

# WWD S

## INCAWave and Energy+

The only way to achieve EPMA performance on a SEM



*The Business of Science®*



# Superior peak separation and trace element detection using WDS

## 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



## Accuracy

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

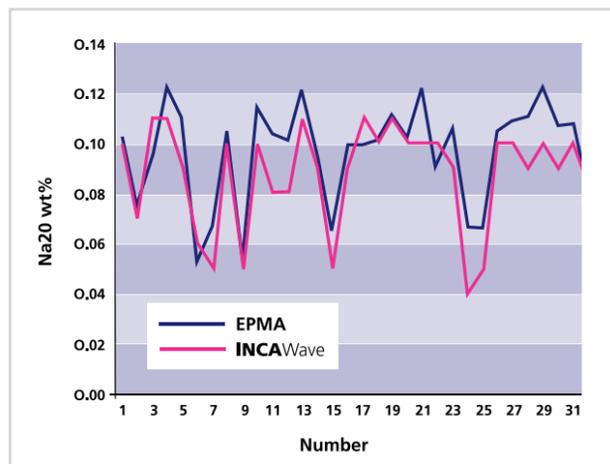


Figure 1: Graph showing how INCAWave WDS closely mirrors EPMA accuracy when analysing 32 different mineral grains containing low concentrations of Sodium

## Resolution

Separates more overlaps than any other X-ray spectrometer

Less than 10eV resolution for resolving important overlaps like Sulfur/Molybdenum.

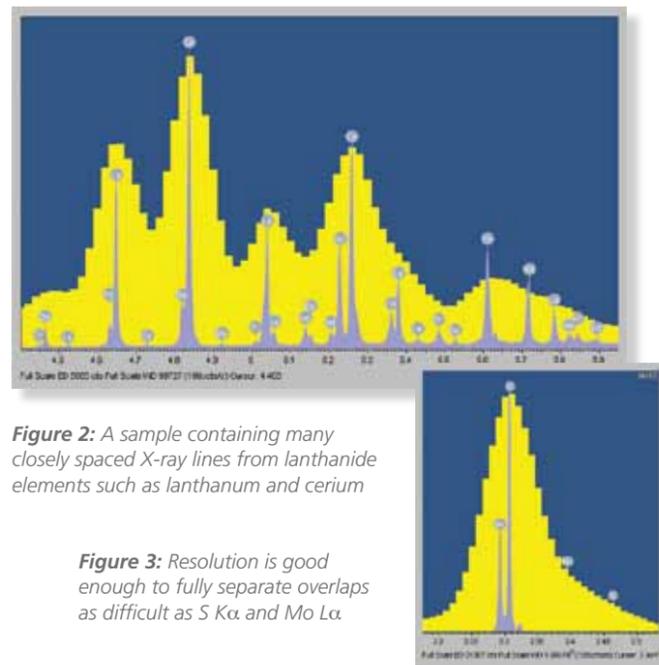


Figure 2: A sample containing many closely spaced X-ray lines from lanthanide elements such as lanthanum and cerium

Figure 3: Resolution is good enough to fully separate overlaps as difficult as S Kα and Mo Lα

## Mapping

Accurate maps immediately

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

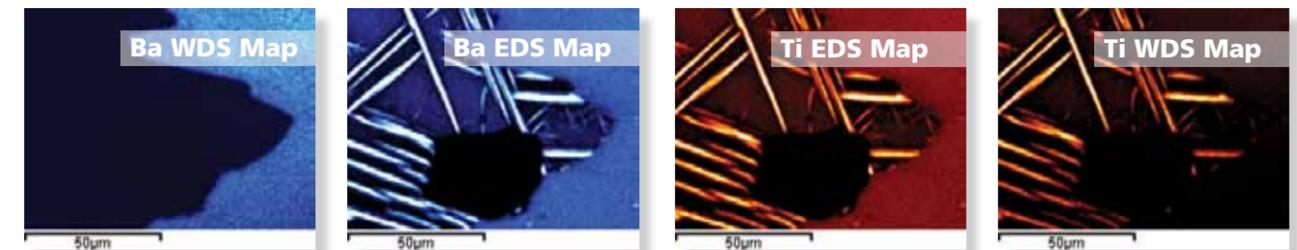


Figure 4 X-ray maps from a sample containing titanium and barium-rich phases. The Ti/Ba X-ray lines are overlapped when using EDS but resolved when using higher resolution WDS. Therefore the EDS maps incorrectly show phases containing both titanium and barium while the WD maps clearly distinguish between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

