Laser Analysis Technologies
An XRF Scientific Ltd Company

APPLICATION AND USE OF THE SPECTROLASER

1. Introduction

This document explains the application of the Spectrolaser and how it is used in the modern laboratory. Following are some very simple answers on how the Spectrolaser operates and analyses materials. These answers have been developed to support the end user in the decision-making process and give an insight into how the Spectrolaser can assist the busy chemist to manage the complexities of the modern laboratory.

2. What is the Spectrolaser and how big is it

The Spectrolaser® is a new instrument that enables rapid determination of the elemental makeup of complex materials, such as minerals, metals, pharmaceuticals and glasses, to detect major and minor elements and trace contaminants.

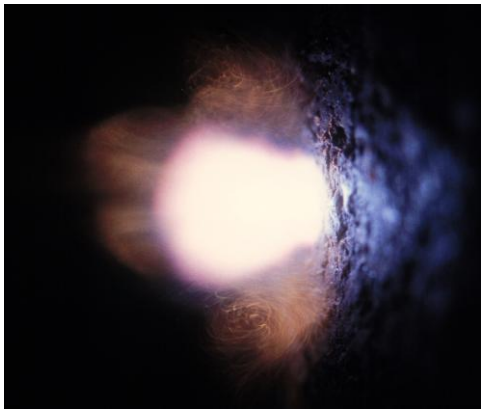
Size:

Width:	40 cm
Length:	86 cm
Height:	30cm

Weight

Weight:	Spectrometer: 40g Power supply: 18kg Computer: 16kg

3. How does the Spectrolaser work?



When placed into the instrument the sample is automatically moved across the path of a high-power laser beam. The laser induces a bright spark (or plasma) at the surface of the material being analysed. The light emitted by this plasma is then resolved by a unique spectrometer and detection system consisting of multiple spectrographs and Charged Coupled Device's (CCD) sensors. This enables the concentrations of all detectable elements to be determined simultaneously in a matter of seconds.

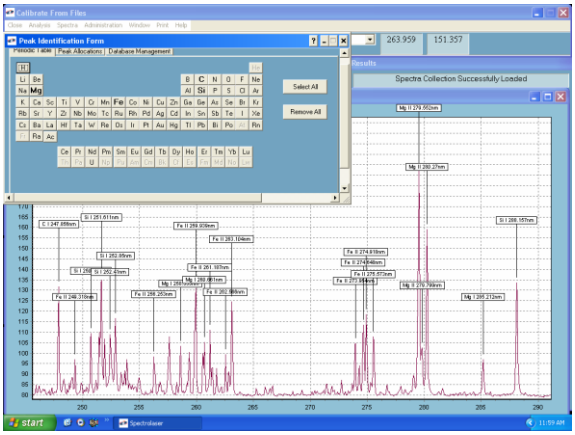
4. Advantages of using the Spectrolaser

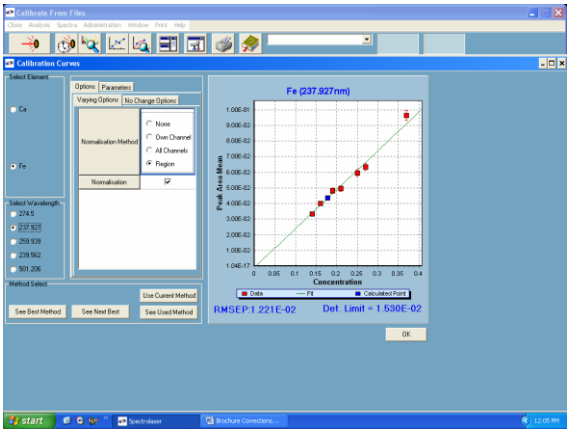
The analysis method used by the Spectrolaser possesses several superior features when compared to other technologies capable of elemental analysis. For instance,

- It is sensitive to a wide range of elements, including light elements (hydrogen, beryllium, boron, carbon, sodium …) that are not easily detected by alternative methods..
- Spectral interferences are reduced or eliminated when compared to alternative technologies such as energy-dispersive XRF analysis.
- The small amount of preparation required for analysis also enables a high throughput of samples to be maintained.

5. Operation

An easy to use Windows® control program enables materials analysis, comparison of data to calibration standards, file saving and the printing of reports. Once configured normal operation of the instrument simply involves presenting the sample for analysis – no further data manipulations are required.





Advanced software controlled features give users the flexibility of further optimizing the Spectrolaser for their application by:

- Varying the laser energy
- Selecting the detector exposure conditions (gating)
- Constructing multiple element calibrations for each material type
- Calculating measurement precision
- Using deconvolution to unravel measurements from complex matrices, and
- Storing multiple calibration sets

6. What type of materials/samples can be presented to the Spectrolaser?

Virtually any solid material, e.g. metals, pressed pellets, fused beads, chips etc, up to 42 mm diameter. Sample weight is not critical and is generally in the range of 1-10g depending on the application. Crushing and pressing samples prior to analysis assists in quantitative determination of heterogeneous materials.

