

INCAWave and Energy+

Superior peak separation and trace element detection using WDS



The Business of Science®

Microprobe Accuracy on a SEM

Accuracy

Achieve the Accuracy of an EPMA on a SEM
Accurate quantitative analysis below 500ppm

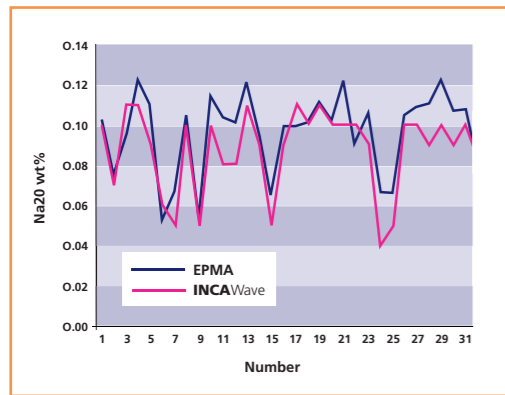


Figure 1 Graph showing how **INCAWave** WDS closely mirrors EPMA accuracy when analysing 32 different mineral grains containing low concentrations of Sodium

INCAWave complements EDS by offering:

- Excellent Peak Separation
- Accurate Trace Element Analysis
- Optimised Element Detection for low and high energy X-rays
- Best Resolution at High Count Rates
- Accurate maps that require no post-collection analysis

Resolution

Separates more overlaps than any other X-ray spectrometer
Less than 10eV resolution for resolving important overlaps like Sulfur/Molybdenum

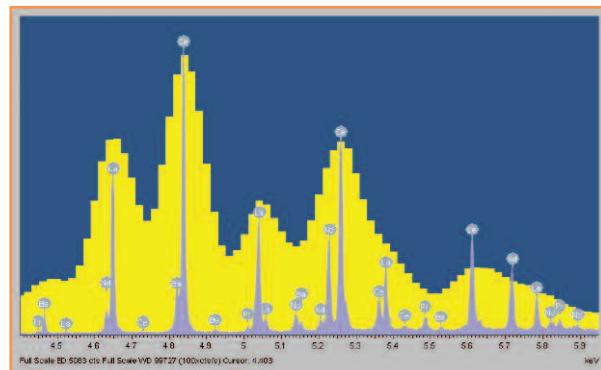


Figure 2 A sample containing many closely spaced X-ray lines from lanthanide elements such as lanthanum and cerium

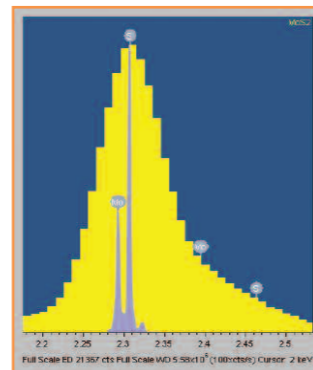
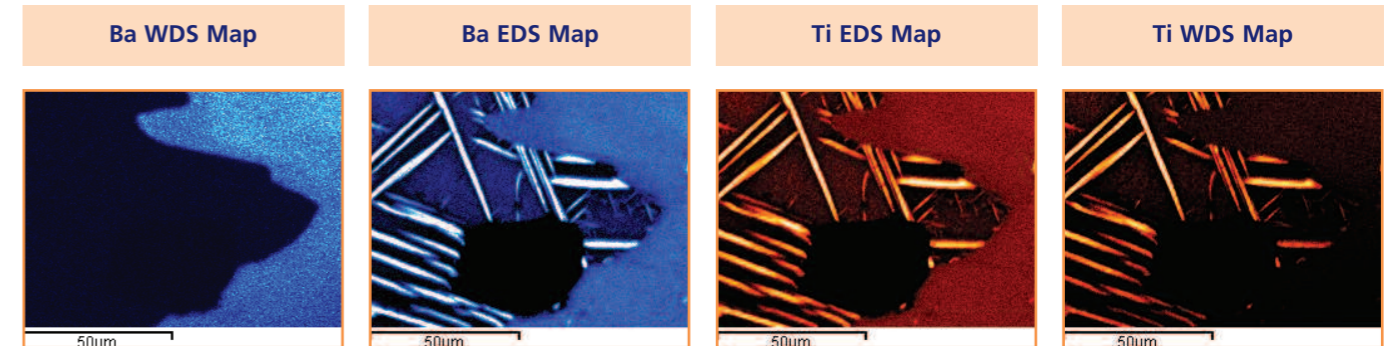


