X-Max

The largest area SDD

SIZE IT MATTERS

20mm^2

50mm^2

80mm^2

For **accuracy** / For **nano-analysis** / For **throughput** / For **productivity**

The Business of Science®

OXFORD INSTRUMENTS

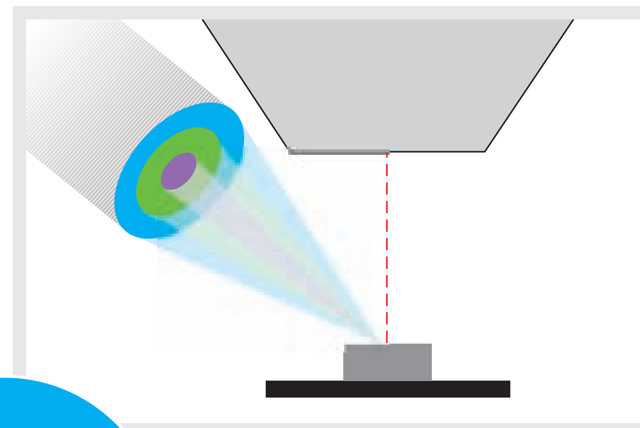
X-Max

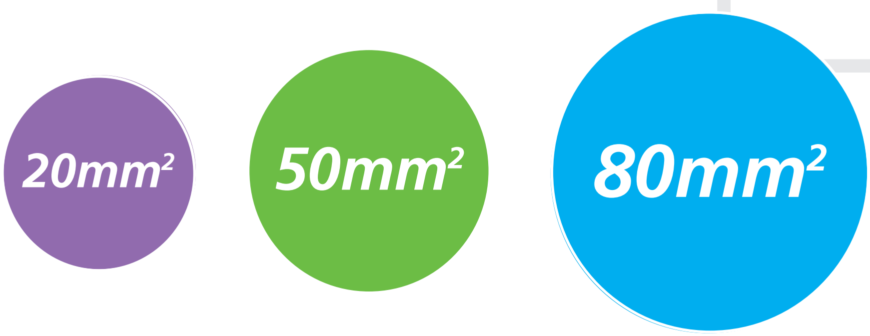
Large area SDD

Analysis with a large area analytical SDD benefits from:

- Simultaneous imaging and analysis without compromise
- Large active area with superb analytical resolution
- Practical nanoanalysis at productive count rates
  - High count rates, even at low kV
  - High count rates, even at small spot sizes
- The correct results

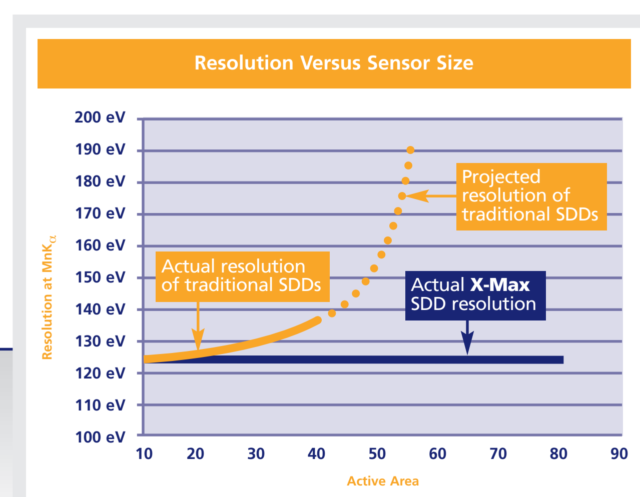
A traditional $10mm^2$ detector has a small capture angle = fewer counts
A modern large area detector has a large capture angle = many counts





X-Max delivers:

- Up to 1,000% greater productivity
- Real 200,000 cps analysis
- Usable nanoscale analysis
- MnK_{α} resolution down to 123eV - even at $80mm^2$



