GDS Series

Glow Discharge Spectroscopy





LECO

EMPOWERING RESULTS

Glow Discharge Spectroscopy

LECO's Glow Discharge Spectrometers are the clear choice of leading companies around the world, providing the most accurate bulk analysis, as well as quantitative depth profiling for a wide variety of sample matrices and applications.

Delivering customers a true turn-key solution, LECO Glow Discharge Spectrometers (GDS) are configured and calibrated at the factory, in order to provide a custom analytical tool optimized to your sample matrices. Due to the robust nature of the system, samples can be analyzed immediately after installation. Only LECO provides this level of customization and customer support.

Using the latest technology in hardware and software, LECO GDS instruments are designed to enhance the performance of both process control and R&D applications. These instruments cover the full spectral range of up to 120 to 850 nm (configuration dependent). Compared with spark sources, GDS employs a non-thermal glow discharge source for atomic excitation. Excitation of the atoms occurs in the glow discharge plasma discretely apart from the sample surface thereby reducing the metallurgical and chemical history inherent in all samples. Emission of ion wavelength spectra is almost completely eliminated thereby giving rise to less complex spectra typical of thermal excitation sources.

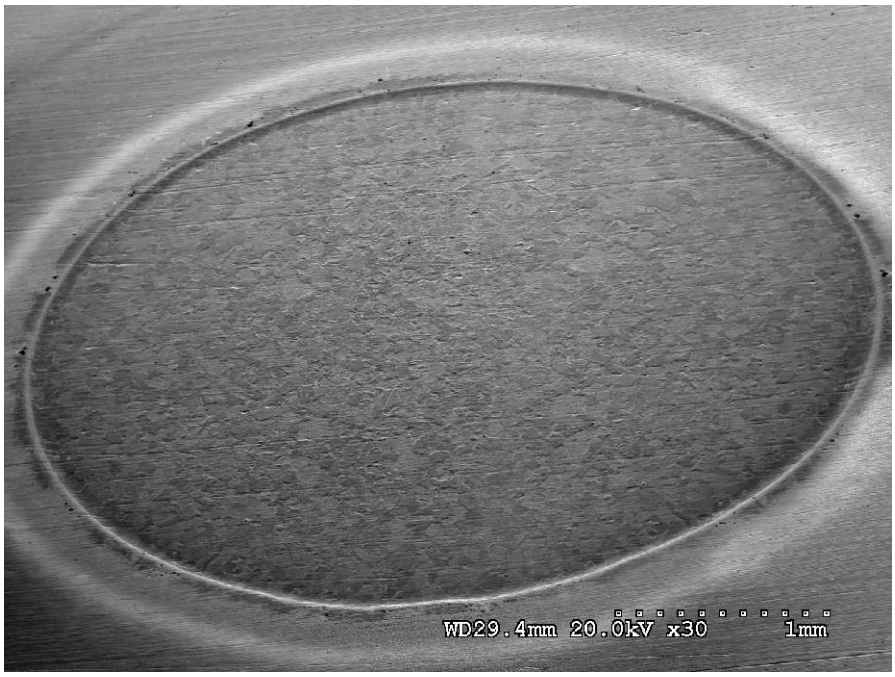
This unique method of excitation results in true bulk analysis providing a distinct advantage in accurately identifying chemical compositions, especially of difficult materials, over other excitation methods.

GDS Advantages Over Other Analytical Techniques

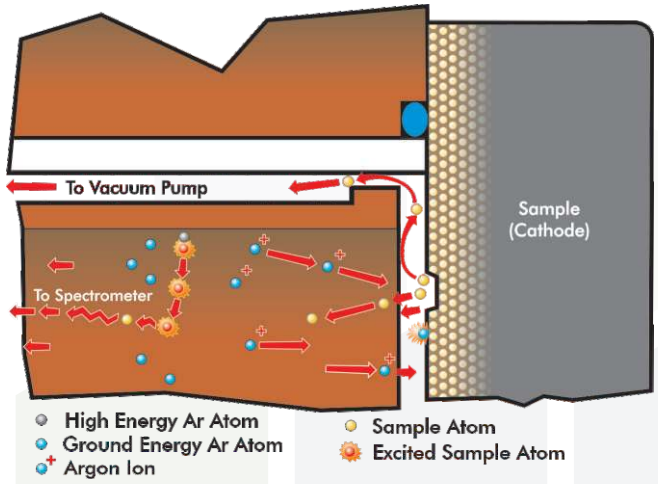
- Separation of sputtering and excitation
- Linear calibration curves with wide dynamic range
- Less self absorption and minimal material re-deposition
- Atomic emission consists primarily of ground state atom lines, resulting in fewer lines and reduced interferences
- Freedom from metallurgical and chemical history
- Fewer standards required for calibration
- Minimal memory effects for a quick matrix change
- Low Argon gas consumption
- Automatic cleaning between samples