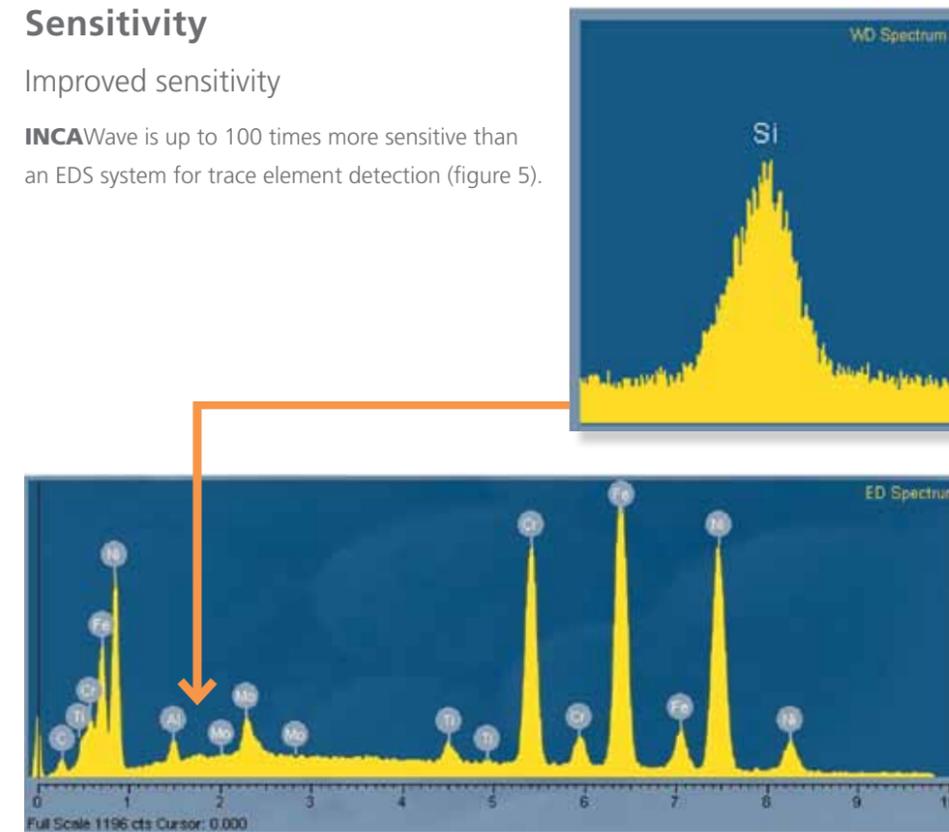


Figure 5 Spectra showing the increased sensitivity of WDS for the identification of silicon (top spectrum) compared to EDS where the Si peak is not visible (bottom spectrum)

# The only way to achieve EPMA performance on a SEM



<p>Easy and quick to set-up for analysis</p>	<p>Fully focussing inclined geometry is insensitive to sample height therefore positioning the sample for analysis is simple</p>	<p>The unrivaled peak to background ratio of the fully focussing design means signals from trace elements can be easily measured</p>	<p>Identify and analyse trace elements</p>
<p>Analyse all elements from Be to Pu</p>	<p><b>INCAWave</b> spectrometers have 4-6 diffracting crystals for optimised detection of elements</p>	<p><b>INCAWave</b> has up to 50 times better peak separation than the best EDS detector</p>	<p>Identify elements where peaks overlap with ED</p>
<p>Guaranteed system performance</p>	<p>All <b>INCAWave</b> spectrometers have guaranteed performance including count rate, peak to background ratio and wavelength position reproducibility</p>	<p>Only <b>INCAWave</b> has two proportional counters, a flow counter optimised for light elements and a sealed counter optimised for heavy elements</p>	<p>Achieve rapid results for all elements</p>
<p>Robust long lifetime operation</p>	<p>No requirement for vulnerable focussing optics in the SEM chamber</p>	<p>Only <b>INCAWave</b> 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. VKa/TKb</p>	<p>Solve the most challenging analytical problems</p>
<p>Most accurate elemental analysis available for SEM</p>	<p>Rival EPMA accuracy with WD for trace elements and ED for major elements using XPP quantitative correction algorithms</p>	<p>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</p>	<p>Determine distribution of minor elements</p>

