

Look at the Surface and Beyond ...

GD-PROFILER Series
Glow Discharge OES Instruments

The excellence of the GD-PROFILER
20 years of experience in Glow Discharge
The expertise of RF source technology



**GD
PROFILER™**
Discover a Whole New World of Information

Look at the Surface and

Do you want to solve problems quickly, easily and reliably with one unique tool? Want to find an alternative to expensive surface analysis techniques but still need the high performance they provide? Then take a look at the SURFACE, INTERFACE, and into the BULK of your solid materials with the GD-PROFILER Series of Glow Discharge OES Instruments. Only the GD-PROFILER Series of Radio Frequency (RF) GD-OES instruments can provide both bulk and depth profile analysis for all sample types, including conductive and non-conductive materials...with the performance in sensitivity and depth resolution you need to look beyond the surface and reveal the sample within.

*Elemental analysis from the first nanometers
down to more than 150 microns*

The GD-PROFILER Series of RF-GD-OES Instruments offers two models, each with a variety of options, to suit an extensive range of applications and budgets. The GD-PROFILER™ offers high performance for a wide range of sample types, while the GD-PROFILER HR™ offers unmatched performance not seen in any other instrument available today. The 1.0m focal length of the polychromator translates to greater performance in the areas of optical resolution and sensitivity. The GD-PROFILER HR is the top-of-the-line in glow discharge instrumentation and offers the performance necessary to achieve accurate, sensitive results in even the most complex materials, such as zirconium and tungsten, precious metals or applications featuring rare earth elements in trace concentrations.

One source - One calibration - For all sample types

Jobin Yvon delivered the first glow discharge instrument more than 20 years ago. The unique RF-Only source was patented and then commercialized in 1992. Compared to a DC source, which only allows the analysis of conductive materials, the RF-Only source expands the realm of applications available to glow discharge while providing a simpler, more accurate method for quantitative analysis. Take a look inside and discover how glow discharge can provide a solution for your world of applications.

Beyond...

RF-Only generator is Class E standard and optimized for stability and crater shape allowing for real surface analysis due to constant frequency and rapid matching box design. It is the only 13.56MHz generator available that offers full power delivered at the fundamental frequency.

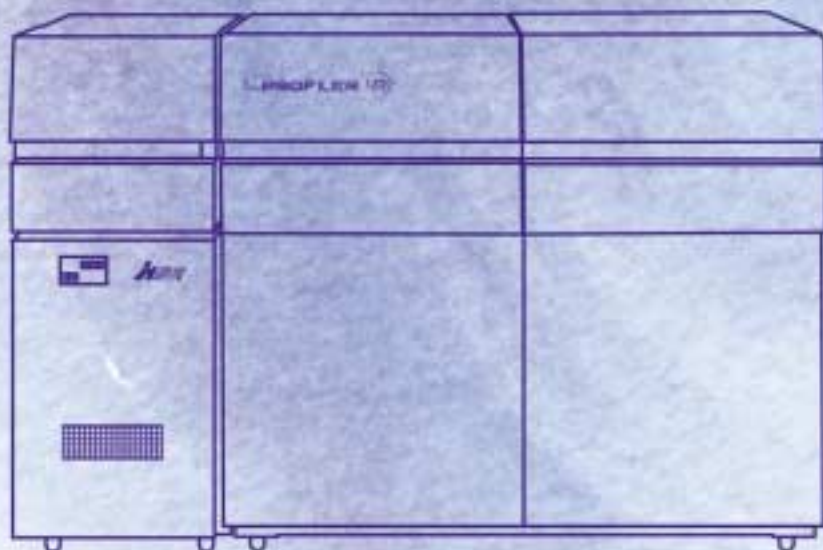
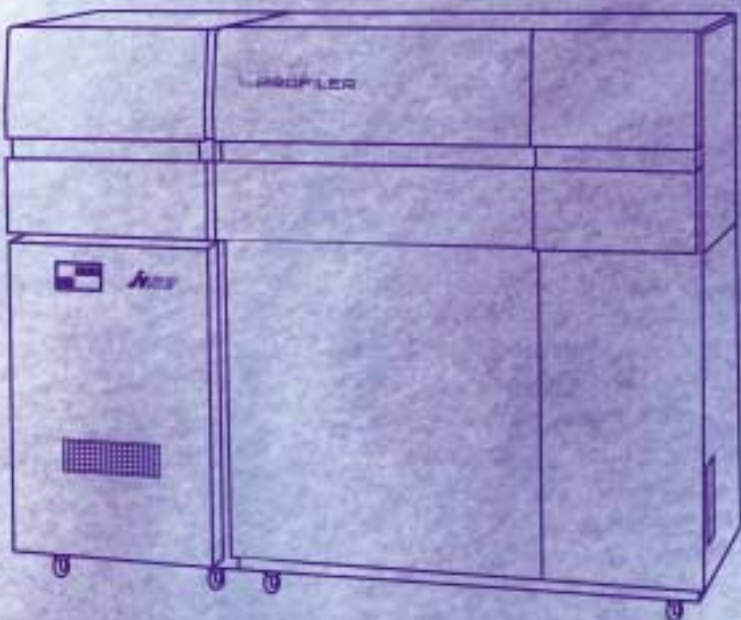
JY original, ion-etched holographic gratings assure the highest light throughput for maximum light efficiency and sensitivity.

High-performance, patented High Dynamic Detection (HDD®) provides speed and sensitivity in detection without compromise – dynamic range of 10^{10} with microsecond speed.