Figure 3 Resolution is good enough to fully separate overlaps as difficult as S K α and Mo L α



Mapping

Accurate Maps Immediately
Easily and unambiguously determine the distribution of all elements in a sample even where peaks overlap (figure 4)

Figure 4 X-ray maps from a sample containing titanium and barium-rich phases. The Ti/Ba X-ray lines are overlapped when using EDS but resolved when using higher resolution WDS. Therefore the EDS maps incorrectly show phases containing both titanium and barium while the WD maps clearly distinguish between the titanium and barium-rich phases

Sensitivity

Improved Sensitivity
INCAWave is up to 100 times more sensitive than an EDS system for trace element detection (figure 5)

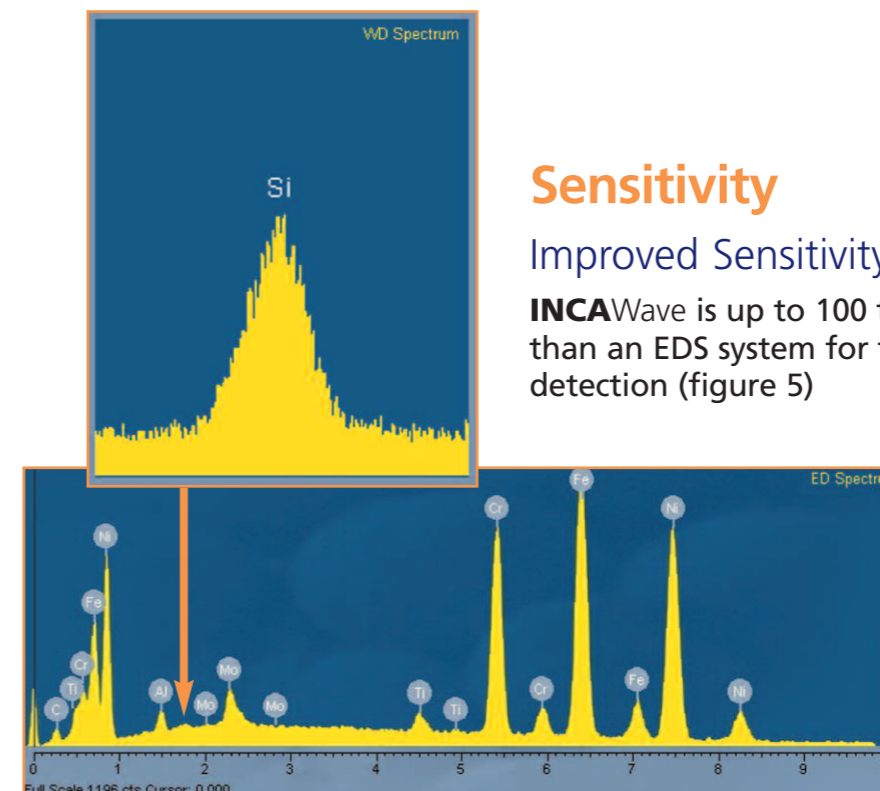


Figure 5 Spectra showing the increased sensitivity of WDS for the identification of silicon (top spectrum) compared to EDS where the Si peak is not visible (bottom spectrum)

INCAWave delivers the power of WDS sensitivity and resolution with the enhanced productivity of the INCA platform

How is INCAWave different from other WDS spectrometers available for the SEM?

INCAWave is a fully focusing spectrometer with a geometry similar to EDS. As long as the sample is in focus for EDS analysis, it's in focus for WDS collection. It uses the crystal to focus the beam into the detectors thus it has no optics and is far less sensitive to sample height changes ensuring accurate quantitative analysis at all times.

Parallel beam detectors use X-ray channeling optics, to focus the X-ray signal into the detector. As a result they are very sensitive to any tiny changes in the sample position & the height of the sample (Figure 6). This means analysis is 100x more sensitive to sample position than EDS. If the sample is incorrectly focused, no WDS signal may be achieved at all and positioning the sample accurately becomes difficult and time-consuming.