# The power of WDS sensitivity and resolution with the enhanced productivity of INCA

## 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.

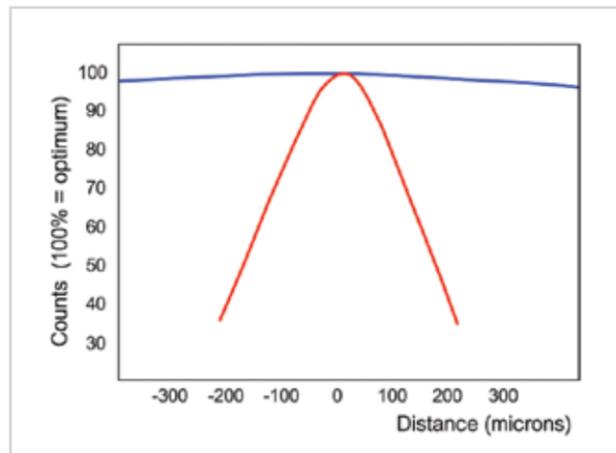


Figure 6 Shows how with a parallel beam spectrometer (red), the signal intensity drops off as the sample height is changed. So if the sample height is incorrect by 200µm, the beam intensity is half its optimum level. This can severely affect quantitative results and X-ray signal intensities when using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

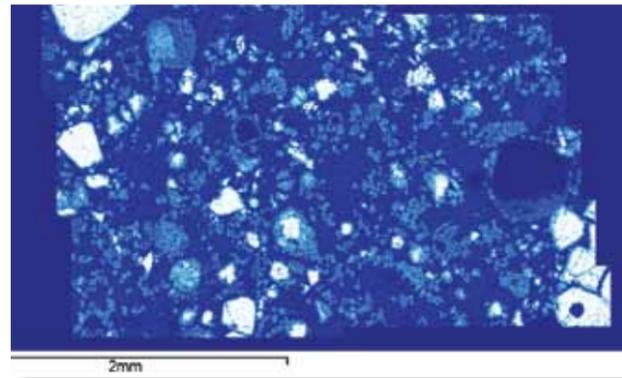
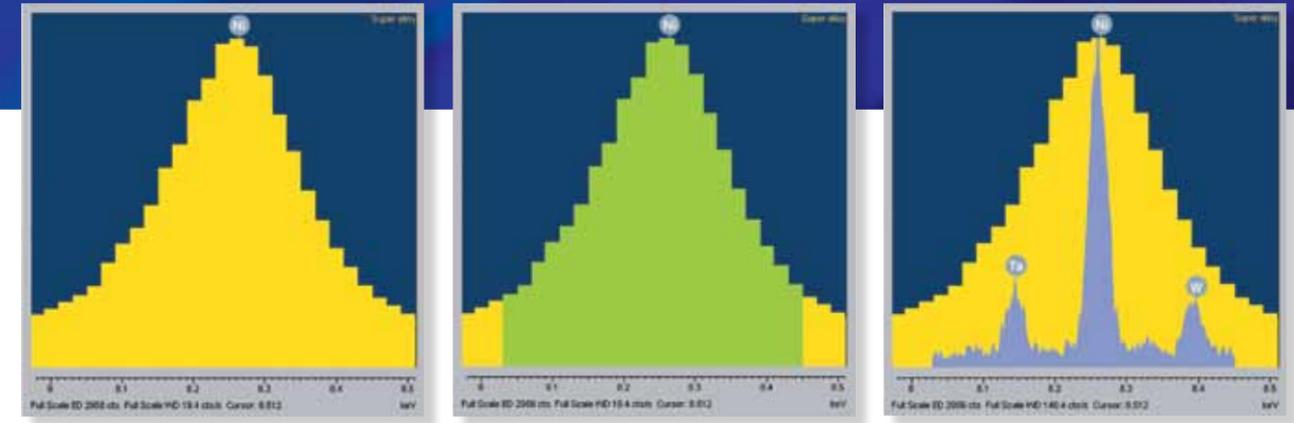


Figure 7 With INCAEnergy+ WDS maps can be collected and montaged as part of the EDS SmartMap acquisition. This is a montaged Cr WD X-ray map consisting of 1024 high magnification maps combined to map a sample 3mm long by 2mm wide

## 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



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 EDS / WDS Quant results for speed and accuracy

Analyse samples quickly and accurately by combining ED and WD Quant

Garnet	Na <sub>2</sub> O	MgO	Al <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	CaO	TiO <sub>2</sub>	Cr <sub>2</sub> O <sub>3</sub>	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/WDS	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.

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