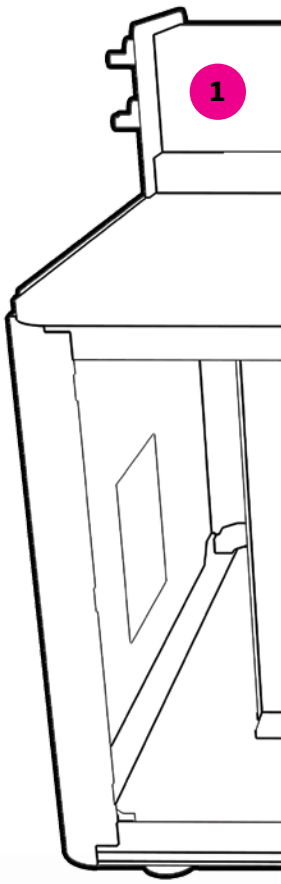
EXPANDING THE HORIZON OF ELEMENTAL ANALYSIS

INTRODUCING THE CHEMREVEAL® LIBS DESKTOP ANALYZER

ChemLogix™

THE NEW FRONTIER IN ELEMENTAL ANALYSIS

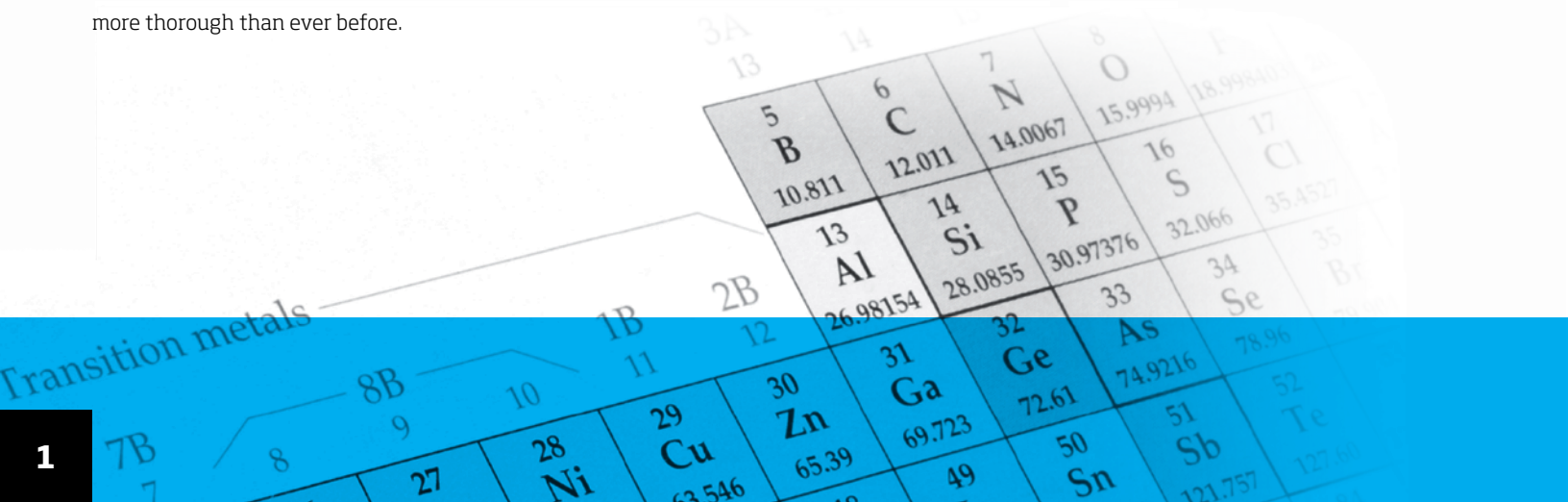
With ChemReveal® LIBS Desktop Analyzer there is now an easy way to directly identify and analyze every element in every matrix of a solid sample.