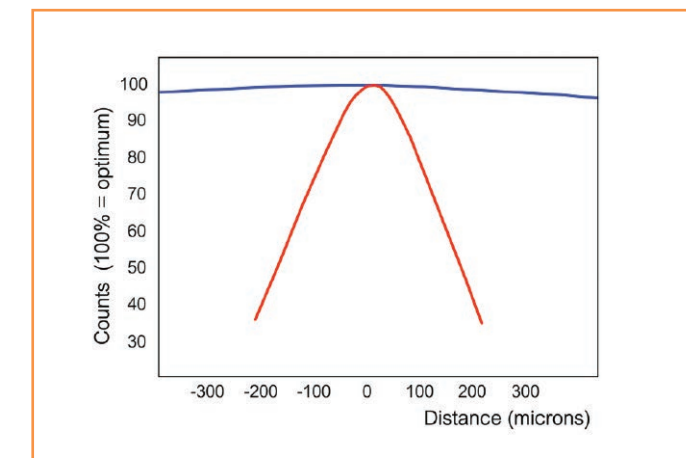


Figure 6 Shows how with a parallel beam spectrometer (red), the signal intensity drops off as the sample height is changed. So if the sample height is incorrect by 200µm, the beam intensity is half its optimum level. This can severely affect quantitative results and X-ray signal intensities when using parallel beam spectrometers. Within INCAWave (blue) sample positioning with 500µm is sufficient to easily obtain reproducible and accurate results

Get the Detailed Big Picture

Montaging multiple WD maps together is the ideal solution for detailed large area mapping.

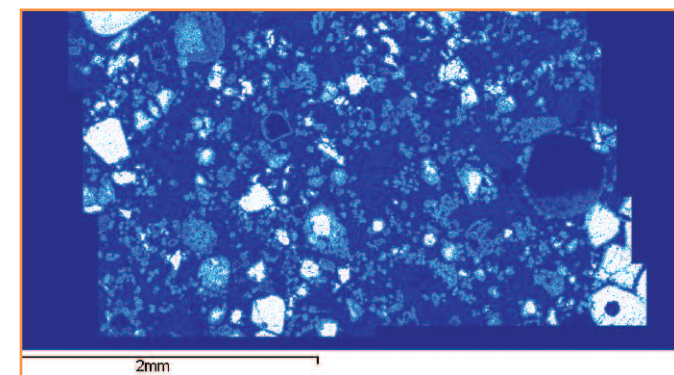


Figure 7 With INCAEnergy+ WDS maps can be collected and montaged as part of the EDS SmartMap acquisition. This is a montaged Cr WD X-ray map consisting of 1024 high magnification maps combined to map a sample 3mm long by 2mm wide

Dual Detection System detects all elements from Be - Pu**

INCAWave is the only WDS Spectrometer with two detectors optimised for detecting high and low energy X-rays. If a WDS system only has one detector, it becomes compromised in its ability to detect either higher or lower energy X-rays

* Please note that the montaging of WDS maps requires Energy+, Automate+ and Montage software

** Wave700

Easy and quick to set-up for analysis

Fully focussing inclined geometry is insensitive to sample height therefore positioning the sample for analysis is simple

Analyse all elements from Be to Pu

INCAWave spectrometers have 4-6 diffracting crystals for optimised detection of elements

Guaranteed system performance

All INCAWave spectrometers have guaranteed performance including count rate, peak to background ratio and wavelength position reproducibility

Robust long lifetime operation

No requirement for vulnerable focussing optics in the SEM chamber

Most accurate elemental analysis available for SEM

Rival EPMA accuracy with WD for trace elements and ED for major elements using XPP quantitative correction algorithms



Identify and analyse trace elements

The unrivalled peak to background ratio of the fully focussing design means signals from trace elements can be easily measured

Identify elements where peaks overlap with ED

INCAWave has up to 50 times better peak separation than the best EDS detector

Achieve rapid results for all elements

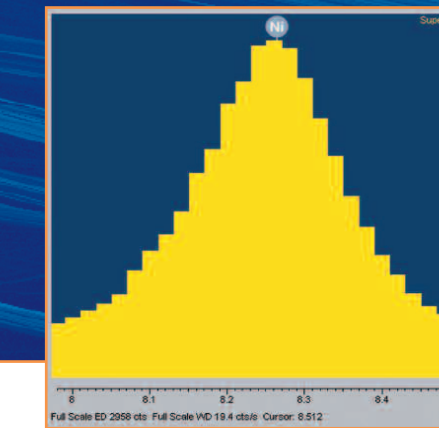
Only INCAWave has two proportional counters, a flow counter optimised for light elements and a sealed counter optimised for heavy elements