Liquids, for example engine oil, can also be analysed by first placing a few droplets on standard filter paper then placing the filter paper in the instrument for analysis.

7. What calibration procedures are necessary to use the Spectrolaser?

Qualitative assessment can be undertaken quickly and easily with the Spectrolaser. Automatic peak find and identification features which allow rapid assessment of the elements present in the material.

Quantitative measurement of elements in materials is undertaken by pre-calibrating the Spectrolaser using certified standards or other reference material similar to the matrix being analysed (i.e. coal, metal, mineral etc.). The Spectrolaser calibration feature automatically constructs calibration curves according to the elemental concentrations in the standards, presentation of subsequent unknown samples results in automatic comparison to the instrument calibration and calculation of the corresponding elemental concentrations. Once calibrated for a particular application, analysis is reduced to simply placing the sample in the Spectrolaser and starting the analysis.

8. Advantages of incorporating the Spectrolaser with other laboratory instruments

The demands on the modern analytical laboratory are diverse. From regular sampling of core material to point testing and trouble-shooting there is always need for flexible analytical solutions. Typically a process control laboratory will use XRF (fusion and pressed pellet), ICP and/or Arc Spark instruments. The Spectrolaser can undertake all (or part depending on the detection limits required) of the functions of these instruments. The Spectrolaser's ability for rapid determination of the elemental makeup of complex materials can lighten the workload of other analytical instruments (XRF in particular) in the laboratory, increasing sample throughput, while reducing maintenance and laboratory running costs. The Spectrolaser makes a particularly good complementary instrument for the busy laboratory. It can be used as the day-to-day laboratory workhorse or serve as a very reliable back up instrument for rapid trouble-shooting and assessment applications in the event of equipment breakdown.

Reduced maintenance costs for laboratories using XRF instruments

XRF analysis as applied in laboratories uses 3 basic methods of sample preparation for presentation of the sample to the XRF. These being:

- Fused Beads
- Pressed Powders
- Liquids.

In a typical mineral laboratory where fused beads are the dominant method of sample preparation it is common to find that up to 80% of the analysis comprises fused beads with the remaining 20% being pressed powders. Fused beads are solid glass discs and offer significant advantages over pressed powders in terms of accuracy of analysis and bead stability. An intrinsic advantage of fused beads over pressed powders is this inherent stability of the bead causes little or no contamination of the inner workings of the XRF instrument. Where pressed powders are used regularly in XRF analysis it is not uncommon to completely strip the XRF instrument every 6 months in order to clean and replace bearings due to contamination from the breakdown of the pressed powder. The Spectrolaser has no internal vacuum system and has an automatic dust removal system, thus its use in pressed powder analysis can potentially save many thousands of dollars in reduced XRF maintenance costs.

9. Where does the Spectrolaser fit in relation to other analytical instrument technologies?

The Spectrolaser can perform where other technologies cannot. Sensitivity to light elements (H, Li, Be, B, C, Na etc) is excellent in contrast to XRF technologies which typically have lower sensitivity to light elements. Unlike arc-spark analysers the Spectrolaser can be applied to the analysis of non-conductive materials so a smelter for example can now analyse both their refined metal and slag outputs using the one device. Since the Spectrolaser analysis takes seconds it has clear advantages in those applications where acid extraction techniques are being used (ICP and AAS applications). The Spectrolaser only requires standard mains power to operate adding to its convenience and reducing running costs in many laboratory situations.

10. What consumables and other operating costs are there?

The Spectrolaser uses no chemical consumables in normal operation. Likewise cooling water and compressed gases are also not required. Mains power is the only requirement, and inexpensive disposable sample cups are recommended for simple regular operation.

There are also no expensive x-ray tubes that decrease in performance over time and need periodic replacement. The laser used is suitable for 600 000 separate analyses (up to 10 years of usage) before minor servicing is required that can easily be done in the field.

11. Automation

The simplicity of the sample holder design means that automating the analysis process in any laboratory can be achieved with very little capital expense. LAT can supply a system to meet your needs.

12. What connections does the Spectrolaser require?

- Electrical power outlet (100 –250 VAC)
- Gasses. In most applications measurements are performed in laboratory air however the Spectrolaser has also been fitted with gas inlet and outlet to allow the use of purge gas if required (for example Argon in the determination of Oxygen levels in materials). Purge gases also lower detection limits for some elements – notably sulphur – in materials.