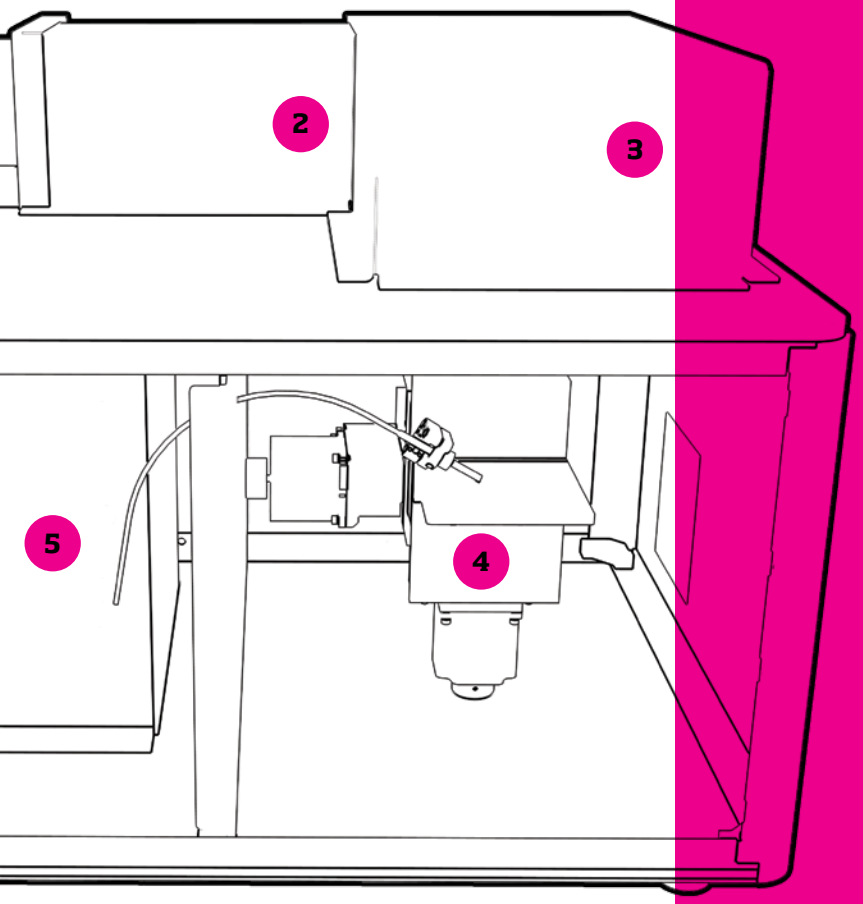
Traditional elemental analysis techniques based on optical emission spectroscopy (OES), including ICP-OES and Arc/Spark OES, have been widely used and accepted for decades to accurately measure the elemental composition of solid materials. Such methods, however, require lengthy digestion of solid samples using hazardous acids, and do not work on non-conductive, amorphous, or loose materials respectively. Similarly, popular elemental analysis techniques like X-ray fluorescence (XRF) are insensitive to elements of Z<14 (lighter than Si).

Unlike traditional methods, laser-induced breakdown spectroscopy (LIBS) – a type of atomic emission spectroscopy – can measure the concentration of virtually all elements, in nearly all solid matrices, without sample preparation. To do so, a focused pulsed laser is used to vaporize materials and create a plasma needed for optical emission spectroscopy (OES). The wavelength of light emitted from the plasma is specific to the elemental composition, and the intensity of the light emitted is correlated to the concentration of the element. As such, LIBS-OES utilizes a single laser pulse to provide a complete multi-element composition of a microvolume of material in virtually any matrix.

Designed to provide a routine, reproducible means of calibration and high quality assurance, the ChemReveal LIBS Desktop Analyzer takes LIBS-OES instrumentation to the next level, making it a powerful alternative to traditional elemental analysis techniques. From trace to bulk concentration, the ChemReveal LIBS Desktop Analyzer delivers the capabilities of LIBS to the laboratory or production line so that chemical analyses are faster and more thorough than ever before.



