Product Sheet XRD 37

VÅNTEC-500 Area Detector for XRD²
Synchrotron Proven MIKROGAP™ Technology for the Laboratory

The VÅNTEC-500 is a two-dimensional (2-D) detector for X-ray diffraction, based on Bruker AXS' proprietary MIKROGAP™ technology. Due to its huge detector window of 140 mm diameter and its capability of collecting images with both high count rate and excellent resolution, the VÅNTEC-500 is the best detector for all 2-D X-Ray Diffraction (XRD²) applications. This includes micro-diffraction, texture analysis, high-throughput diffraction, residual stress determination, Small-Angle X-ray Scattering (SAXS), reciprocal space mapping, etc.

VÅNTEC-500 - The best detector for XRD²

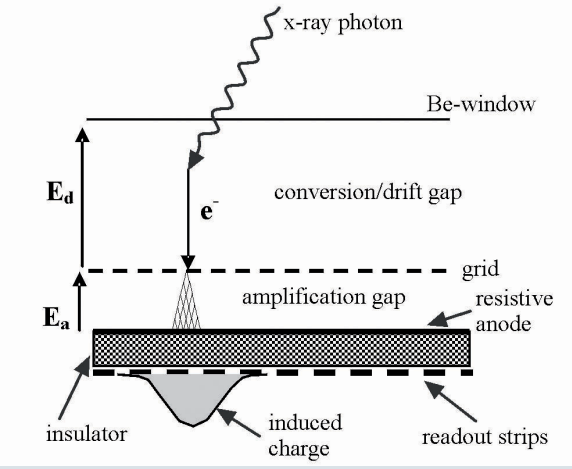
- Huge detection area covering more than 15,000 mm²
- Noise-free operation with less than 0.0005 cps/mm²
- Variable detector positioning
- Proven radiation-hardness
- Maintenance-free design
- Guaranteed without dead or defective areas

VÅNTEC-500 2-D detector

The VÅNTEC-500 MIKROGAP detector is the core technology for the next generation of XRD² systems by combining the best features of classic X-ray film and electronic single X-ray photon detection.
Its huge detector area of more than 15,000 mm² grabs as much 2-D information as classic film cameras in just a few seconds. Superb counting statistics is achieved by "seeing" and counting individual photons in real time. The high speed of the VÅNTEC-500 is ideal for monitoring real time structural and microstructural changes in a material, such as in-situ phase transformation investigation.

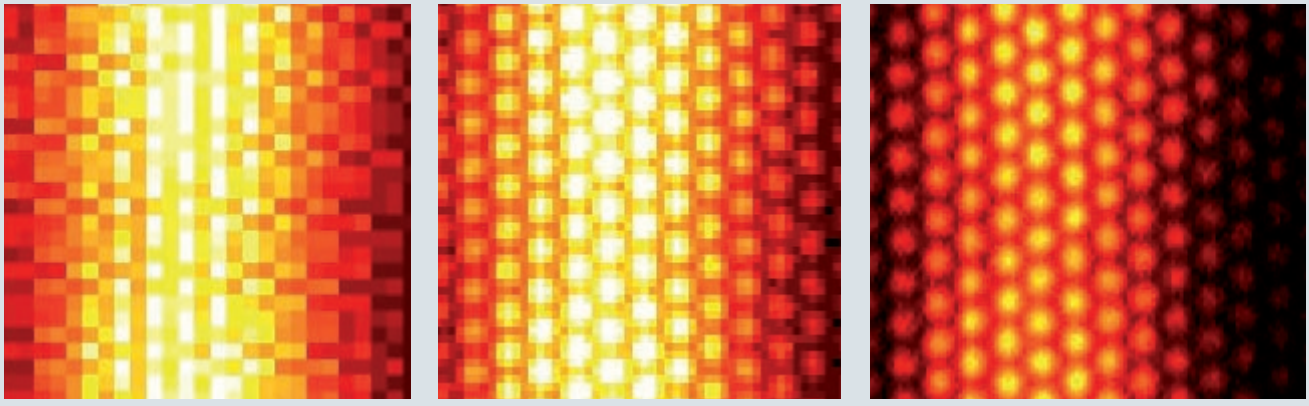
Thanks to the proprietary MIKROGAP™ technology, the VÅNTEC-500 can be operated at very high count rates. Test measurements have shown maximum count rates of 250 Kcps for point-like X-ray signals. At the same time, the VÅNTEC-500 operates virtually noise-free. The only source of background is cosmic rays and the material's natural radioactivity, which accounts to less than 5 cps over the whole detector area. Due to this high local count rate and extremely low background noise, the maximum dynamic range (the ratio of maximum count rate per reflection to background fluctuations in the local area) is excellent: 10^9 times the square root of the collection time in seconds. Hence, the VÅNTEC-500 is ideal for the analysis of both weakly and strongly scattering samples.
The resistive anode, which is the key feature of the MIKROGAP™ technology, ensures stable detector operation over a wide energy range.
The MIKROGAP detector can even tolerate accidental intensive or high energy radiation, as proven by tests at the European Synchrotron Radiation Facility [1].
By design, the VÅNTEC-500 is also extremely robust with respect to mechanical shock or vibration.
Thanks to extensive experience and in-house detector development, the VÅNTEC-500, like any other detector manufactured by Bruker AXS, is guaranteed to be exemplary and without any defective detector areas.