Easily accessible sample compartment allows plenty of room for sample loading, even with large samples. Accessories for small samples or non-flat samples are available. CenterLite™ laser pointer (patent pending) for precise sample loading.

Simultaneous 0.5m optic provides full spectral coverage from 110 to 800nm, including deep UV access to analyze H, O, C, N, and Cl. GD-PROFILER features optical resolution of 18-25pm and the analysis of up to 47 channels.

The monochromator option available only from JY provides the perfect tool to increase instrument flexibility while adding “n+1” element capability and allows full spectrum analysis.



Completely fingerprint your sample in only 2 minutes...full spectrum analysis available only with JY and IMAGE.



GD-PROFILER HR offers 1.0m focal length providing optical resolution of 14pm with the simultaneous analysis of up to 60 channels.



The optional 1.0m monochromator of the GD-PROFILER HR offers the highest optical resolution available of 9pm in the UV.

20 years of Glow Discharge experience and RF source expertise produces the excellence of the GD-PROFILER Series.

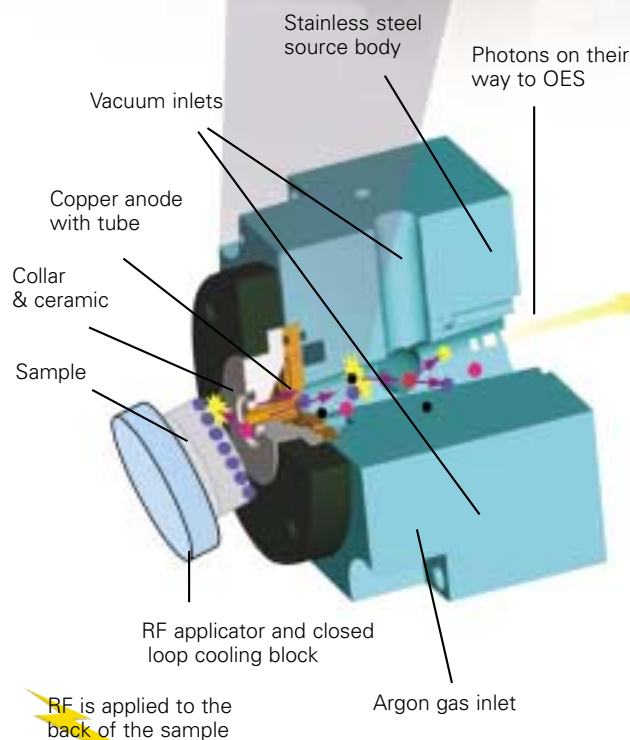
BULK, SURFACE AND DEPTH PROFILING, CONDUCTIVE AND

RF BOSS Delivers Perfo

GD-PROFILER Series RF-GD-OES combines a glow discharge powered by a radio frequency (RF) source with an optical emission spectrometer. The essence of a glow discharge instrument is the source, which supplies power to create the GD plasma. The RF-BOSS-DVS is a unique combination of the Grimm Lamp, featuring a cathode block with potential in contact with the sample and a dual pumping system, and the RF-Marcus Lamp, where RF is applied to the back of the sample using no cathode block and no differential vacuum.

The spacious sample compartment provides room for a variety of sample sizes and provides ease in sample mounting due to the primary vacuum and CenterLite laser pointer mounted on the automatic cleaning reamer behind the sample.

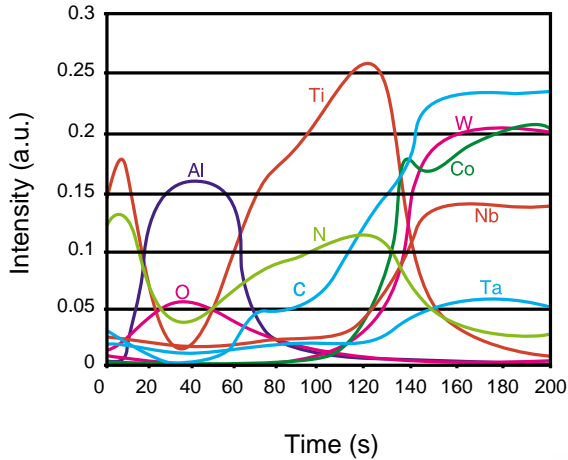
RF BOSS-DVS
Radio Frequency Source • Back of Solid Sample • Dual Vacuum System



- Separation of the sputtering and light emission area minimizes matrix effects, providing linear calibration curves and allows for the mixing of various alloys in one program.
- Cooling of the sample with a recirculating water system allows temperatures close to zero degrees Celsius, making it possible for the analysis of thin films, such as polymers, which may melt at higher temperatures.
- Smooth sputtering allows for the analysis of compacted, powdered samples.
- Analysis of gaseous elements (C, H, O, N) and other elements that are commonly difficult or impossible to analyze with other techniques such as XRF. The tightness of the lamp seal and the combination with the OES results in more analysis on one instrument type, reducing the overall time and cost of analysis.
- Low argon consumption of less than 0.3 L/minute minimizes the cost of analysis.
- RF design allows a fast analysis of conductors and non-conductors, as well as non-conductive coatings on conductive samples.

NON-CONDUCTIVE...

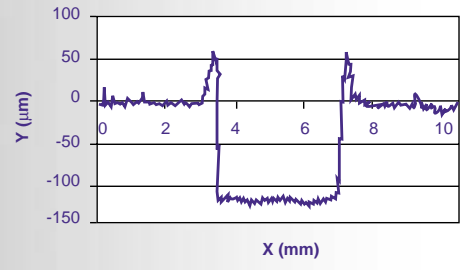
Performance for Your Sample



The full spectrum overlay of 3 steel samples.