UNSURPASSED CHEMICAL ANALYSIS OF SOLIDS



With its large sample chamber (accommodating samples 9" x 5" x 5") and integrated imaging, optics, and software-based controls, chemical analysis of solids can now be completed quickly and comprehensively with the ChemReveal LIBS Desktop Analyzer.

1. Laser
High-powered Nd:YAG pulsed laser is used to ablate material and create plasma. ChemReveal offers application-specific laser wavelength and energy options.

2. Optics Train
Robust opto-mechanical design for alignment-free operation, adjustable spot size, and laser energy monitoring.

3. Sample Imaging
Dual imaging camera solution for both large field-of-view and high magnification imaging of sample. See the sample's fine morphology and abnormalities in context to the whole sample, and focus the analyses on areas of interest.

4. Sample Manipulation
XYZ stages with micron-scale control for precise sample targeting.

5. Optical Emission Spectrometer
Collection optic and spectrometer for OES detection. ChemReveal offers application-specific spectrometer and detector combinations, including high-resolution Echelle spectrometers with iCCDs.

6. PC with LIBS-OES Software (not shown)
Basic software for technician level operation and control of the instrument. Advanced ChemLytics™ software for method development and detailed data inspection.

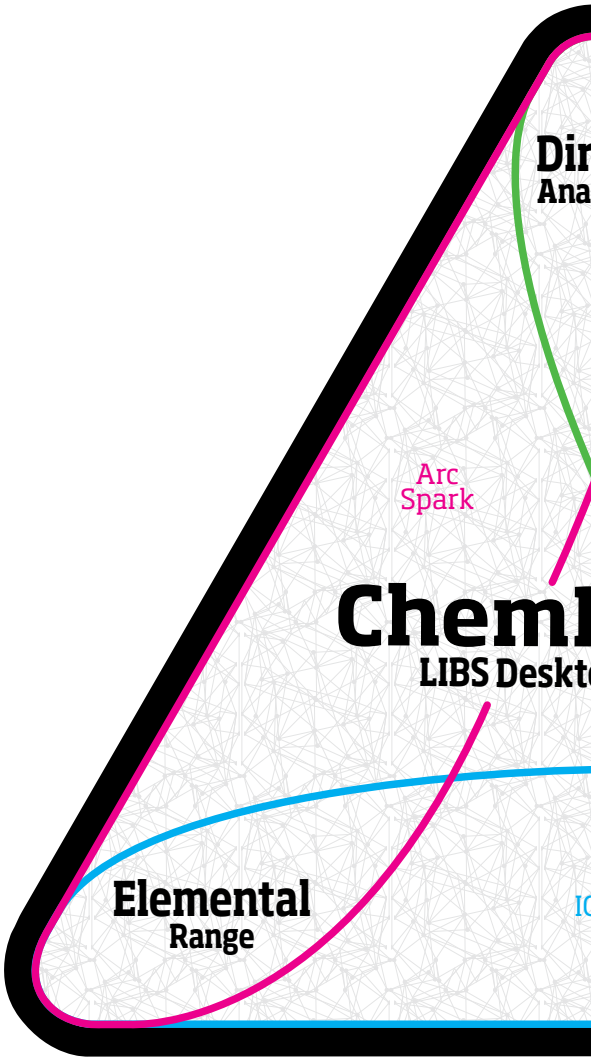
DIRECT ANALYSIS OF EVERY ELEMENT IN EVERY MATRIX