The Power of Glow Discharge Spectrometry

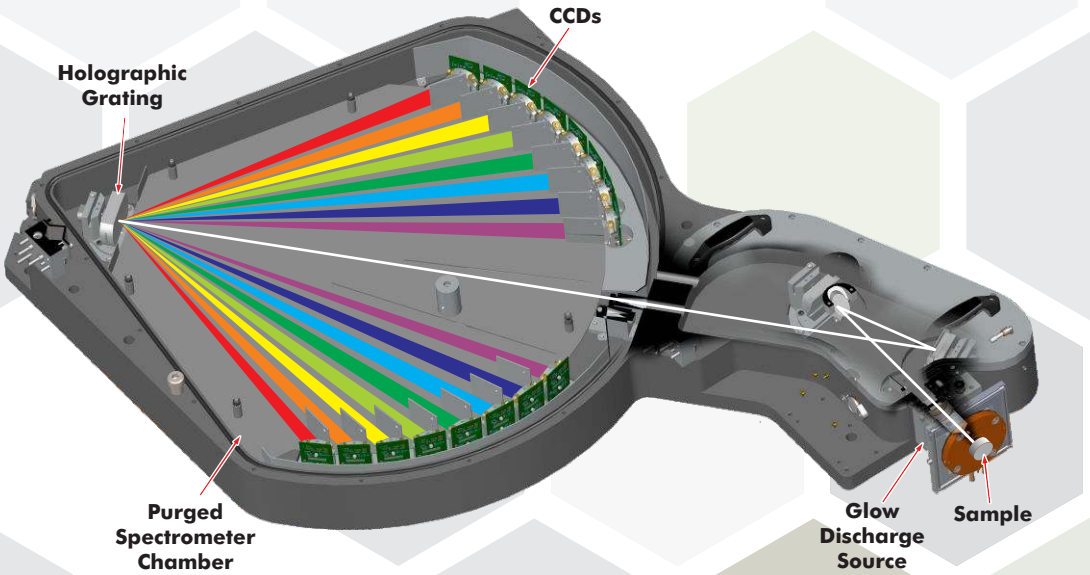


The signature "sputter spot" from glow discharge spectrometry shows uniform sample removal and provides the large representative area needed for accurate sampling of bulk content and depth profile information. Competitive methods cannot provide this quality of data because of their random sampling processes. The cathodic sputtering process of the Grimm-type lamp is created by applying a controlled voltage, current, and argon pressure to the sample surface. The diagram below details the excitation and emission of the sample atoms in the argon plasma. Reduced line interferences by glow discharge result in simple linear calibrations. GDS delivers higher precision with fewer calibration standards for an unbeatable advantage over arc spark.



Other methods may preferentially attack the sample surface and do not always provide a representative sample to analyze. With glow discharge spectrometry, sample material is uniformly sputtered from the surface. The non-thermal nature of the sampling process makes this an excellent technique for difficult applications. The sputtering produces atoms for excitation that takes place away from the sample surface.

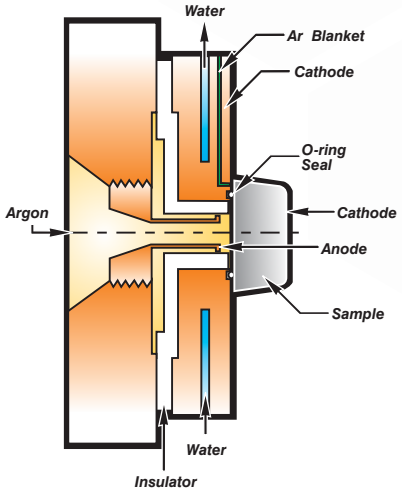
When the excited atoms return to ground state, they emit light. Each wavelength emitted is characteristic of the element from which it came. A holographic diffraction grating separates and focuses the light by wavelength. Exit slits pass the light of your chosen elements on to the detectors for accurate measurement.



Instrument Highlights and Features

Glow Discharge Source Advantages

- Simple, Linear Calibrations: GDS provides narrow emission lines, less interference, increased dynamic range, and less complex spectra when compared to other sources.
- Controlled Excitation: GDS provides a non-thermal source to uniformly remove sample material from the surface. Excitation of the sample occurs away from the surface, reducing chemical and metallurgical effects. Very little sample-to-sample carryover allows quick matrix changes. Uniform sample excitation offers improved precision.
- Interchangeable Anodes: Choice of 4 mm and 2 mm anodes to optimize spot size to sample size and type.
- Reduced reference material consumption allows more acquisition between required resurfacing and shallower burn spots requiring less material removal during resurfacing.





Detection System Advantages

- The inherent sensitivity, dynamic range, and linearity of CCD detectors coupled with the GDS source ensures stability, flexibility, and performance for all bulk elemental applications.
- The all CCD detection system provides full wavelength coverage from 120 nm to 850 nm (configuration dependent).
- 30 pm (0.030 nm) resolution to differentiate even the most complex features of bulk elemental spectra (configuration dependent).
- Recirculated argon-purged spectrometer increases the life of optical components, and eliminates the need for multiple gas sources and associated accessories, reducing operating costs.

System Level User Advantages

- Very easy to operate, maintain, and service. Minimal training required.
- Low consumable consumption for minimized cost-per-test.
- Automatic cleaning between samples saves time, minimizes matrix effects for increased precision.
- Open lamp design and ambidextrous controls allow both right- and left- hand operation.