Comparison of an element at low levels of concentrations (0.05% to 0.3%) from 3 spectra of steel. Note the resolution of the monochromator is shown at about 7pm. While the first line is ionic and very sensitive in ICP it is not intense in GD and is also interfered by a Fe line, therefore not recommended by the GD library.

Hard coatings are of major commercial interest and are commonly prepared by chemical vapor deposition (CVD) or physical vapor deposition (PVD). RF-GD-OES has much to offer to this industry by assisting in the development of new products and in quality assurance and production problem solving. The GD-PROFILER series of instruments offers the perfect solution for these types of samples, which are multi-layered, complex coatings. The above depth profile shows the analysis of a PVD coating by the GD-PROFILER.



Typical 2-D crater obtained on Zn coated steel. The double pumping system of the JY RF-BOSS-DVS lamp minimizes the redeposition on the edges of the crater due to the larger anode-to-cathode gap. This allows analysis down to 150 microns with excellence in flatness, which is critical for depth resolution.

Element	Concentration (%)
Al	0.0000
As	0.0000
Br	0.0000
Ca	0.0000
Cd	0.0000
Co	0.0000
Cu	35.44
Fe	0.0000
Ge	0.0000
Li	0.0000
Mn	0.0000
Ni	0.0000
Pb	0.0000
P	0.0000
S	0.0000
Se	0.0000
Si	0.0000
Sr	0.0000
Ta	0.0000
Ti	0.0000
V	0.0000
Zn	64.56

Typical bulk analysis of brass sample. Glow discharge provides an excellent alternative to spark OE systems for bulk analysis, providing less matrix effects and increased linearity in calibration.

GD-PROFILER Points

- RF GD provides the ability to perform the same types of bulk, elemental analysis as with traditional OE systems (arc/spark) with a typical precision of 0.4% for the main elements and an analysis time of about 90 seconds
- JY provides calibrations for both bulk and quantitative depth profile (QDP) for steels, cast irons, alloys of Al, Cu, Ti, Ni, Co, Zn, Sn and Pb using Certified Reference Materials. Custom calibrations are also available
- Literature published today comparing RF and DC shows RF provides a more energetic plasma and therefore greater sensitivity compared to DC
- The GD-PROFILER Series offers a world of applications opportunities for thin films, PVD/CVD coatings, coated steels, oxidation/corrosion/passivation, surface treatments, semiconductors, metal alloys, ceramics, powders, and glasses
- ISO Technical Committee TC 201 recognizes RF Glow Discharge as a valid technique for both bulk and surface analysis

EXCEPTIONAL RESULTS FOR ANY APPLICATION...

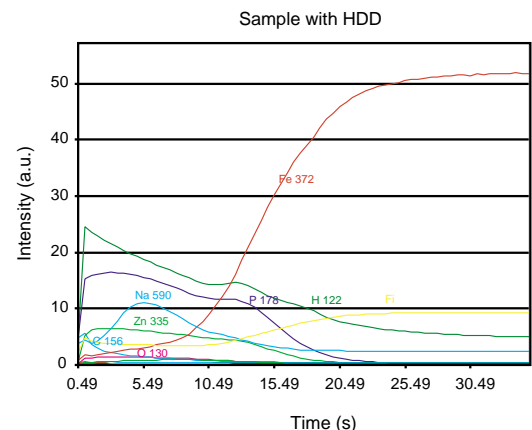
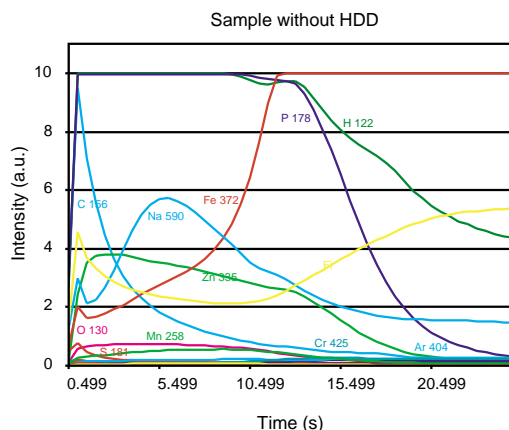
Speed and Sensitivity

Depth profile analysis is a continuous process of sputtering through a sample at a rate of typically 3 microns per minute. At such a speed, two parameters are critical. First and foremost is time. Valuable information is lost with any time spent waiting or integrating. Secondly, the ability to respond accurately and immediately to the rapidly changing concentrations as you work through different layers and arrive at various interfaces.

This means the ability to measure elements at both trace and major concentrations instantaneously. The same element, which may be at a trace level in one layer, could become a major component in another layer. This type of analysis demands a detection system that has high sensitivity for low intensity levels without using long integration times. It also requires an optical design and electronic acquisition system that can acquire a large quantity of information very rapidly.

JY developed and patented the High Dynamic Detection (HDD) system. This unique design offers speed and sensitivity in detection without compromise. Because it utilizes a PMT, it offers unsurpassed detection capability for trace elements using short integration times, allowing the instrument to acquire more critical information at the surface and in the first seconds of sputtering or at the interfaces. The HDD design also extends the linear dynamic range of acquisition to 10^{10} , thus allowing the instrument to respond to signals at the interface varying from low counts to millions in the millisecond timeframe without saturation or voltage preadjustment. This response cannot be achieved with fixed high voltage systems or solid state detectors. With the optional IMAGE feature, the GD-PROFILER instruments can also perform full spectrum fingerprinting of your sample or layer using the automatic HDD detection system and ultra fast acquisition electronics.