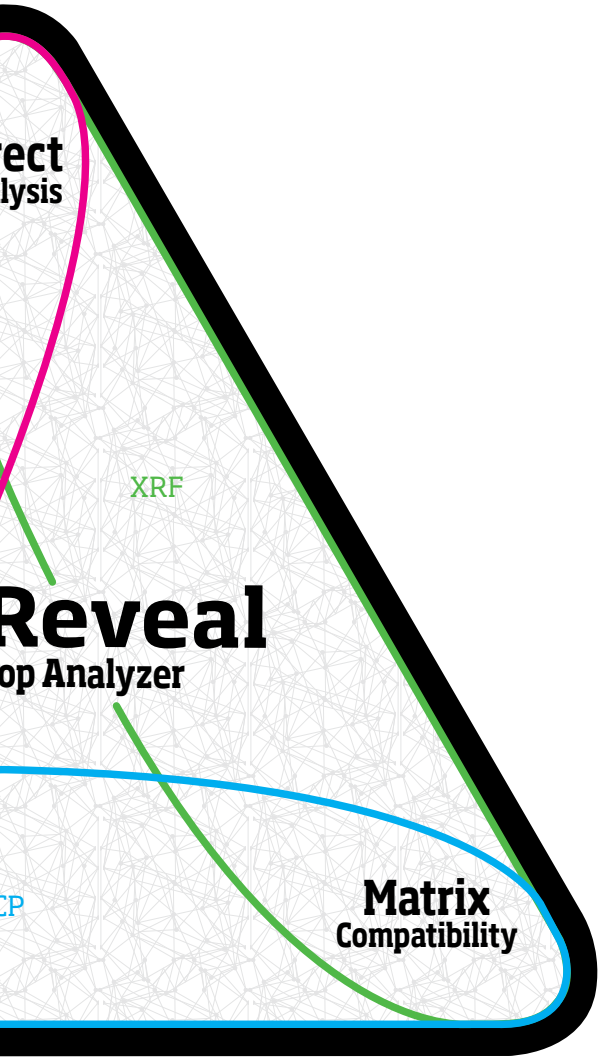
DIRECT ANALYSIS IN SECONDS

ChemReveal LIBS Desktop Analyzer is capable of direct, fast, multi-elemental and chemical analysis of solids with minimal to no sample preparation. Unlike ICP, LIBS does not require laborious digestion- it can analyze solids directly. When used as a pre-screening tool for ultra-trace ICP, LIBS rapid elemental identification results can help determine which digestion protocols should be applied, and often times, whether ultra-trace elemental analysis is required at all. Using ChemReveal LIBS Desktop Analyzer to prescreen your ICP samples improves the throughput and efficiency of your ICP sample preparation.

THE COMPLETE ELEMENTAL RANGE

When detection of truly light elements like Al, Mg and C is needed, and time to make flat samples is not available, LIBS is the perfect alternative to XRF. In fact, the ChemReveal LIBS Desktop Analyzer can measure: organic elements (C, H, O, N) with the aid of purge gas to remove background interferences; samples that are not perfectly flat due to its longer depth of focus of the laser pulse and its smaller sampling size; and the chemical composition of features as small as 5 µm in diameter.





MATRIX COMPATIBILITY WITH VIRTUALLY EVERY SOLID SAMPLE

LIBS complements other elemental analyzers by bringing solid material compatibility to OES.

Arc/spark-OES does not work on amorphous, powder, non-conductive samples. On the other hand, when used on glass, polymers, and non-conductive coatings and films, the ChemReveal LIBS Desktop Analyzer provides fast and complete analysis of solids with micro-scale targeting of material defects such as inclusions. Additionally, spatial mapping allows users to determine the elemental composition on the surface of a sample as a function of the position on a sample, while depth profiling of a material can be achieved by analyzing the same spatial position with successive laser shots.

All other methods compromise one of these benefits. Whether for use in Pharmaceuticals, Ceramics/Glass, or Polymers/Coatings, use the only solution that provides speed, compatibility with all types of solid matrix, and the complete elemental range: the ChemReveal LIBS Desktop Analyzer.

DO YOU HAVE SEPARATE ICPS FOR DIFFERENT CONCENTRATIONS?

One for so-called dirty samples and another for trace? How do you know which one to run? Use LIBS-OES to screen your samples quickly for contaminants and interferences like phosphorous.

