

Thermo Scientific MagnaRay



Wavelength Dispersive X-ray Spectrometer



Resolution



Sensitivity



Quantification



Identification

WDS Precision and Confidence with EDS Ease

The Thermo Scientific MagnaRay spectrometer is the first intelligent WDS spectrometer. The built-in expert system automatically handles alignment, analysis settings and acquisitions. Data is automatically combined with EDS results to produce the first truly integrated EDS/WDS system.

The MagnaRay™ spectrometer is so closely integrated with the Thermo Scientific NORAN System 7 X-ray microanalysis system that you will find it hard to detect the operation. MagnaRay automatically determines the elements to analyze and performs all of the WDS operations while the EDS detector is still collecting data. The details of the spectrometer setup and operation are handled automatically by the embedded expert system. Whether the need is for peak overlap, trace element confirmation or accurate quantitative analysis, MagnaRay simply and quickly performs the analysis.

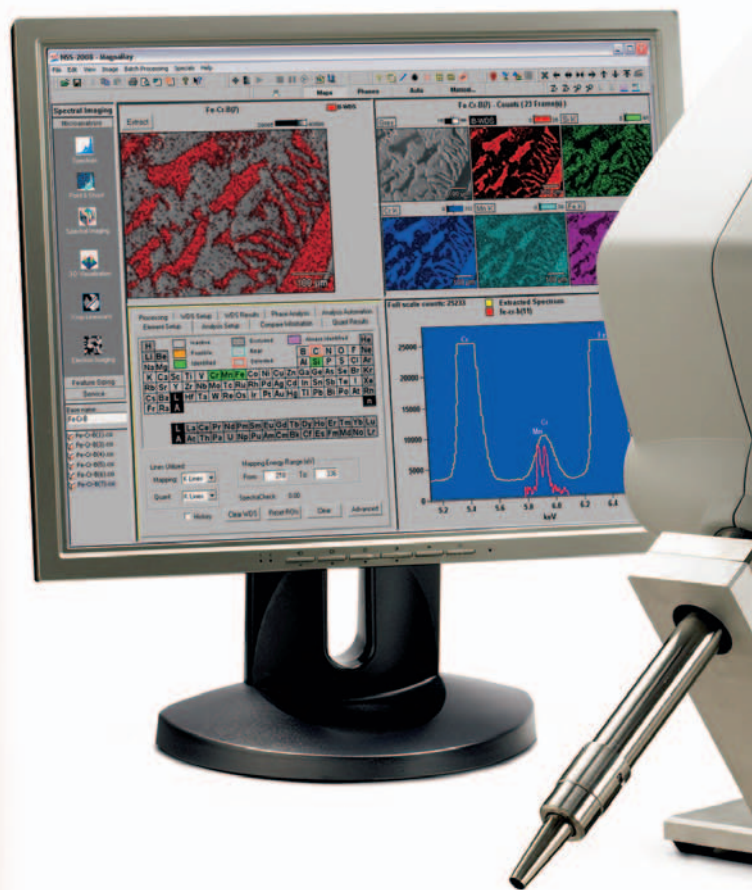
- **Unparalleled microanalysis results**
- **High resolution**
- **Sensitivity for trace elements**
- **Continuous spectrometer coverage for full spectral range**
- **Guaranteed sensitivity specifications**

Speed and Precision

The MagnaRay spectrometer incorporates a revolutionary design with direct-drive mechanisms on both the diffracting crystals and counter. This allows the MagnaRay to change between elements as quickly as 0.25 seconds enabling rapid analysis of multiple elements in the time that older WDS spectrometers are still moving to the first element. Encoders coupled to the direct-drive system ensure angular precision of better than 0.001 degree ensuring WDS peaks always have the correct location.

A Great Fit for Any SEM and Low Voltage Application

The X-ray optics deployed on the MagnaRay spectrometer extend into the SEM chamber similar to a solid state EDS detector. MagnaRay is ideal for applications where high sensitivity, light-element detection, overlapping peaks, high peak-to-background, or high spatial resolution are critical. Only MagnaRay provides this level of application performance under low beam current and low-voltage operating conditions.



Sensitivity

Breaking from older WDS technology, MagnaRay uses an X-ray path design that incorporates a focusing optic that transforms the divergent X-ray emission from the sample into an intense, focused parallel beam. The beam then undergoes Bragg diffraction using one of the diffracting crystals. Using a patented hybrid* X-ray focusing optic that incorporates both a polycapillary and grazing incidence optic, MagnaRay provides excellent count rates at both low and high energies. The hybrid optic is joined by a single low-energy capable sealed Xenon proportional counter simplifying design and operation and improving throughput for all elements as compared to older gas flow proportional counter designs.