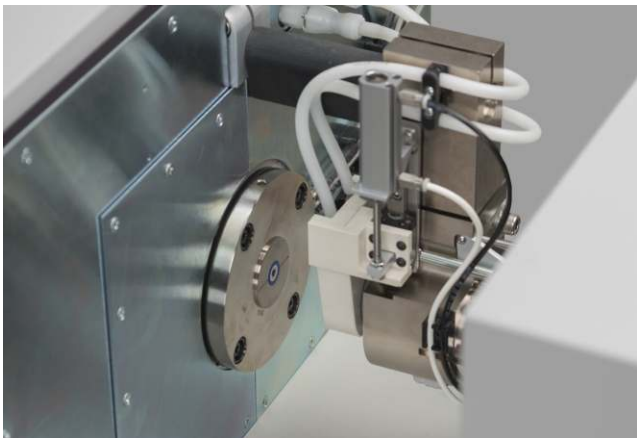




Reliability with Trusted Service and Support

- Knowledgeable sales force with a customer-centered focus dedicated to helping you understand and identify the best instrumentation fit for your application.
- State-of-the-art Technical Services Laboratory with experienced technical application chemists to assist in method development and other application-related requests.
- Global and regional LECO service network comprised of regional support centers and over 25 international LECO subsidiaries, dedicated to providing service and support offerings, including field service visits over the lifetime of the instrument.

The Power of Glow Discharge Spectrometry



DC Lamp

Standard lamp on both the GDS900 and GDS950. The DC lamp supports electrically conductive sample analysis, both bulk and CDP applications, but is not applicable to electrically non-conductive materials. The DC is the optimal lamp for electrically conductive samples like metals.



DC/RF Lamp

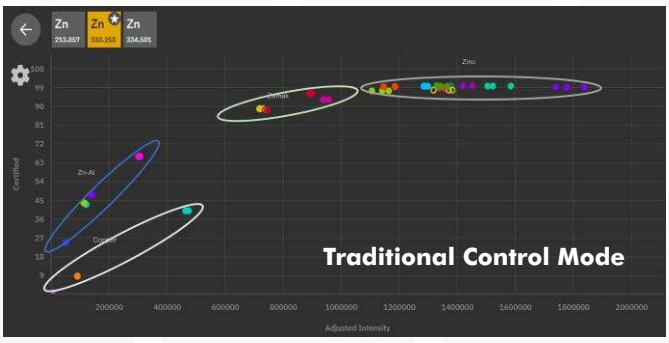
The DC/RF combination lamp is optional on the GDS950 and not available with the GDS900. The DC/RF lamp supports not only the analysis of electrically conductive materials in both DC and RF modes, but also supports the analysis of electrically non-conductive materials in RF mode. Changing from DC mode to RF mode no longer requires timely hardware changes and is now a software-based method parameter. The DC/RF lamp is the most flexible option and supports the widest range of applications.

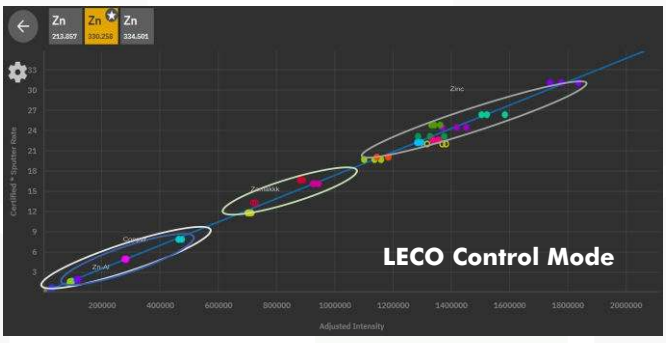
Pulsed RF

Pulsed RF expands the capability of the DC/RF lamp in RF mode by adding the capability to pulse the plasma at various duty cycles. A pulsed mode can help to mitigate heat dissipation, preventing overheating of thermally liable samples, by allowing cool time between the pulses. Pulsing can also concentrate power into short surges, allowing higher peak power than with traditional constant power applications.

Multi-Matrix Calibration

LECO's innate understanding of how lamp settings and matrix difference affect sputter rates allows the GDS system to minimize the family effect which is common with other emission spectrometers. Correlating sputter rates to concentration allows LECO GDS to compensate for matrix variations, which enables essentially full-range calibrations and eliminates the need for type standardization.





True Plasma Power® (TPP)

In conjunction with LECO's patented front coupling is the exclusive treatment of RF power to ensure that lamp parameters are constant regardless of matrix and material thickness. TPP is power control in real-time which compensates for the various RF power losses. Compensated losses include transmission losses, absorption losses, and radiative losses, in addition to real-time compensation of reflected power.

It has been well documented that GD lamp conditions are affected by specimen matrix. It is necessary to apply precise control to the voltage and current for accurate quantification. The voltage-current relationship is important for accurate and consistent results and these parameters can be measured directly in DC. In contrast, for RF, only the voltage and power in Watts can be measured. When the TPP is held constant and the voltage is maintained precisely by varying the lamp pressure, the current is also constant. In this manner the DC control mode is emulated where both voltage and current can be measured and are held constant.

Bulk Elemental Analysis

Unlike other methods, GDS can handle your bulk applications like sheet, powder, fastener, pressed, and mounted samples. Even small samples like wire (0.25 mm diameter) can be accurately tested. Thin sheets (down to 0.02 mm in thickness and even thinner) may be successfully analyzed using a backplate and cooling puck. Just about any sample form can be characterized by glow discharge technology. The flexibility of LECO instruments allows you to easily add depth profiling capabilities as your needs change.



Bulk Applications

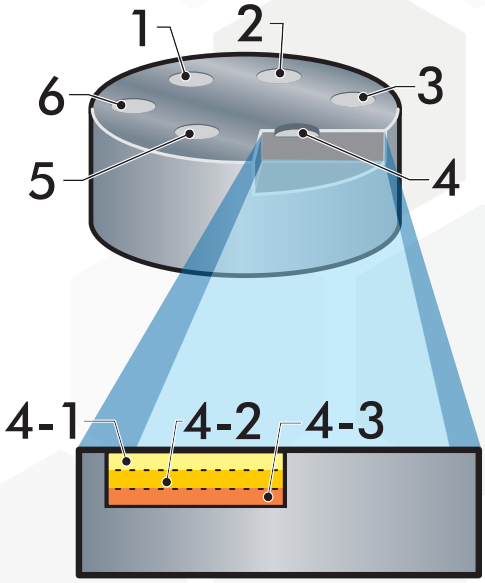
LECO delivers a fully calibrated instrument based on your applications; a few examples provided below.