The simultaneous optic of the GD-PROFILER instruments provide coverage from 110 to 620nm. The optic offers a direct view of the plasma without the use of fiber optics, maximizing the efficiency in the UV. Ion-etched holographic gratings and few reflective surfaces mean maximum light throughput and efficiency for excellent detection limits. A nitrogen purge is used for low UV analysis; therefore no time is lost waiting for vacuum conditions to return. The enhanced resolution of the GD-PROFILER HR provides the performance required for more difficult sample types and applications.



Phosphatation layer on steel without and with HDD. Without HDD the signals of P, H and Fe are saturated due to poor adjustment of the HV conditions. HDD allows the separation of the P, H and Fe signals, as can be seen in the depth profile on the right.

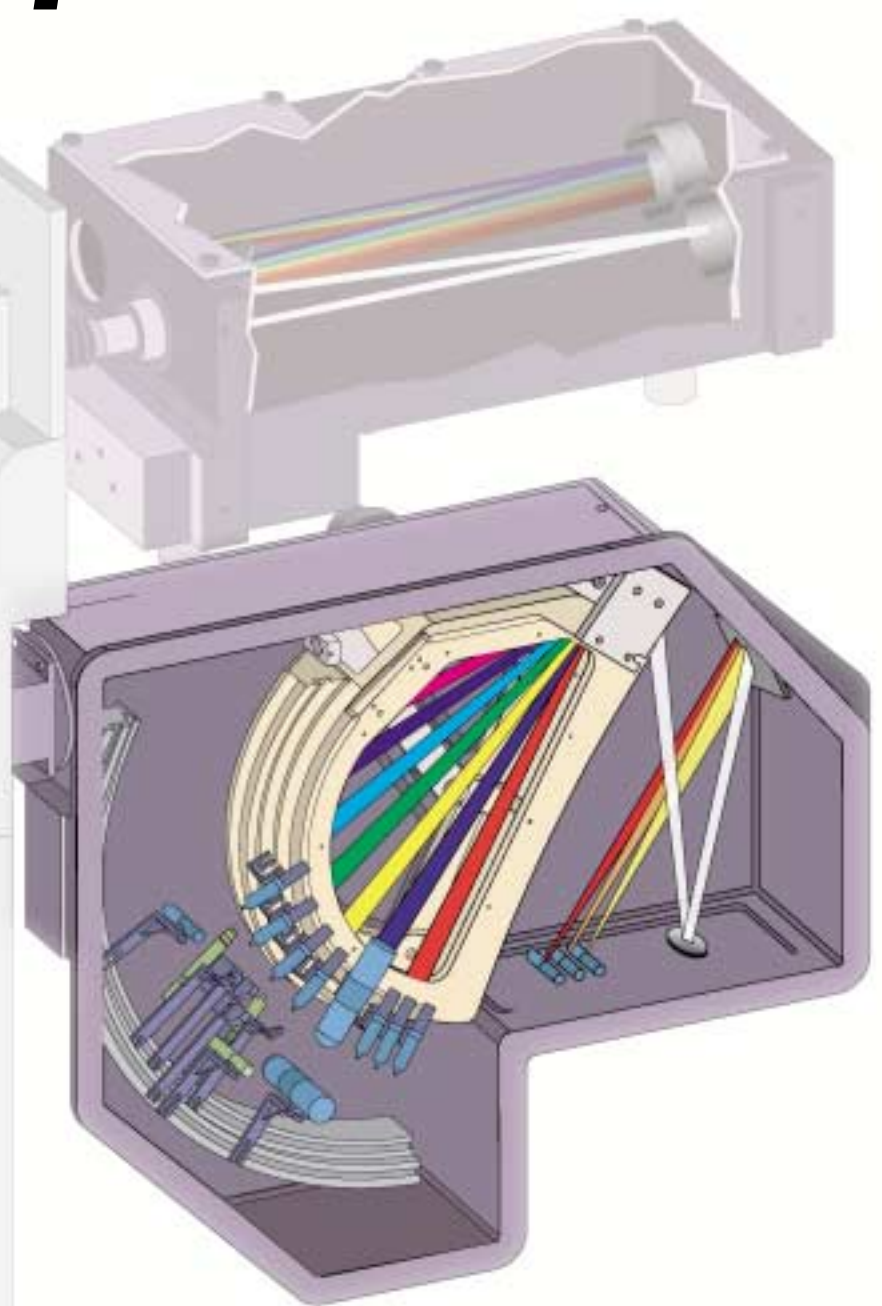
without Compromise

JY offers the unique ability to extend the flexibility of your GD-PROFILER instrument by adding a monochromator. The simultaneous "n+1" analysis during depth profiling is critical in research, where flexibility is key. The directly viewed monochromator features a gigantic, ion-etched 3600 groove/mm holographic grating. The mono option offers improved resolution compared to the poly, which is beneficial in bulk and surface analysis.

Addition of the IMAGE option allows full spectrum fingerprinting of a sample in less than 2 minutes. Using IMAGE, JY has developed wavelength libraries specific to glow discharge. These lines are often different from classical Spark or ICP lines.