* Hybrid optic patent is 5,926,522.

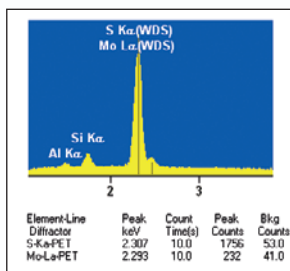
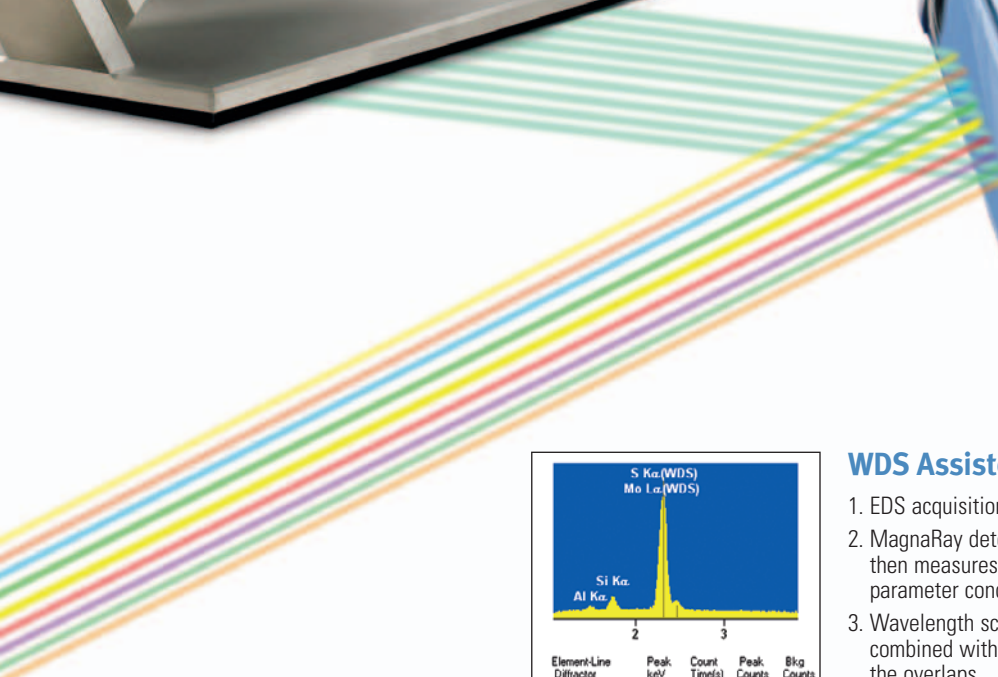
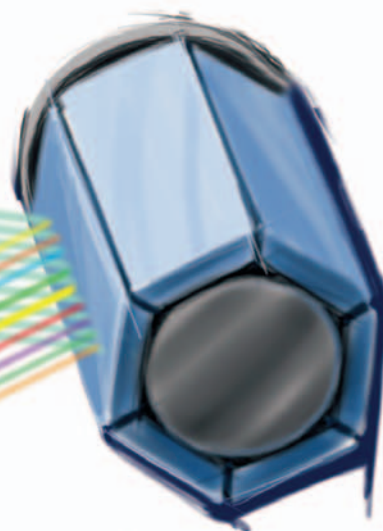




Enabling Nanoscale Analysis

Superb peak-to-background ratios and extreme X-ray collection rates make WDS suitable for trace elemental analysis. With older WDS technology, the spectrometer dictates the operating conditions of the SEM. Older instrumentation typically requires beam voltages starting at 10 kV with beam currents greater than 10 nA resulting in a large electron beam spot size and potential sample damage. With the MagnaRay, operating conditions are dictated by the sample and the SEM – not the spectrometer. Modern nanoscale materials require SEM operating conditions under 5 kV, with a probe diameter

less than 10 nm, and at times using less than 1 nA beam current. Designed exactly for these extreme operating conditions, MagnaRay makes SEM-based nanoanalysis a reality. MagnaRay also solves sample charging and sample damage problems commonly encountered with high-energy high-current traditional WDS. MagnaRay is also ideal on samples where a small interaction volume is critical, such as nano-particles or thin films. MagnaRay gives you the best features of WDS, without the detrimental requirements of high acceleration voltage or high beam current.