- Steel (low and high alloyed, leaded, resulfurized)
- Iron (as-cast, chilled-cast, gray, ductile)
- Aluminum (high Si, composites)
- Copper
- Brass/Bronze (leaded)
- Nickel
- Cobalt
- Titanium
- Tungsten
- Magnesium
- Solders (Zn, Pb)
- Zinc
- Carbides
- Powdered Metals
- Low Melting Point Alloys
- Elements not in Solid Solution

Sampling/Sputtering

Traditionally, sampling by alternative atomic emission techniques has been limited to the x/y-plane of the sample surface due to the large heat affect zone and subsequent degradation of surrounding material. Due to the non-thermal nature of argon sputtering, GDS expands sampling capability beyond the surface of the sample spot to inward of the sample spot along the z-axis, allowing multiple acquisitions at the same spot. This expands access to virgin material in multiple dimensions, increasing speed of analysis, reducing sample preparation requirements, and increasing the life of valuable reference materials.

		GDS900 DC	n=150	GDS950 DC	n=146	GDS950 DR/DC	n=150	GDS950 DR/RF	n=129
CFe2-5		AVG	STDEV	AVG	STDEV	AVG	STDEV	AVG	STDEV
Cert. Value	**Fe**	96.30		96.28		96.28		96.28	
0.01	**Al**	< LOQ		0.0033	0.0007	0.0037	0.0004	0.0035	0.0005
0.0032	**B**	0.0033	0.0002	0.0033	0.0001	0.0033	0.0001	0.0033	0.0002
0.32	**C**	0.32	0.006	0.32	0.008	0.32	0.008	0.32	0.01
0.03	**Co**	0.027	0.001	0.032	0.002	0.027	0.003	0.031	0.002
0.59	**Cr**	0.60	0.008	0.60	0.005	0.61	0.01	0.60	0.007
0.31	**Cu**	0.31	0.003	0.31	0.003	0.31	0.003	0.31	0.004
0.44	**Mn**	0.45	0.007	0.45	0.004	0.45	0.005	0.44	0.005
0.28	**Mo**	0.30	0.005	0.30	0.005	0.30	0.002	0.31	0.005
0.015	**Nb**	0.020	0.003	0.019	0.002	0.018	0.0015	0.017	0.002
0.83	**Ni**	0.90	0.01	0.91	0.012	0.90	0.013	0.90	0.013
0.048	**P**	0.044	0.002	0.045	0.0008	0.045	0.0008	0.046	0.001
0.011	**S**	0.012	0.0013	0.012	0.0003	0.012	0.0002	0.012	0.0004
0.32	**Si**	0.33	0.003	0.33	0.003	0.32	0.005	0.33	0.007
0.015	**Ti**	0.015	0.0008	0.015	0.0005	0.015	0.0006	0.015	0.0006
0.3	**V**	0.31	0.007	0.31	0.002	0.31	0.003	0.31	0.005
0.033	**Sn**	< min λ		0.035	0.0003	0.035	0.0004	0.034	0.0008



Compositional Depth Profiling (CDP)

CDP is an ideal method for early identification of potential problems with your materials (including coatings, layers, and thermochemical treatments). Why use GDS? The GDS technique can perform a depth profile analysis continuously from nanometers to ~100 µm. Combined with a fast sputtering rate (0.5 µm to 30 µm/min.), GDS provides the complete chemical composition (ppm to 100%) from the surface to the substrate in only a few minutes. All elements are acquired simultaneously, increasing sample throughput while minimizing cost-per-analysis.

CDP Applications

Your instrument will be fully calibrated for your specific application upon delivery; a few examples provided below.

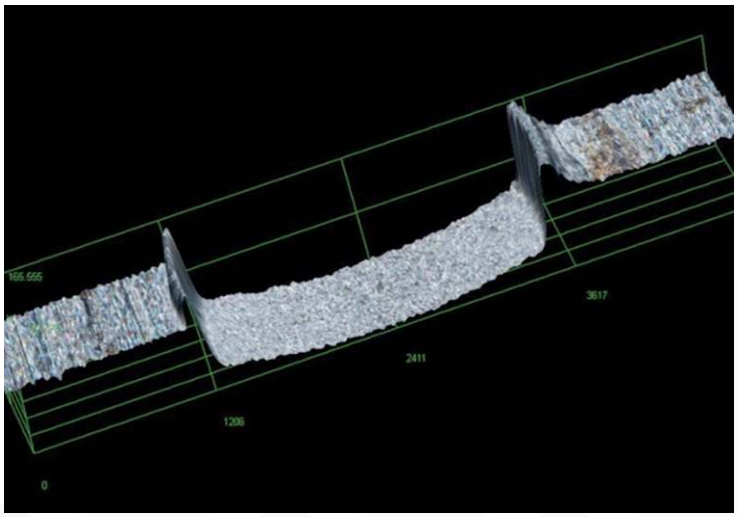
- Galvanizing (EG, Hot Dip, Galvalume, Galvanneal, Galfan, Zinc-Nickel)
- Plating (Sn, Cr, Cd, Ni, Cu)
- Thermochemical treatments (Carburizing, Nitriding, Carbonitriding)
- Hard coatings made by PVD/CVD
- Clad (Aluminum)
- Oxide layers
- Organic coatings
- Semiconductors
- Glass/Ceramics