The unique double lens system features a removable entrance lens for easy cleaning. The perfect positioning feature of the lens leaves no room for error when replacing the lens after cleaning. No realignment is necessary as with systems using mirrors. The patented Polyscan™ feature extends the elemental capability by providing a scan of +/- 2.2nm around each channel. The system utilizes the second lens to ensure that no de-focusing occurs and maximum intensity is maintained.

The flat field option extends the wavelength range to 900nm to include Li, K, F and Cs. JY was the first to design and patent the flat field in 1978. This unique design utilizes the primary optical beam directed to a second 1200 groove/mm grating.



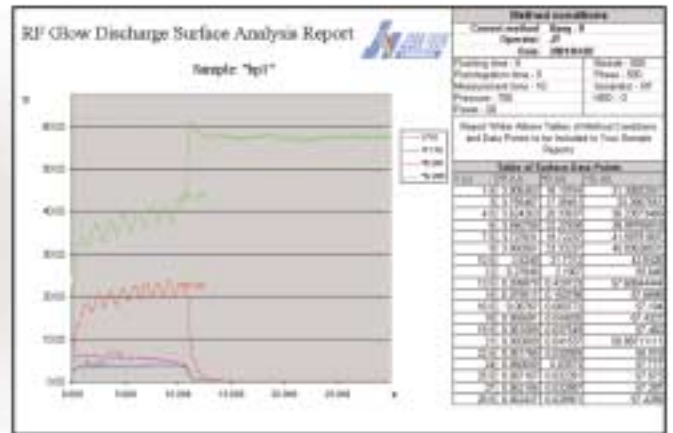
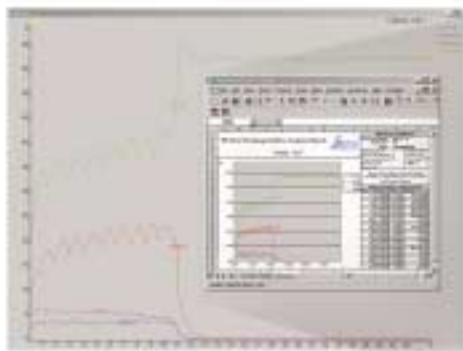
GD-PROFILER Points

- JY offers three possible optical combinations for maximum spectral coverage and flexibility. The monochromator option is a feature unique to JY and not found on any other commercially available GD
- All GD-PROFILER instruments offer patented HDD detection resulting in automatic high voltage adjustment
- HDD is perfect for small, unknown samples where only one spot can be made, as it provides a tailored acquisition for accurate analysis
- IMAGE provides a great tool for semi-quantitative analysis, method development and sample archiving

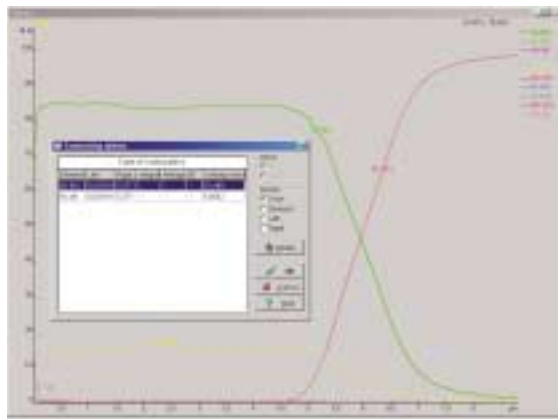
BRINGING TECHNOLOGY AND INFORMATION TOGETHER ...

QUANTUM™ 2000 Software

What good is a powerful instrument without intuitive software that makes it easy to use and to interpret the results? QUANTUM 2000 is not just an instrument operating software - it's a comprehensive management tool for the GD-PROFILER Series. It's loaded with features like IQ – Intelligent Quantification – that take the mystery out of the math behind producing concentrations at exact depths. And with the powerful QUANTUM Tabler™ feature, your valuable data is organized and presented in easily customizable formats. QUANTUM also offers tools for in-depth research and development, such as seamless integration with the IMAGE option for sample fingerprinting and unknown identification.



The QUANTUM Tabler automatically creates sample reports after bulk or surface analysis simply with the click of the mouse. The reports are managed with Microsoft® Excel templates and include the measured raw data, the operating conditions of the method, and the data profiles as displayed in QUANTUM, as well as other tables of interest such as the coating mass for depth profiles. These reports may be customized to meet all of the requirements of your laboratory.