Traditional SDD
X-Max SDD

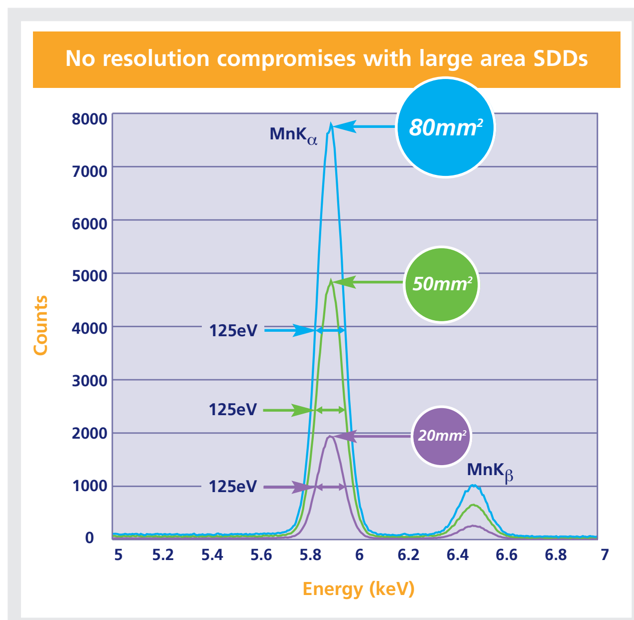
X-Max

Productivity and accuracy combined

20mm², 50mm², and 80mm² SDDs with identical world-beating analytical performance

Now you can have count rate, imaging, and analytical performance all at the same time:

- Up to 80mm² active area
- Count rates > 500,000 cps
- Throughput > 200,000 cps
- MnK_{α} typically 125eV



Maximum counts from larger detectors with increased solid angle:

- Count for less time - increase productivity
- Or count for the same time and get more precise results
- Or gather data at much lower beam currents meaning:
  - No sample damage
  - Longer filament tip lifetimes
  - Reduced contamination
  - Better spatial resolution
- Practical nanoanalysis with productive count rates at low accelerating voltages

X-Max analytical SDDs offer the best solution for productive analysis

X-Max features

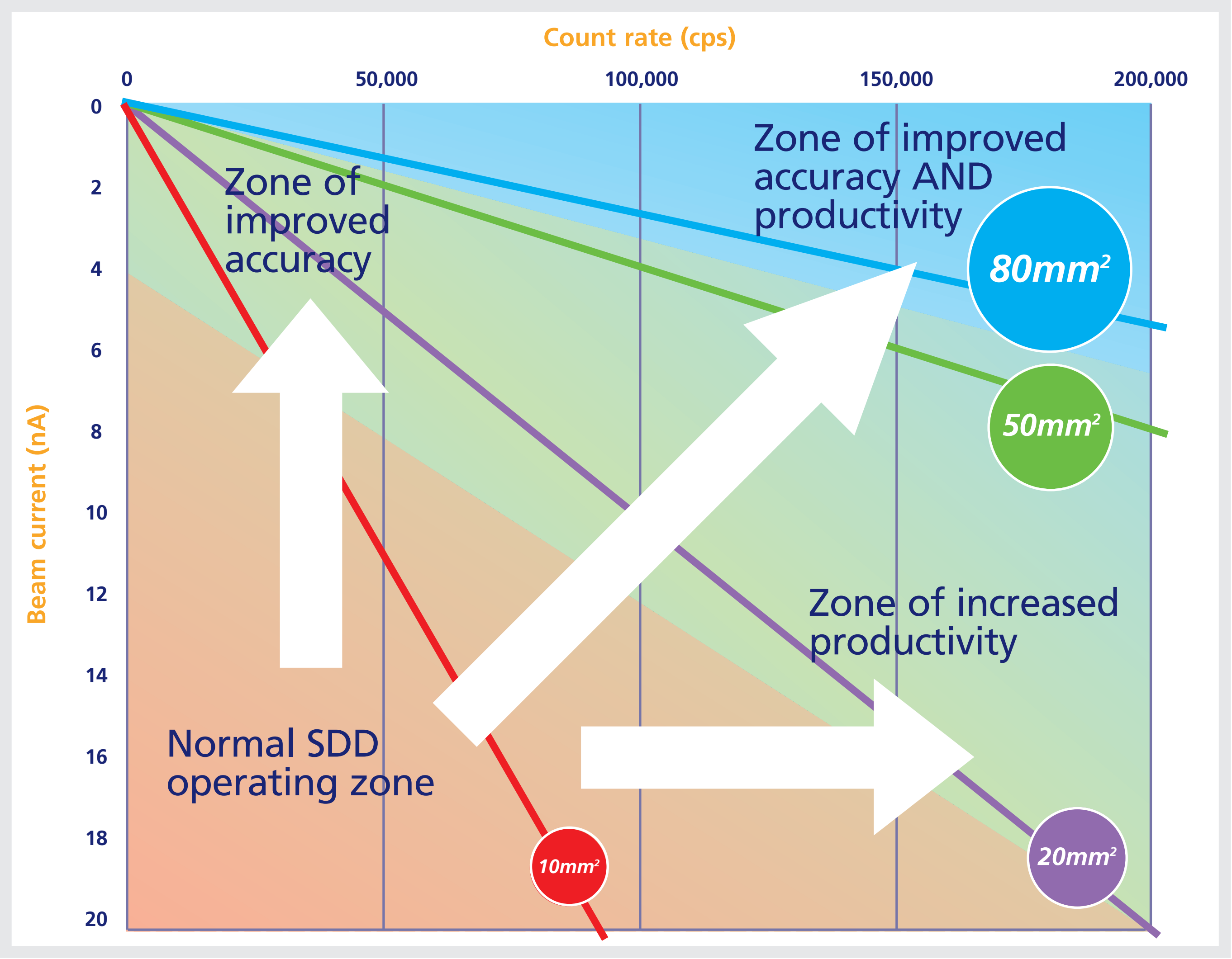
- Unique large area SDD sensors
- Discrete PentaFET® design - accuracy at all sizes
- Sensor enclosed in self-contained vacuum assembly - no oxygen X-ray absorption
- Unique electron trap for maximised solid angle
- Only one pulse processing channel required
- Tube diameter no bigger than a 10mm²