CDP Quickly Identifies

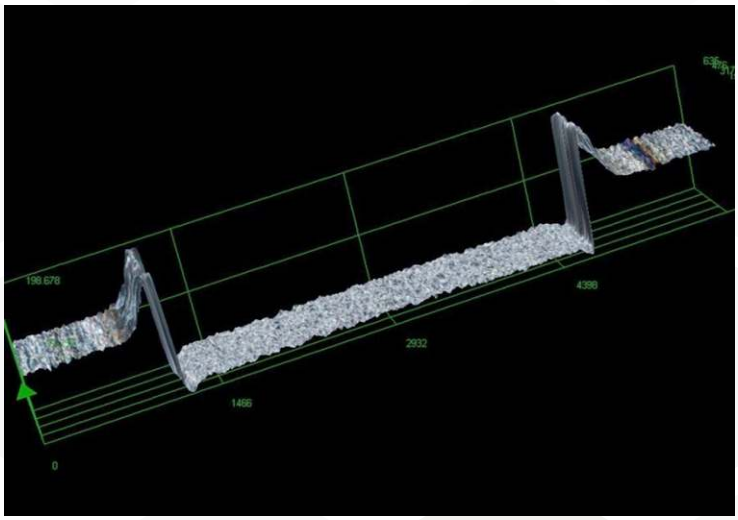
- Contamination and cleanliness at the surface and interfaces
- Migration and diffusion at interfaces
- Heterogeneity of coating/substrate
- Adherence issues
- Oxidation/corrosion
- Inclusion/blister
- Chemical composition
- Layer thickness/coating weight

Lamp Control and Stability (DC/RF/RF Pulsed)

Different materials sputter best at different lamp conditions, and dynamic materials require a system that can quickly adjust for changes in composition. Having the understanding and ability to optimize and control lamp parameters like current, voltage, pressure, and pulse parameters helps to ensure a flat crater which is paramount for accurate depth and elemental composition measurements. LECO GDS method parameters are optimized to provide flat craters, while the combination of LECO hardware and software provide the rapid and accurate control necessary to empower accurate and dependable results.



Sub-optimal lamp conditions result in a concave sputter spot, which obscures layer definition due to uneven sputtering, making accurate depth measurement extremely difficult.



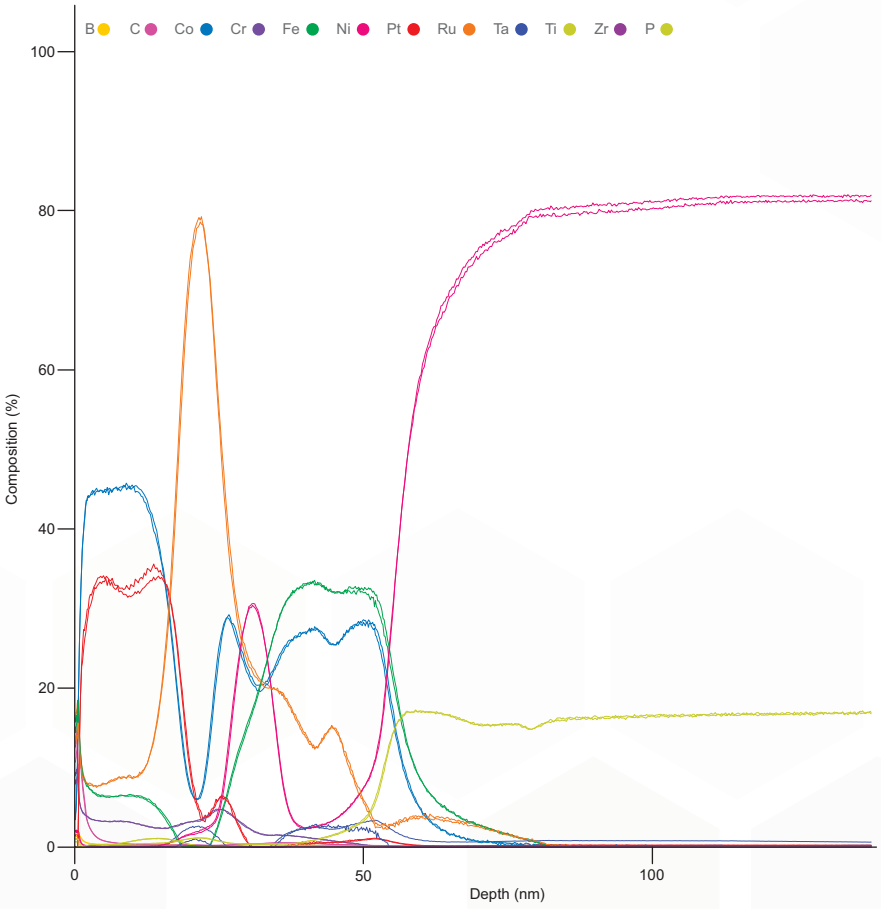
Optimized lamp conditions result in a flat bottom sputter spot, which minimizes layer diffusion due to uneven sputtering, allowing accurate depth measurements.