Solve the most challenging analytical problems

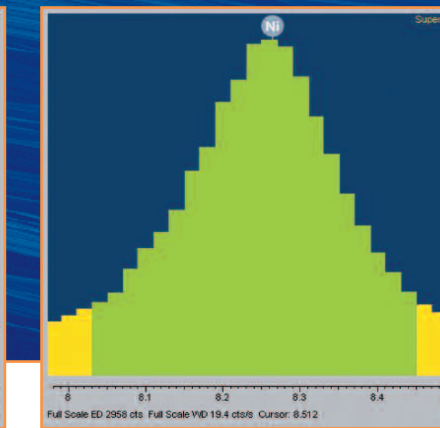
Only INCAWave has a variable slit which optimises resolution and peak to background for each X-ray line individually. Manual control allows the separation of the toughest overlaps e.g. VKα/TKβ

Determine distribution of minor elements

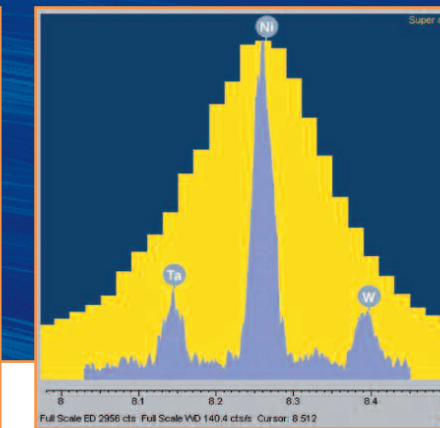
Excellent peak to background ratio combined with diffraction of single X-ray lines for counting is ideal for the collection of X-ray maps of low concentration elements



EDS spectrum indicates the presence of Nickel



A swipe of the mouse starts the WDS scanning



WDS spectrum shows two further elements

Energy+ combines the Accuracy of WDS with the Speed of EDS

Investigating peak overlaps has never been easier

- Use EDS for a quick and rapid analysis of the sample
- Switch to WDS to focus in on peak overlaps and minor elements
- View ED and WD results simultaneously with instant peak recognition

Traditionally WD spectrometers work at higher beam currents than ED detectors but with the introduction of SDD detectors, there is no compromise required and data can be collected simultaneously with both techniques.

...All with just one Swipe of the Mouse

Combined ED / WD Quant Results for Speed and Accuracy

Analyse samples quickly and accurately by combining ED and WD Quant

Garnet	Na ₂ O	MgO	Al ₂ O ₃	SiO ₂	CaO	TiO ₂	Cr ₂ O ₃	MnO	FeO	TOTAL
EPMA	0.07	19.71	19.68	42.04	4.93	0.31	5.23	0.37	7.6	99.95
EDS	ND	19.67	19.52	42.04	5.04	0.36	5.29	0.53	7.92	100.37
ED/WD	0.06	19.56	19.34	41.96	4.99	0.28	5.31	0.37	7.85	99.72

Results Analysed with INCAEnergy+ Results Analysed with INCAWave Results Analysed with EPMA

This dataset compares results from a mineralogical sample taken on (1) a dedicated EPMA with multiple WDS spectrometers (2) An EDS spectrometer using INCAEnergy+ (3) INCAEnergy+ (combined EDS / WDS). Results show that EDS is comparable to a dedicated EPMA when measuring major elements, however, when trace element concentrations (i.e. Mn & Na), are too close to EDS detection limits to provide reliable results for EDS alone, the use of INCAEnergy+ allows you to combine the EDS with WDS data results and still achieve comparable results to an EPMA



History of INCAWave WDS Technology



- 1940s**
 - First EPMA developed
- 1970s**
 - The first commercial single spectrometer for SEM (Microspec WDX 210) is launched by Microspec Corporation
 - First WDX-210 shipped
- 1980s**
 - Microspec WDX 2A with computer control for all operations is launched
 - First WDX-2A shipped
 - Microspec WDX 3PC with PC control for all operations is launched
 - First WDX-3PC shipped
- 1990s**
 - Microspec WDX600 with 6 crystals is launched making detection down to Be possible.
 - ISIS Theta is the first combined WDS/EDS software to be launched
 - Oxford Instruments acquire Microspec Corporation
 - First WDX-400/600 shipped
 - **INCAWave** is launched combining the sensitivity and accuracy of the Microspec spectrometer with the speed and ease of use of the **INCA** platform
- 2000s**
 - **INCAEnergy+** launched making combined ED/WDS analysis easy
 - **AutoMate+** and **Montage** are launched providing automated unattended data collection and large area ED/WDS mapping

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Wave/01/0409



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