a unique role in the aluminum manufacturing and producer's analytical testing requirements. The Z offers fast, precise analysis for a wide range of aluminum alloy applications, comparable to benchtop argon-based spark OES units. But unlike OES, the Z is packaged into a 4 lb. handheld form factor thus offering the portability of handheld XRF. The combination of portability and breadth of analysis is not available with any other handheld technology.

¹ Reference: <http://www.totalmateria.com/Article55.htm>