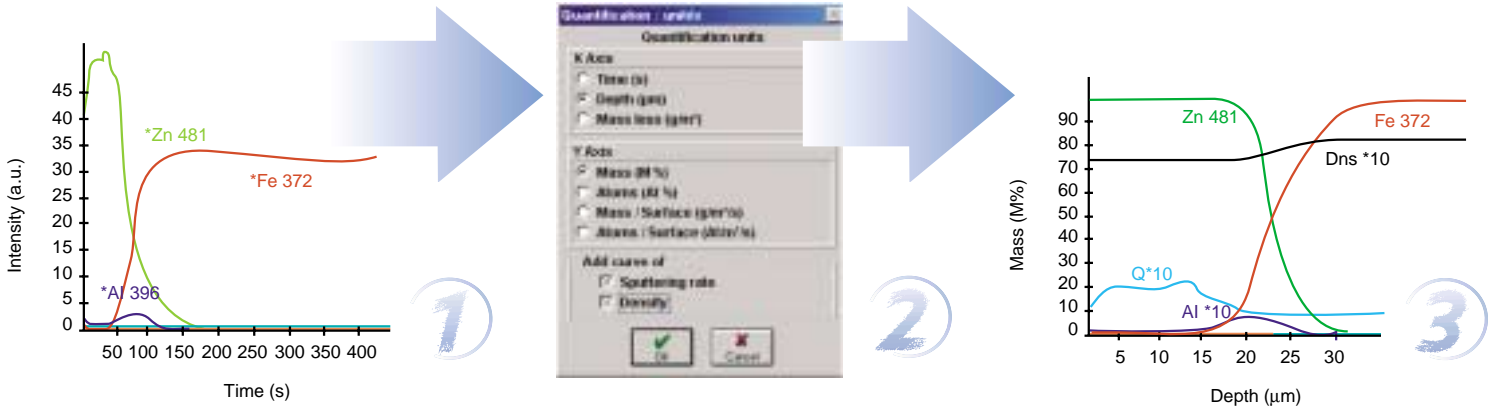


Coating weight is an important parameter of interest for automotive applications. For example, after the quantitative depth profile analysis of a zinc-nickel coated sample, the coating mass may be automatically calculated and placed in a table.

Element	Low Limit	High Limit
Al	0.00000	0.00000
As	0.00000	0.00100
C	0.00000	0.02500
Ca	0.15000	0.35000
Co	0.00000	0.30000
Cu	0.00000	0.00000
Fe	0.00000	0.00000
Ge	0.00000	0.00000
H	0.00000	0.00000
Mn	0.00000	0.00000
N	0.00000	0.00000
Ni	0.00000	0.00000
O	0.00000	0.00000
P	0.00000	0.00000
Pb	0.00000	0.00000
Se	0.00000	0.00000
Si	0.00000	0.00000
Sr	0.00000	0.00000
Ti	0.00000	0.00000
V	0.00000	0.00000
Zn	0.00000	0.00000

Grade is a description of a family or set of defined samples. It defines concentration limits for individual chemical elements, which may be used to determine if a sample belongs to a particular family. For example, after the bulk analysis of a steel sample, the field "Validity" indicates whether the measured values are within the limits of the grade of interest.

with IQ™

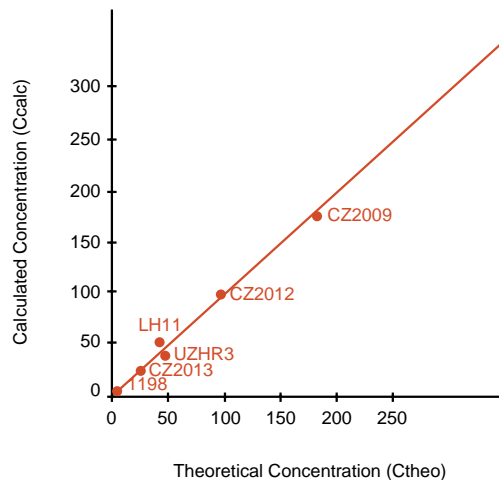
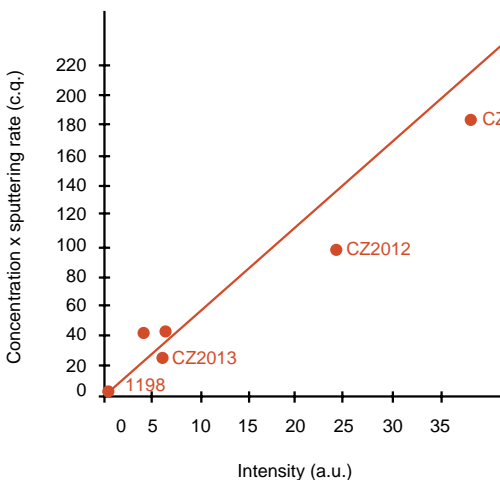


Intelligent Quantification or IQ is an outstanding feature of the QUANTUM software, which allows RF-GD-OES qualitative depth profiles to become quantitative depth profiles with a click of one button! For example, in (1) the raw data for a hot-dipped galvanneal sample is acquired, (2) with a mouse click the desired display axes are chosen, and (3) the quantitative depth profile appears. During the quantification process the sputtering rate and density are also calculated and may be displayed in the quantified depth profile.

- Real-time control of all instrument parameters
- Powerful data handling with easy Tabler feature
- Real-time display during acquisition with zoom feature
- Flexible data manipulation, plotting and printing features
- IQ – Intelligent Quantification- for quantitative depth profile analysis
- Real-time correction for sputtering rate variation in multi-matrix samples
- Automatic coating mass calculation
- Integrated libraries and databases on reference materials, sputtering rates and useful GD wavelengths
- Automatic grade classification for bulk analysis of materials such as ferrous and non-ferrous alloys
- Multi-lingual on-line help and tutorial
- Automatic calibration and re-calibration
- Automatic background correction



QUANTUM provides easy automation of repetitive operations. For example, storing data, printing, and exporting the data to a designated location can all be executed automatically as defined by the user.