LIBS IS THE SUPERIOR CHOICE TO ALTERNATIVE ELEMENTAL TECHNIQUES.

In applications such as Mg characterization in pharmaceutical tablets, carbon and metal determination in carbon nanotubes, Boron analysis in glass, and metals in thin polymer films - LIBS is the superior choice to alternative elemental techniques.

THE COMPLETE CHEMICAL ANALYSIS SOLUTION

CHEMREVEAL INSTRUMENT SOFTWARE – *FOR THE TECHNICIAN*

Every ChemReveal LIBS Desktop Analyzer comes complete with instrumentation control and advanced method development and data exploration software. The ChemReveal instrument software provides the flexibility to control different laser energies, spot sizes, spectrometer gating times, and more.

Advanced Imaging:

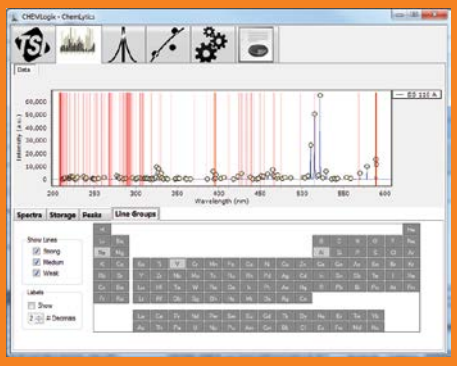
+ Easily orient and view larger samples (mm-scale) with both wide-field and magnified views
+ Analyze micron-scale locations of interest with precise pinpointing

Precise Sample Control:

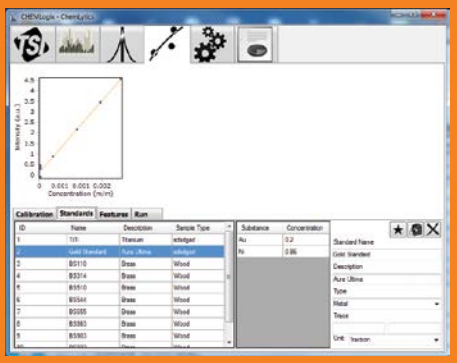
+ Optimize focusing and spatial positioning with high-precision XYZ stages
+ Lay down sampling grids to map samples easily

Application-Customized LIBS Calibration Models:

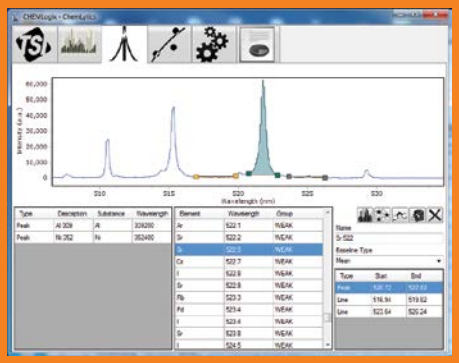
+ Import calibration models for rapid pass/fail and quantification outputs. No need to even look at or understand OES Spectra!



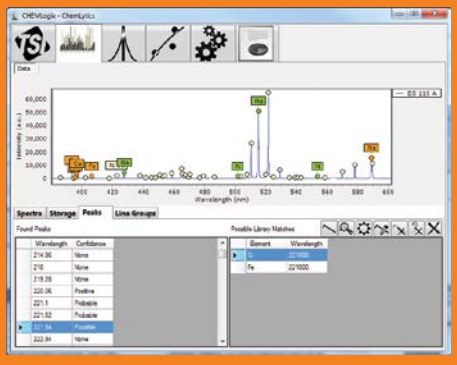
Quickly identify elements from the NIST OES database (included).



Create standard calibration curves intuitively and seamlessly apply to the quantification of elements in unknowns.



Specify precisely peak regions and background areas to avoid interferences and ensure robust calibrations.



Automatically identify elements in OES spectrum or match entire spectra with library entries to identify materials.