SIZE IT MATTERS

X-Max

Large area SDD

Why size matters



X-Max The largest area SDD

Discover the benefits of working with large SDDs.

Previously, users had to chose between:

1. Working at low beam currents to maintain accuracy
2. Working with high beam current to get high count rates, risking beam damage and contamination

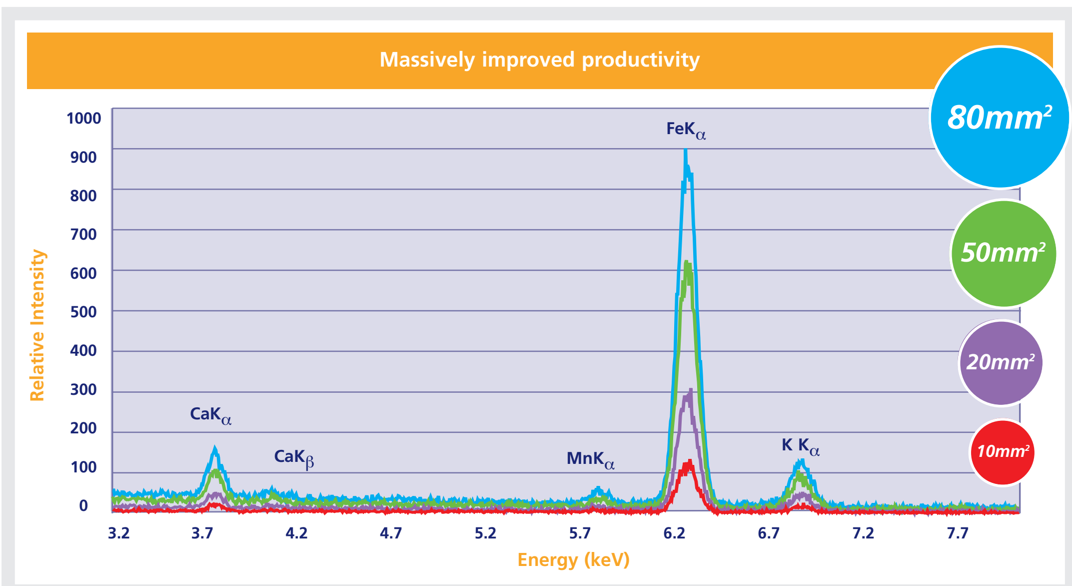
Now X-Max offers users two more options:

3. Work at low beam currents with high count rates and improved accuracy
4. Or decrease analysis times

X-Max

Size and productivity

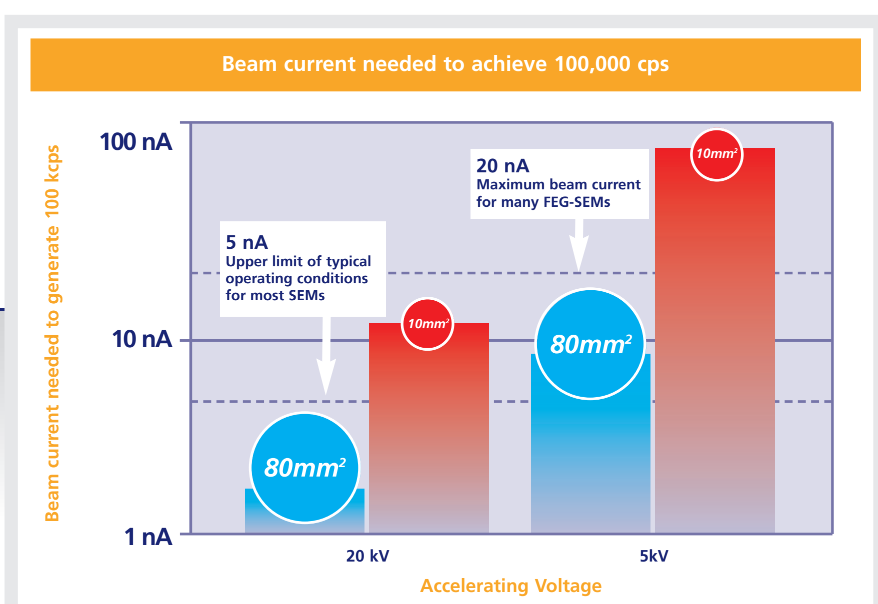
Benefit immediately with increased counts from **X-Max**



These almandine garnet spectra were collected using a 10mm² SDD detector and the new 20mm², 50mm², and 80mm² **X-Max** detectors. The larger **X-Max** detectors collect more X-rays under the same collection conditions.

True 100,000 cps performance

Many more analyses can be performed with 80mm² detectors at 100,000 cps



This logarithmic scale bar chart shows how high the beam current needs to be to achieve 100kcps on a traditional 10mm² SDD at 5kV and 20kV. It is a ten-fold increase over what is required to generate the same count rate on a new **X-Max** 80mm² SDD detector.

SIZE IT MATTERS

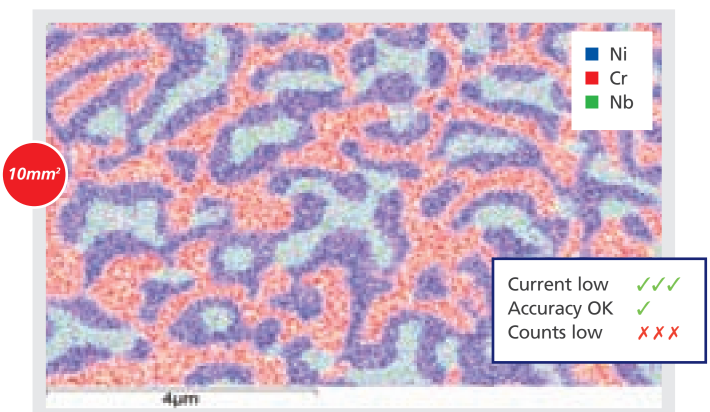
X-Max

Large area SDD

The effect of beam current on analytical data

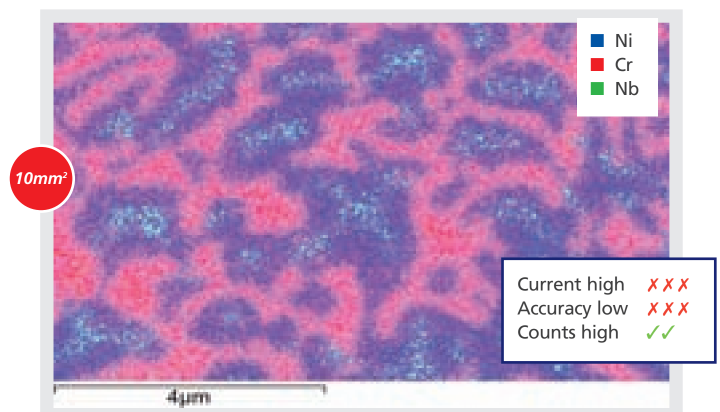
Data collected with standard 10mm² SDDs

Insufficient data for usable nanoanalysis



Some detail but very few counts
Data collected with a 10mm² detector for 45 minutes at 3.3nA. Insufficient data has been collected which means a poor map that is not usable for analysis.

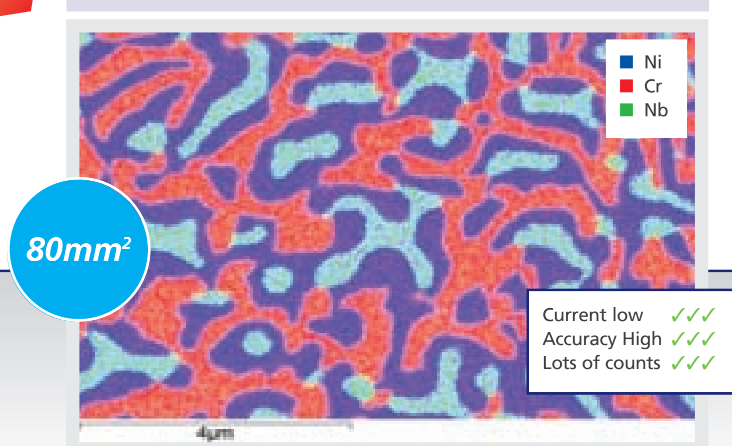
High beam current reduces accuracy



Lots of counts but no detail
Data collected with a 10mm² detector for 45 minutes at 36nA. The map shows lots of counts but the detailed information is blurred by a large spot size at this current.