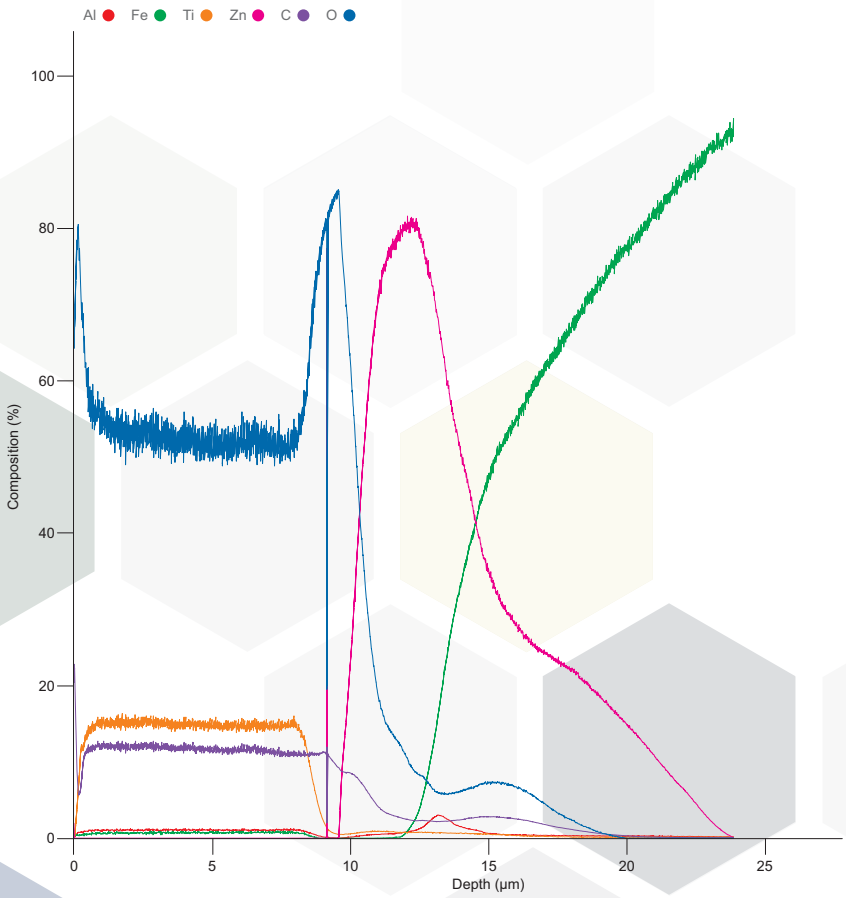
Compositional Depth Profiling (CDP) Solutions

Meeting production, process, and research requirements.

Hard Disk Surface Evaluation

Hard disk drives consist of one or more non-magnetic platters that are coated with a thin layer(s) of magnetic material, with an outer diamond like carbon layer for protection. These layers vary in chemistry and capacity by manufacturer and range from 10-20 nm in depth. GDS CDP supports the determination of layer composition, magnetic layer thickness, protective layer thickness, substrate chemistry, and more in seconds.