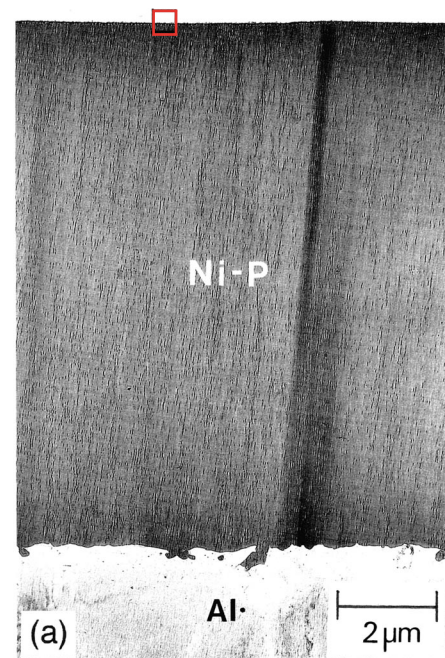
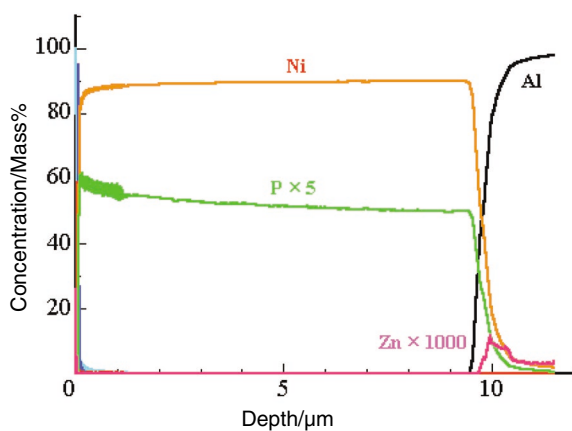


DC Bias Voltage (Vdc) is a measurement of the constant voltage on the surface of the sample, which varies depending on the sample matrix. For unknown or multi-matrix samples, the matrix can change at unknown varying depths. This change results in minor variations as a result of changing impedance or emission yield. Relative sputtering rate is always measured and used in depth profile calibrations, however, further improvement can be seen when measuring the changing Vdc. The curve on the left shows a typical calibration with relative sputtering rate measurement. The curve on the right shows the improvement in accuracy seen when Vdc correction is applied.

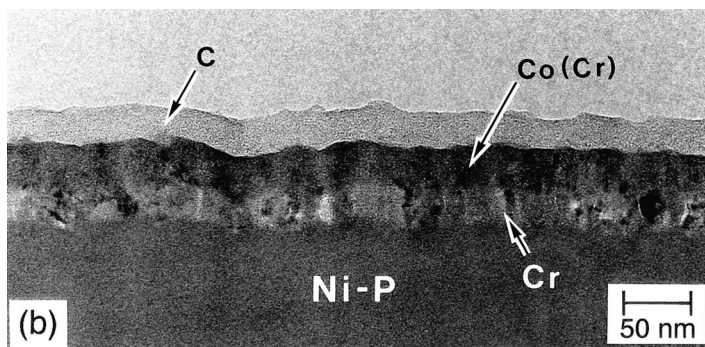
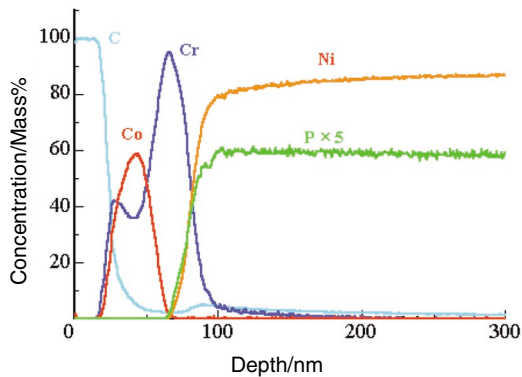
AN ALTERNATIVE TECHNIQUE FOR NEAR SURFACE MEASUR

RF Glow Discharge for Surface

While RF-GD-OES is new to the surface science world, it is capable of true surface analysis. The speed of RF-GD-OES allows depth profiles of both thin and thick films. The typical sputtering rate in RF-GD-OES is 10-150nm per second representing 30-500 atomic layers per second, but since the counting rates of the patented High Dynamic Detectors (HDD) are very fast the instrument is routinely capable of making 1-10 measurements per element per atomic layer.

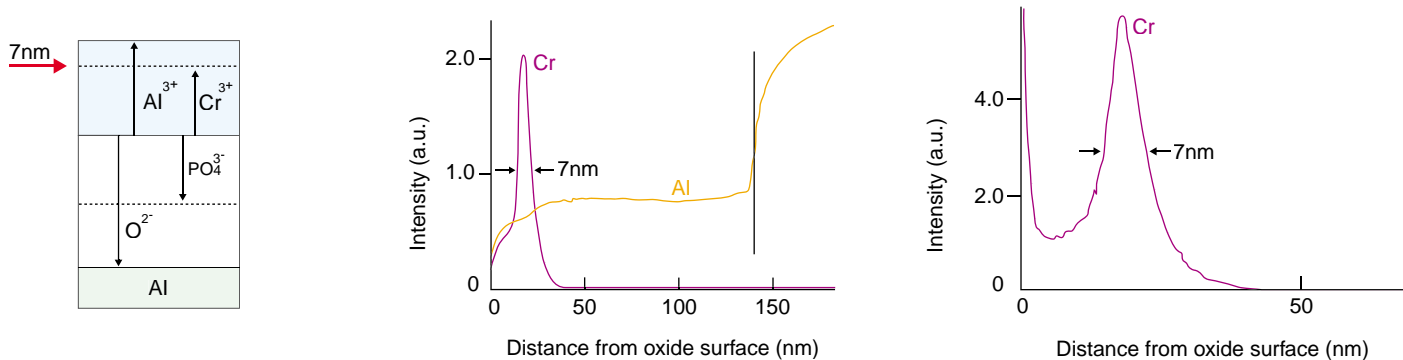


The analysis of commercial hard disks is a challenge for most surface techniques, due to the large variations in thickness throughout the layers of the disks. The full-scale depth profile above shows the ability of GD-OES to sputter through the 12μm amorphous Ni-P layer to the Al-Mg substrate in less than 200 seconds (sampling time 0.1 seconds). The transmission electron micrograph images of an ultra-microtomed section of the hard disk confirm the presence of these layers on the disk substrate. At top right, (shown in a), a general view at low magnification.