Data collected with 80mm² **X-Max** SDD

Lots of counts and high quality data at low beam current



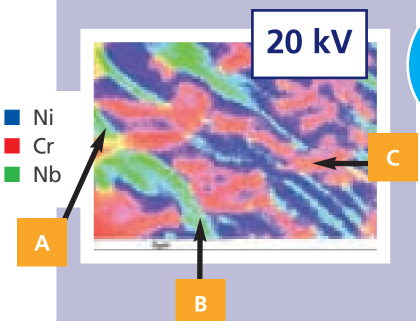
Lots of detail AND lots of counts
Data collected with an 80mm² detector for 45 minutes at 3.3nA. The mix map shows good spatial resolution and contains lots of data for good quantitative analysis.

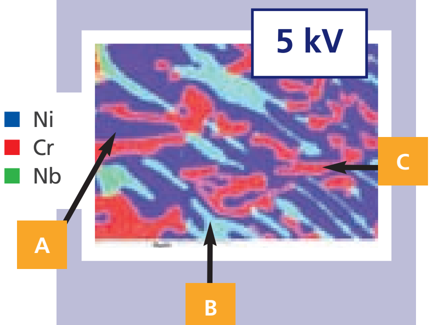
X-Max

Size and accuracy

Increasing accuracy by lowering accelerating voltage

X-Max offers unparalleled benefits when working at low kV (and low count rates).





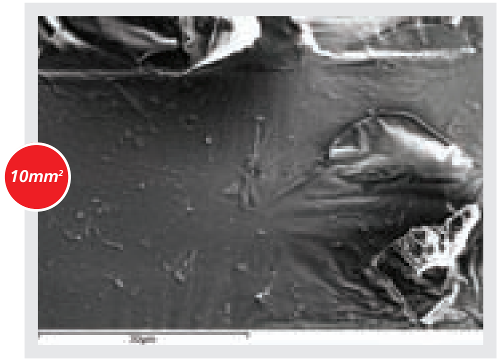
Maximise counts for accurate nanoanalysis with X-Max

These two maps were collected from the same area under the same conditions, changing only accelerating voltage. While superficially similar, points A, B, and C are actually very different. This is because reducing accelerating voltage (kV) reduces the interaction volume from which the X-rays are generated. As a result, the 20kV map shows X-ray signals from structures below the surface not seen in the 5kV map. Analysing at low kV benefits nanostructure analysis as it means that X-rays are only collected from the surface structures.

Larger detectors cause less surface damage

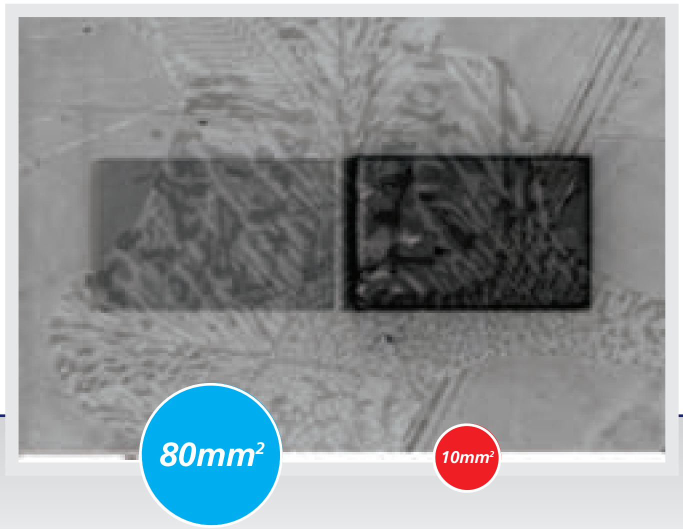
Beam damage on sensitive samples

This image is of a polymer sample, taken at 0.2nA. Features on the surface and striation from sample preparation can clearly be seen.



The same sample imaged at 2nA shows extensive surface damage and distortion as a result of the higher beam current.