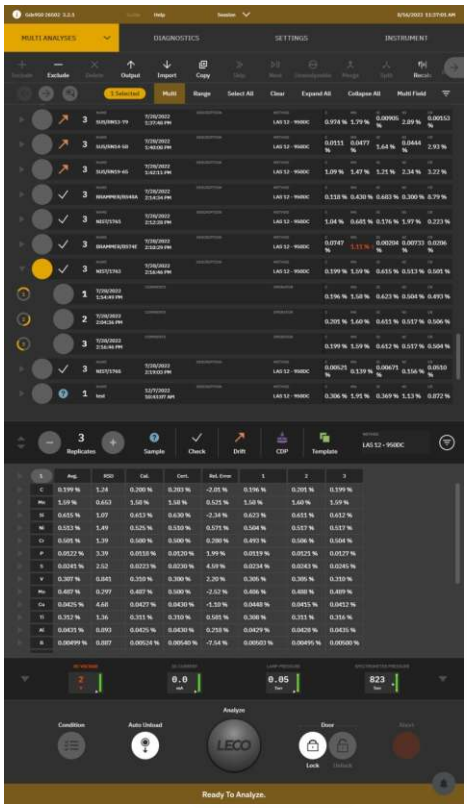


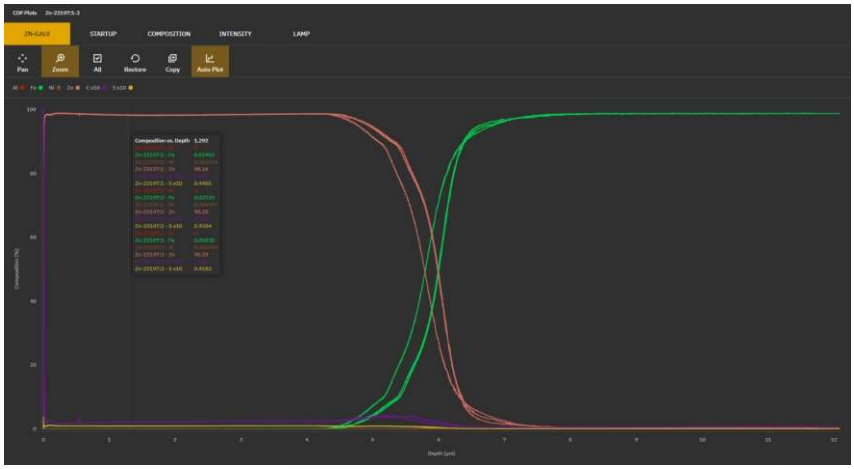
Galvanized Sheet Evaluation

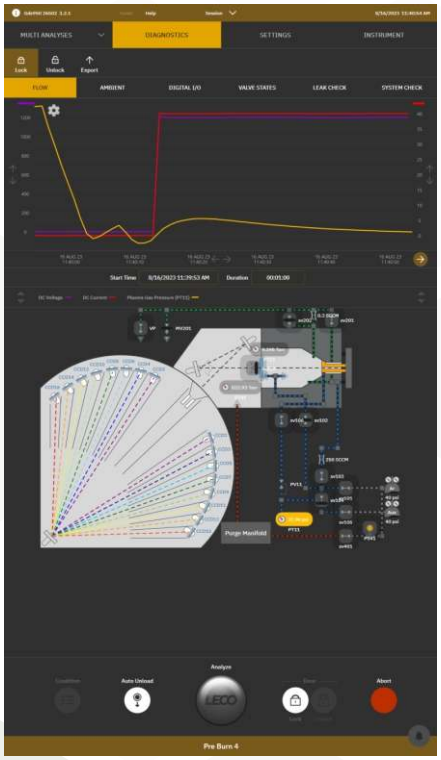
Galvanization is a common and relatively inexpensive method of protecting metal surfaces from corrosion. Although straightforward, care must be taken to confirm proper chemistry and thickness to insure a long-lasting barrier to corrosion. GDS CDP supports the determination of coating thickness, coating chemistry, total coating weight, substrate chemistry, and insight into layer diffusion and surface.

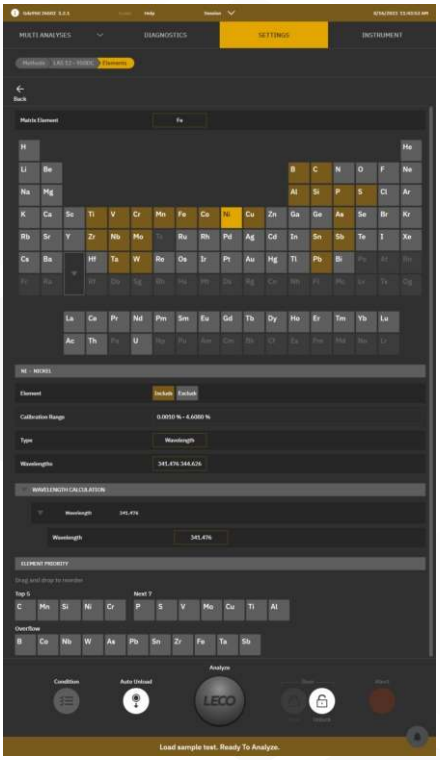
Software Features & Benefits

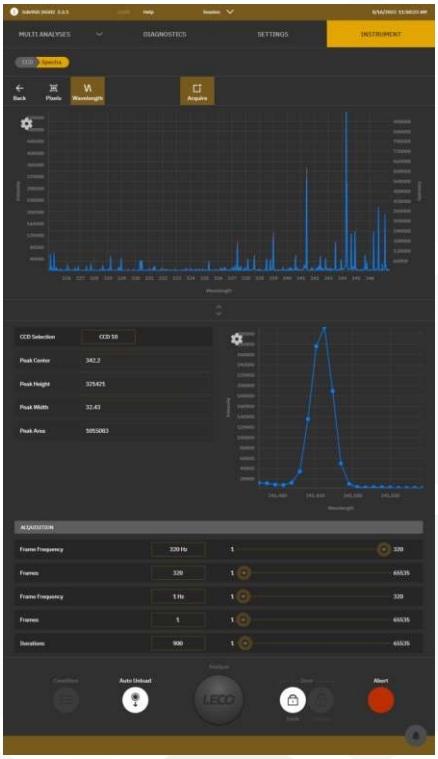
Cornerstone® brand software is divided into four main sections—Analysis, Diagnostics, Settings, and Instrument—for simplified navigation and organization. Toolbars, sliders, and drop-down menus make it easy to set parameters for calibration and data processing. The software also included real-time monitoring of ambient monitors, with fully animated system diagrams. Advanced diagnostic features include a thorough digital on-board manual, maintenance animations, photo illustrations, and screen captures that quickly provide the direction needed without having to refer to multiple manuals. *Cornerstone* also supports extended data archiving and flexible reporting capabilities.











Packages

LECO glow discharge spectrometers are split into two different series, each with a selection of additional options to help the analyst better tailor the system to their individual needs. The GDS900 supports electrically conductive samples only, has a lower resolution than the GDS950, and a narrower wavelength range. The GDS950 supports both electrically conductive and non-conductive samples, has a higher resolution for enhanced peak separation, and a wider wavelength range. Both systems support bulk analysis, optional compositional depth profiling analysis, optional extension spectrometer, and rotary vane or a dry roots pump option. Please contact your local LECO representative for more details.