WDS Assisted Qualitative Analysis

1. EDS acquisition begins
2. MagnaRay determines potential peak overlaps then measures overlapped peak using optimum parameter conditions
3. Wavelength scans automatically collected and combined with the EDS spectrum to illustrate the overlaps
4. Qualitative results perfected using the WDS results

Quantitative Analysis

WDS quantification has traditionally required close attention to sample position, beam current and spectrometer setup. The embedded expert system of MagnaRay has made those concerns unnecessary. Alignment of the spectrometer is handled automatically when it is needed. Using information from the EDS spectrum, MagnaRay chooses the most appropriate element and aligns the sample and spectrometer for optimum operation. Beam current measurements are automated as well, ensuring accurate quantitative results.

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Filter Fit With Standards Chi-squared value: 6.072 Errors: +/-1 Sigma

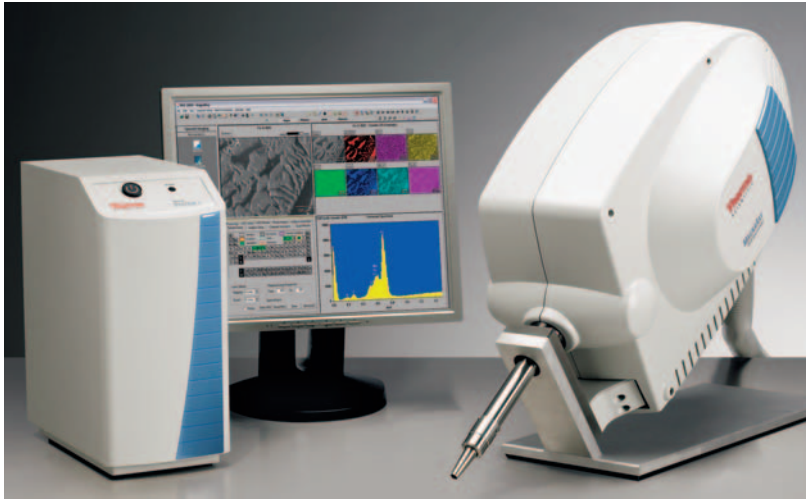
Correction Method: Proza (Phi-Rho-Z)

Acc. Voltage: 20.0 kV Take Off Angle: 53.3 deg(EDS) 35.0 deg(WDS)

Element	Net	Source	Element	Wt. %	Standard
Line	Counts		Error		Name
Si K+	603	WDS	0.79	+/-0.04	Si Std
Cr K	78944	EDS STD	18.47	+/-0.12	Chromium Standard(2)
Mn K+	1089	WDS	1.82	+/-0.07	Mn Std
Fe K	161043	EDS STD	63.01	+/-0.31	Iron Standard(1)
Ni K	24897	EDS STD	14.84	+/-0.15	Nickel Standard(1)
Mo L+	842	WDS	3.66	+/-0.14	Mo Std

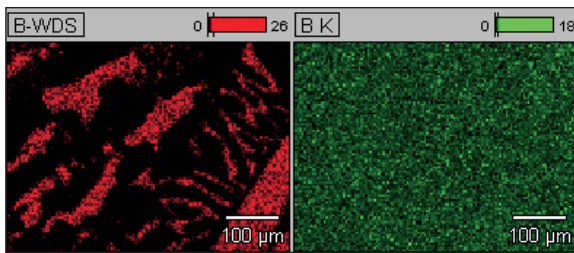
Total +WDS Element 102.59

X-ray Maps and Linescans Par Excellence



Traditional EDS X-ray maps and linescans display integrated peak counts. This data includes both characteristic elemental X-rays and background Bremsstrahlung X-rays. At low energies, the background can become quite high, which results in a low peak-to-background ratio and low contrast X-ray maps or linescans. The WDS technology in MagnaRay provides inherently higher peak-to-background ratios, producing X-ray maps and linescans with high contrast for

low concentration materials. Acquisition of WDS maps and linescans are no more difficult than selecting an elemental line in the periodic table of the NORAN System 7 software. All of the spectrometer settings are automatically set to the best operating conditions possible for that line. Complete transparent WDS integration within the NORAN System 7 software means that an EDS operator is already trained for WDS analyses.



WDS

EDS

MagnaRay WDS demonstrates the ability to detect and map trace levels of elements. The concentration of Boron in this steel sample is less than 3%. The WDS (red) map clearly shows contrast in the image as compared to EDS map (green).

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