Beam contamination



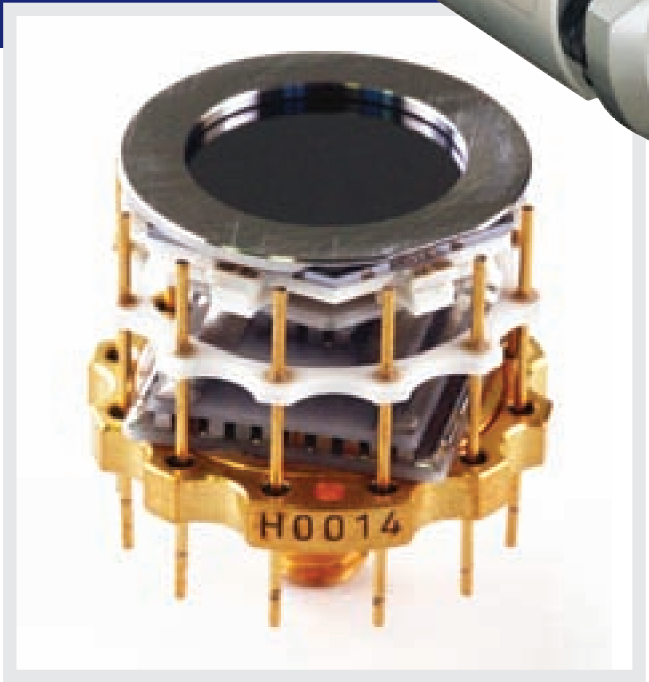
This image is of a sample from a nickel spinner bowl. Two areas have been examined, the one on the left using a large area detector, the one on the right with a traditional 10mm² detector. To collect the same data the sample had to be exposed for ten times longer with the smaller detector and as a result has far worse contamination.

SIZE IT MATTERS

X-Max

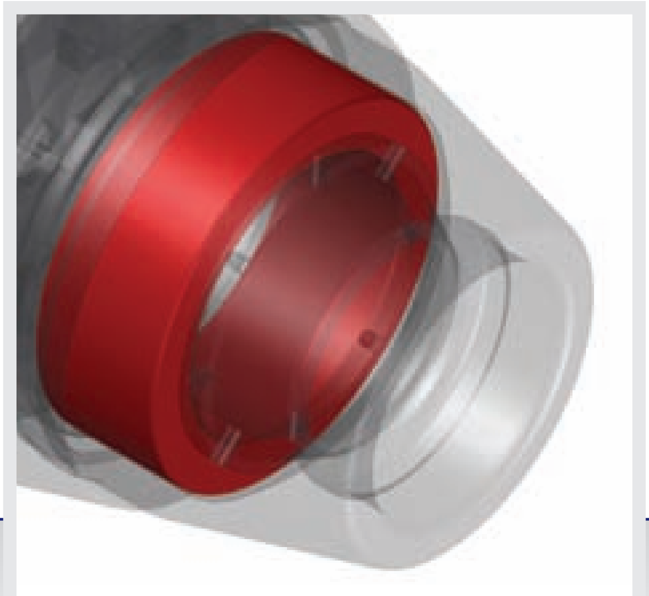
Technology leadership

Unique large area sensors



- Discrete PentaFET® design offers the following benefits:
  - Protects FET from X-ray damage*
  - Superior thermal design and FET gain stabilisation means detectors cool quickly and stabilise fast
  - Radial design for minimal ballistic deficit*
- Polycrystalline Si construction process for extreme low leakage

Unique magnetic trap design



- Allows large area sensor very close to samples
- Minimum sample to sensor distance = maximum capture angle
  - Typically 10 times greater than standard $10mm^2$ SDDs
- Uses optimised rare earth element design

* For more information about silicon drift sensor technology and what makes an SDD detector analytical, go to www.oxinst.com/sdd to request a free copy of 'SDD Explained'