MIKROGAP Technology



In a MIKROGAP detector, the grid, the anode, the delay lines and the Xe-CO_2 gas mixture are contained in a sealed vessel with a beryllium entrance window. In the conversion region, the incoming X-ray photons produce primary electrons by gas ionization. These electrons drift towards the anode under a high electric field. The number of electrons is multiplied in the amplification gap. This signal amplification is by far larger than any solid state detector provides thus very weak signals can be detected. The location of each X-ray photon is determined by readout strips through the X and Y delay lines.
The key feature of the MIKROGAP technology is the presence of a resistive anode to allow a very thin amplification gap, which greatly improves the local count rate.

Spatial resolution with MIKROGAP technology

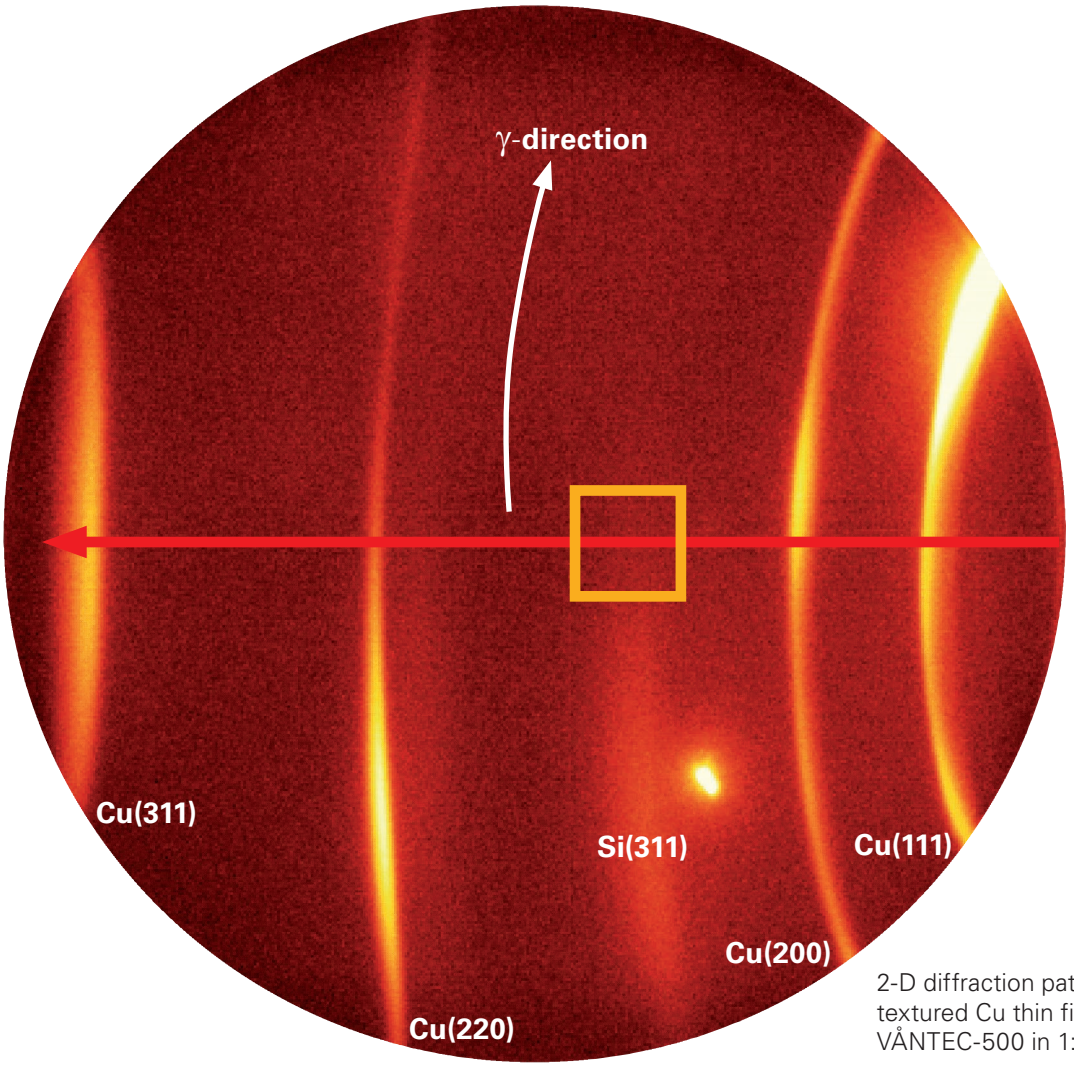


272 µm pixel (512x512) | 136 µm pixel (1024x1024) | 68 µm pixel (2048x2048)

68 µm pixel size reveals the best spatial resolution, the resolution can be switched by the measurement software

The detector design is optimized with the complete XRD² system. Its light weight allows using the detector on both horizontal and vertical diffraction systems. High diffraction angles, e.g. for residual stress measurements, can be achieved thanks to the cone-shaped front side surface. The detector entrance window has a spherical shape to reduce parallax effects, with a radius of the curvature that is designed to match the medium sample-to-detector distance.

In addition, the variable positioning of the VÅNTEC-500 along the track allows for a wide range of sample-to-detector distances to optimize angular coverage and resolution for various applications. In combination with DAVINCI design implemented into the new D8 Diffraction Solution family, the actual distance is even actively recognized by the XRD² system and used to automatically pick up the required detector settings.



2-D diffraction pattern of a textured Cu thin film with VÅNTEC-500 in 1:1 scale