CHEMLYTICS™ SOFTWARE – *FOR THE LAB MANAGER*

The ChemLytics software, with incorporated NIST OES Database and standard univariate calibration wizard, allows the advanced user to develop routine methods, view raw spectral data in higher detail, and develop calibration models. Additional features and benefits include:

Element ID:

+ Ensure methods to detect both low and high concentration elements with NIST-reference weightings of the spectral lines for a given element
+ Investigate peak shapes and centroids, backgrounds, and interferences to ensure concentrations are accurate and precise

Element Quantification:

+ Create a quantification curve with standard materials intuitively
+ Check and quantify the concentration of elements in an unknown
+ Set up calibrations for high and low concentrations of the same element using different wavelengths with differing relative intensities to ensure the best possible quantification at each analytical range of interest

Material Classification and Match:

+ Determine the similarity between one sample to another
+ Classify material with user-created or commerical libraries of materials to compare and match new materials

CHEMLYTICS™ PLUS SOFTWARE: MULTIVARIATE CHEMOMETRICS – *FOR THE ADVANCED USER (OPTIONAL)*

The ChemLytics Plus software enlarges the scope and enhances the precision of chemical analysis. Its chemometric software creates multivariate models for quantification in complex matrices, and provides library matching for challenging positive material identification.

Multivariate Calibration:

+ Correlate element concentrations with more than one spectral peak of interest
+ Set up calibrations with dozens of spectral features to offer the best possible model between standard concentrations and spectral response

Beyond Elemental Analysis:

+ Create customized calibration and classification models for materials
+ Correlate chemical and non-chemical properties to LIBS spectra (e.g. ash content in coal, source identification of gems, etc.)
+ Classify materials beyond spectral peak-matching (e.g. use laser energy density, matrix, etc. in models)

ABOUT CHEMLOGIX™ CHEMICAL ANALYSIS INSTRUMENTS

The ChemLogix™ family of instruments simplifies complex chemical analysis.

Its line of ChemReveal laboratory-based solutions utilizes laser-induced breakdown spectroscopy (LIBS) to provide rapid and reliable identification of materials and chemical composition of solids.

Equipped with advanced ChemLytics software and backed by TSI's global sales and support, ChemLogix instruments truly are the smarter – and more logical – choice for chemical analysis.

ABOUT TSI INCORPORATED

For over 50 years, TSI has been recognized as an industry leader in the design and production of precision measurement instruments. In fact, TSI researchers and engineers have been granted more than 50 patents and have a proven record of developing instruments that are the first, the only, and the best of their kind. With headquarters based in the U.S. and field offices throughout Europe and Asia, TSI has established a worldwide sales and service presence in the markets we serve, including: aerosol research, bio-detection, contamination control, dust monitoring, respirator fit testing, nanoparticle measurements, and many more. TSI's Quality System is registered to ISO 9001:2008.

CHEMREVEAL LIBS DESKTOP ANALYZER APPLICATIONS

Since its first introduction in 1963, LIBS technology has been featured in over 2000 published articles for a wide range of applications, including:

Metals	Pharmaceuticals	Environment / Agriculture	Petro / Geochemistry	Others
Metals identification and composition	Elemental impurities in pharmaceuticals	Pb, Cd, and Cr in electronics, jewelry, and toys	Drill-core samples	Carbon nanotube impurity analysis
Composition of Aluminum Alloys	Tablet coating surface uniformity	Particle loaded filters	Heat value, ash content, and sulfur in coal	Measurement of trace and minor elements in glass
Composition and Classification of Steel and Stainless Steel	Tablet coating depth profile	Combustion Aerosols	Elemental analysis in ores and geological samples	Fingerprinting and identifying materials (Forensics)
Detection of Rare-Earth Elements	Blend uniformity	Analysis of Pb and Be contaminated soils	–	Thin film coating analysis
Li metal research (Battery Manufacturing)	–	Measurement of the nutritive balance of soils	–	Inclusions imaging and elemental analysis

ChemLogix™

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