GDS900 Packages

Part Number	*Description*	*DC*	*DR*	*B*	*Q*	*EX*	*O*	*P*
GDS900DCBO	PKG GDS900 SPECTROMETER BULK PC	STD	NA	STD	NA	NA	NA	NA
GDS900DCEXBO	PKG GDS900 SPECTR W/EXT SPECTR BULK PC	STD	NA	STD	NA	STD	NA	NA
GDS900DCQO	PKG GDS900 SPECTR DC/CDP/OIL PC	STD	NA	STD	STD	NA	NA	NA
GDS900DCQEXO	PKG GDS900 SPECTR DC/CDP/EXT/OIL PC	STD	NA	STD	STD	STD	NA	NA

GDS950 Packages

Part Number	*Description*	*DC*	*DR*	*B*	*Q*	*EX*	*O*	*P*
GDS950DCBO	PKG GDS950 SPECTR DC/BULK/OIL PC	STD	NA	STD	NA	NA	STD	NA
GDS950DCBEXO	PKG GDS950 SPECTR DC/BULK/EXT SPECTR/OIL PC	STD	NA	STD	NA	STD	STD	NA
GDS950DCBP	PKG GDS950 SPECTR DC/BULK DRY PC	STD	NA	STD	NA	NA	NA	STD
GDS950DCBEXP	PKG GDS950 SPECTR BULK/EXT SPECT/DRY PC	STD	NA	STD	NA	STD	NA	STD
GDS950DCQO	PKG GDS950 SPECTR DC/CDP/OIL PC	STD	NA	STD	STD	NA	STD	NA
GDS950DCQEXO	PKG GDS950 SPECTR DC/CDP/EXT SPECT/OIL PC	STD	NA	STD	STD	STD	STD	NA
GDS950DCQP	PKG GDS950 SPECTR DC/CDP/ DRY PC	STD	NA	STD	STD	NA	NA	STD
GDS950DCQEXP	PKG GDS950 SPEC DC/CDP/EXT SPECTR/DRY PC	STD	NA	STD	STD	STD	NA	STD
GDS950DRBO	PKG GDS950 SPECTR RF/BULK/OIL PC	NA	STD	STD	NA	NA	STD	NA
GDS950DRBEXO	PKG GDS950 SPECT/RF/BULK/EXT SPECTR/OIL PC	NA	STD	STD	NA	STD	STD	NA
GDS950DRBP	PKG GDS950 SPECTR RF/BULK/DRY PC	NA	STD	STD	NA	NA	NA	STD
GDS950DRBEXP	PKG GDS950 SPECTR RF/BULK/EXT SPECTR/DRY PC	NA	STD	STD	NA	STD	NA	STD
GDS950DRQO	PKG GDS950 SPECTR RF/CDP/OIL PC	NA	STD	STD	STD	NA	STD	NA
GDS950DRQEXO	PKG GDS950 SPECT RF/CDP/EXT SPECTR/OIL PC	NA	STD	STD	STD	STD	STD	NA
GDS950DRQP	PKG GDS950 SPECTR RF/CDP/DRY PC	NA	STD	STD	STD	NA	NA	STD
GDS950DRQEXP	PKG GDS950 SPECTR RF/CDP/EXT SPECTR/DRY PC	NA	STD	STD	STD	STD	NA	STD

Package Options

DC – DC lamp for optimal analysis conditions of electrically conductive samples.

DR – Dual mode lamp that supports both DC and RF operation. Ideal for those needing to support the analysis of both electrically conductive and nonconductive samples.

B – Bulk elemental analysis software support.

Q – Compositional depth profile (CDP) analysis software support

EX – Extension spectrometer supporting the analysis of peaks at wavelengths between 460-850 nm

O – Rotary vane pump

P – Roots pump. For installations in lab environments where oil vapor is incompatible.

Methods

Glow discharge methods are classified under two distinct approaches, bulk elemental determination and compositional depth profile, and are created to meet your specific testing requirements. These needs will be discussed during your technical sales consultation and will be calibrated and tested in our factory before shipment, providing a turnkey solution upon installation by a trained service engineer. Please contact your local LECO representative for more details, and to schedule a consultation.

Optional Accessories



Enhance the ergonomics of the system with the choice of an optional integrated desk or mobile workstation.



LECO—Consumables



Use genuine LECO consumables for optimal GDS performance. These include the anode, reamer assembly, insulating sleeve, and o-ring in the lamp assembly. The spectrometer box gas recirculator requires reagents used to purify the purge gas, including anhydrone, LECOSORB®, and copper sticks.

Vacuum Pump Sound Enclosure



Optional vacuum pump sound abatement enclosure reduces ambient noise from vacuum pump by ~7 dBa.

High Purity Gas Cylinder Regulators

LECO Corporation offers High Purity Gas Cylinder Regulators for use with its full line of high performance elemental analyzers, calorimeters, thermogravimetric analyzers, and spectrometers. The construction of these regulators has been carefully selected to ensure the highest leak integrity, contamination resistance, and ease of use.



In-line Brass Regulator



Ultra High Purity
Two-Stage Brass Regulator

Sample Preparation Equipment

LECO Corporation also offers sample preparation equipment. Choose from the BG32 dual or BG30 single belt grinders or the a PX300 manual grinder polisher. All of these systems provide an efficient, safe, reliable, and clean grinding/polishing solution for spectrographic samples.







LECO—Your Source for Total Analytical Solutions



CS Series: Carbon/Sulfur by Combustion

- Carbon and sulfur determination by combustion infrared detection
- Quick, accurate, and affordable determination for both production control and research
- Calibration, analysis, evaluation, and diagnostic functions accessible via user-friendly *Cornerstone* brand software



ONH Series: Oxygen/Nitrogen/Hydrogen by Fusion

- Oxygen, nitrogen, and hydrogen by inert gas fusion
- State-of-the-art infrared and thermal conductivity detectors with no moving parts and no manual adjustments
- User-friendly *Cornerstone* brand software
- Custom software interface designed specifically for touch-screen operation

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EMPOWERING RESULTS

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