SIZE, the most important feature of 2-D detectors

A large 2-D detector like the VÅNTEC-500 allows the user to:

- Collect several Bragg reflections over a large γ range in one frame
- Measure several polefigures with background correction simultanously
- Cover broad diffraction peaks of a stressed sample in a single shot
- Enhance the statistics on a spotty diffraction pattern of a micro sample

A large detector window not only enables increased data collection speed, it also provides information that is simply not accessible with a 0-D or 1-D detector (red line). Even small 2-D detectors (orange box) that inherently cover only a limited γ range, will always miss important information.

Technical Specifications		
Sensor Type	Photon-counting, Xe-based MIKROGAP™ detector (US Patent 6,340,819) Window size: 140 mm in diameter	
	Number of pixels	Pixel size
	2048 x 2048	68 µm x 68 µm
	1024 x 1024	136 µm x 136 µm
	512 x 512	272 µm x 272 µm
Simultaneous 2Θ coverage of a single frame at different sample-to-detector distances	Detector distance	2Θ range
	5 cm	83°
	10 cm	56°
	15 cm	42°
	20 cm	33°
	25 cm	27°
	30 cm	23°
Detection Quantum Efficiency	80% for Cu Kα (8.04 keV), residual 20% absorbed by the Be-window	
Energy Range	3-15 KeV (Cr, Fe, Co and Cu radiation)	
Energy Resolution	20% for Cu Kα (8.04 keV)	
Global Counting Rate	Maximum: 1.0 Mcps Linear (10% deviation from linearity): 0.5 Mcps	
Local Counting Rate	Maximum per a point-like reflection: 250 Kcps Linear (10% deviation from linearity): 160 Kcps	
Background	< 5 cps per whole area (< 0.0005 cps/mm²)	
Maximum Dynamic Range	$10^9 \times \sqrt{t}$ (t = collection time in seconds)	
Radiation Hardness	10^{12} X-ray photons/mm² (10^{16} photons in total)	
Maintenance	not required	
Detector Guarantee	Bruker Detector Guarantee: no defective/dead areas	

References

[1] Nuclear Instruments and Methods in Physics Research A 563 (2006) 172–176

Bruker AXS GmbH

Karlsruhe · Germany
Phone +49 721 50997-0
Fax +49 721 50997-5654
info.baxs@bruker.com

www.bruker.com