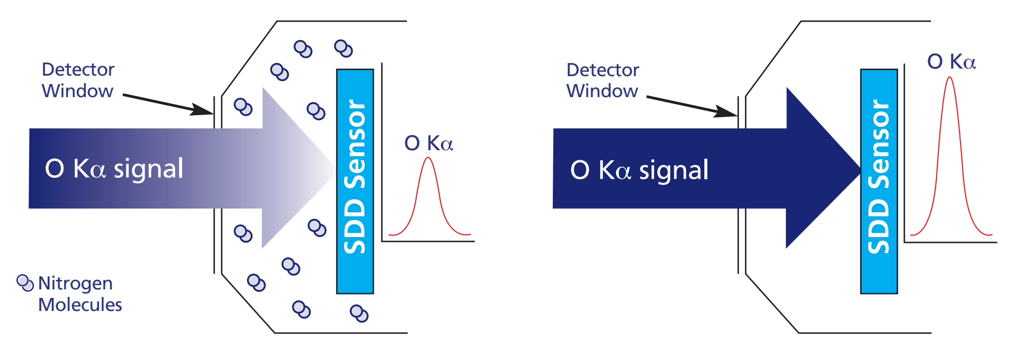
X-Max

Pushing the boundaries

Vacuum enclosed sensor

- No gas fill to absorb light elements
  - Nitrogen gas in other SDDs absorbs oxygen and other low energy X-rays
  - Vacuum enclosure increases analytical accuracy
- Long lifetime design
  - Uses OI vacuum technology
- Vacuum allows far greater cooling
  - Dramatically reduces thermal noise in large area SDDs
  - Not possible with gas-filled systems

How does nitrogen gas affect oxygen



Nitrogen filled SDD detector — **X-Max** SDD detector

The oxygen X-rays are absorbed by the nitrogen molecules present in the 'vacuum' so only a fraction of the X-ray signal gets through to the sensor.

The oxygen X-rays are not absorbed as there is no nitrogen present so you can see the true shape and height of the oxygen peak.