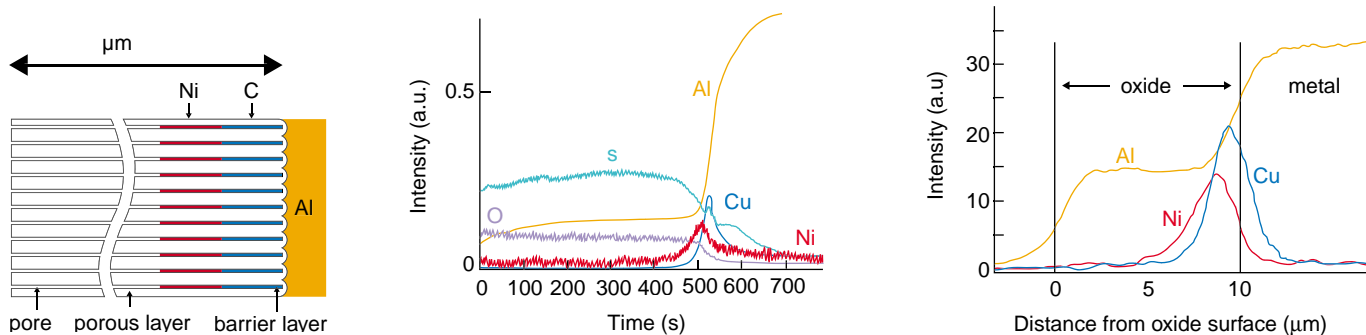


A zoom of the near-surface region above (left) reveals the lubricant layer, diamond-like carbon protective layer, and the cobalt-chromium magnetic alloy and chromium layers, each approximately 20-30nm thick, which were successively deposited over the disks. Sampling time of the near-surface region was 0.01 seconds. The above right image (shown in b) is a zoom of the near-surface area (shown in the red box in a) at higher magnification.

and Thin Film Analysis



Anodic oxidation of aluminum films in appropriate electrolytes leads to the formation of thin (<1µm) barrier anodic oxide films. The top left schematic shows such a film after anodizing in a sodium chromate solution. A comparison of the GD-OES analysis (top middle) and that of secondary ion mass spectrometry (SIMS) (top right) was made for this sample. The distribution of chromium in the film compares well between the two techniques, however, the time of analysis was quite different. In GD-OES the time to reach the metal/oxide interface was 9 seconds, as compared to 60 minutes to reach this interface with SIMS.



The top left schematic above shows a porous anodic oxide film (10µm thick) with controlled distributions of coloring species (copper and nickel) deposited electrolytically within the first µm of the film. A comparative analysis of the film was made by GD-OES (top middle) and electron probe microanalysis (EPMA) (top right). The excellent depth resolution of GD-OES was revealed by the good agreement between the measured average thickness of the copper/nickel layer for GD-OES (700nm) and that estimated by the deposition conditions (500nm). In contrast, the EPMA line scan analysis indicated a thickness of 3µm, which was overly enhanced by the beam spreading effect within the specimen, which is evidence of the limit of the spatial resolution of the technique.



JY RECEIVED THE PRESTIGIOUS
NASA EXCELLENCE AWARD

Over 180 years of JY optical experience provides the platform for NASA projects. This same quality is at the heart of every GD-PROFILER Series instrument.

GD-PROFILER Points

- Analysis times are typically 100 times faster with GD than other surface techniques
- Sensitivity offered by GD is in the range of 10¹⁷ atoms/cm³
- GD allows the detection of hydrogen, which is difficult or impossible with other surface techniques
- Non-conductors can be analyzed with GD without pre-treatment (no surface charging effects)
- GD is a complimentary technique to other surface techniques. It does not provide molecular information on chemical bonds nor does it provide lateral resolution (2mm diameter is smallest spot size)

VISUALIZE THE POTENTIAL WITH CREATIVE SOLUTIONS...

Discover A Whole New World of Support

We know GLOW DISCHARGE.

We know that you need a SOLUTION.

With our 20-year history of excellence in glow discharge, we understand that GD is still a maturing technique with many application possibilities for surface analysis, and as such requires a higher level of support and development assistance in order that you may achieve the highest return on your investment. Our staff of analytical specialists, advice from world-recognized experts in GD, a comprehensive database of GD publications and links to other JY GD users around the world provides the tools necessary to achieve results.

- Training programs that balance theory with practical hands-on experience
- Applications assistance for support in method development
- User Group meetings and WorldLink User Forum provide continuous communication
- ALLIANCE online catalog of supplies, accessories and upgrades for the future growth of your instrument
- Financing with flexible terms to suit your Company's specific needs
- Remote Diagnostics for service and applications support via modem
- Comprehensive partnership agreements for service maintenance

Personalized, expert service sets JY apart.

The ALLIANCE Service Program is an extension of JY to your company where your goals become our goals through our commitment to the continued successful operation of your instrument and the support to your operators. Visit www.jyoriba.com/emission/alliance today.

All backed by
ALLIANCE
Service



ISO 9001:2000
Certificate No A 25



Specifications and instrument appearance subject to change without notice.

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