On site 8-hour repair capability

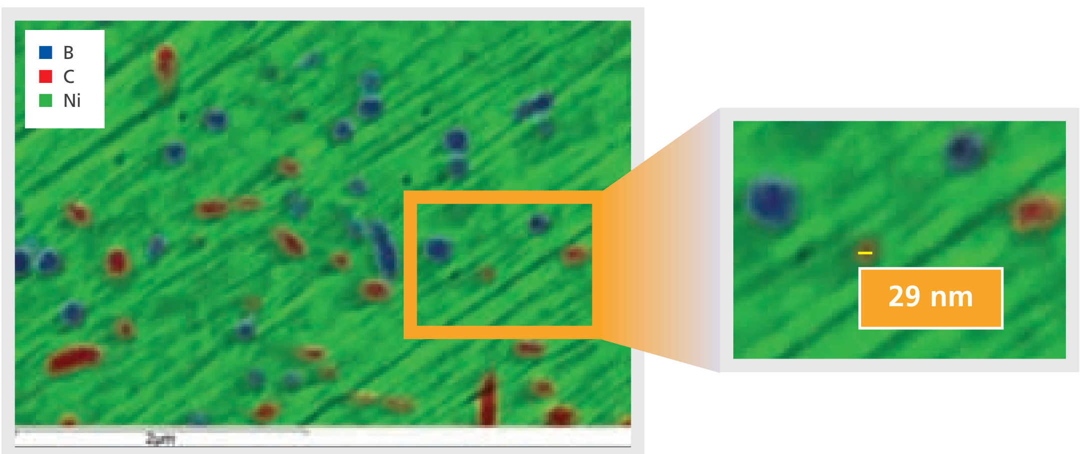
- Includes window breakages

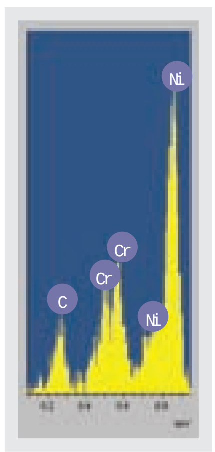
SIZE IT MATTERS

X-Max

Applications

Low energy mapping of nano-particles



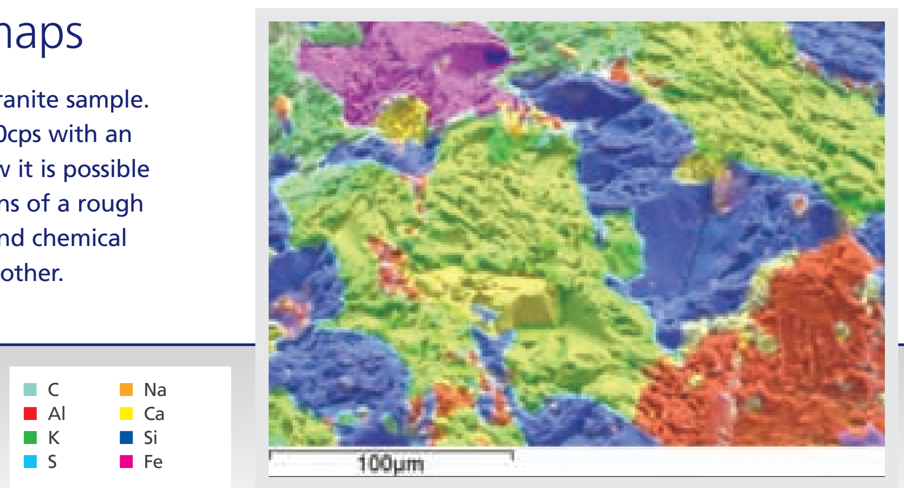


X-Max achieves excellent resolution. It also allows the user to do extraordinary nanoanalysis under conditions where other detectors struggle to produce sensible results. This means **X-Max** not only allows detection of small precipitates, but can map them as well.

Here we see a sample containing very small boride and carbide precipitates. The map clearly distinguishes between the different phases and even identifies the chemical composition of precipitates as small as 30nm. The spectrum above is from the highlighted 30nm carbide precipitate and includes data equivalent to a 0.5 second acquisition.

Very high count rate maps

Texture analysis of fracture surface of a granite sample. This map, taken at a count rate of 400,000cps with an **X-Max** 80mm² detector, shows clearly how it is possible to map the different chemical compositions of a rough surface to see how the textured surface and chemical composition of the surface relate to each other.

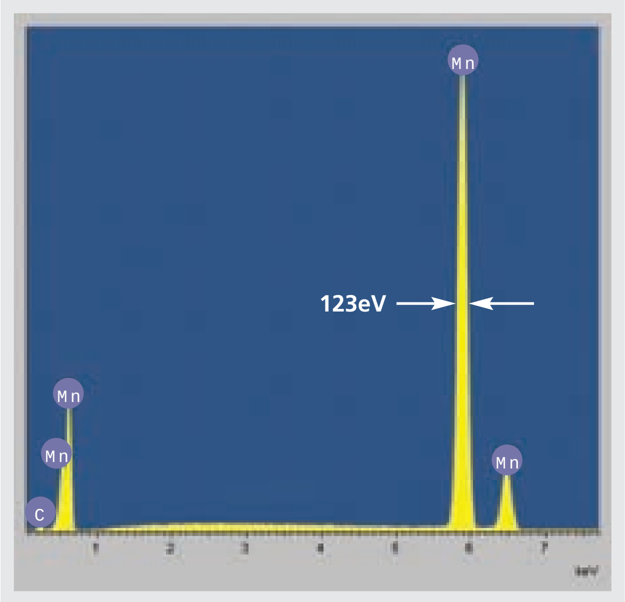


X-Max

Superb performance

Why does an **X-Max** EDS system give such exemplary performance?

- A great detector
  - Maximum real active area
  - Excellent resolution at high and low energies
  - Good throughput
  - ISO15632:2002 resolution compliance
- Excellent electronics
  - Highly linear analogue to digital conversion
  - Good rejection of simultaneous events (Pulse-pile-up)
  - Excellent signal to noise ratio
  - < 1eV change in peak resolution and position between 1 and 100,000cps
- Unique OI-owned interpretation algorithms
  - Complete - and correct - database of X-ray lines and edges
  - Software correction of sum-peaks
  - Highly accurate deconvolution, AutoID, and Quantitation



At $80mm^2$, **X-Max** gives Mnk_α resolution that other SDDs can't match. Here we see 123eV; 6 eV better than the guaranteed specification of 129eV.

(Spectrum courtesy of P Russell, Appalachian State University. Recorded at 20kV, 168pA).

What the system doesn't have:

- Shelf, tail, and shift correction - only real data is analysed
- Fan cooling - no vibration
- Forbidden elements - all elements from Be to Pu can be analysed
- Identification of absent elements - no false positives

X-Max

*For **accuracy** / For **nano-analysis** / For **throughput** / For **productivity***

SIZE IT MATTERS

X-Max

In practice

Detector area	20mm²	50mm²	80mm²
Resolution (eV):			
MnK$_\alpha$ resolution	129	129	129
Operating angle	0° to 45°		
Temperature range	10°C to 30°C		
Altitude	Sea level to 1,500m		

Comparison of detector type

	Si(Li)	Other SDD	X-Max
LN_2-free	NO	YES	YES
Maximum single sensor active area	30mm²	30mm²	80mm²
Typical analysis conditions for most productive count rate			
Spot size	Small	Large	Small
Beam current	Low	High	Low
Accuracy at low kV	High	Low	High
Maximum throughput	Low	High	High
Productivity at low beam currents	Low	Low	High

Part no: OIA/160/A/0908

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