RAYSPEC
X - RAY SPECTROSCOPY

RaySpec Research SDD Detector Product Guidelines

Sensor	Number of Channels	1 to 19				
	Active Area (mm²)	10	40	65	100	170
	Collimated Area (mm²)	7	30	50	80	150
	Thickness (µm)	450				
	Resolution (eV)	<133	<133	<133	136	139
	P/B Ratio	>10,000:1				
	FET or ASIC Cube [1]	Option				
	Peltier cooled cryostat	Standard				
	Temperature stabilization	Standard				

Window	Polymer AP3.3 (2)	Option	Option	Option	-	-
	Windowless	Option				
	DuraBeryllium[3] - 8µm	Standard	Standard	-	-	-
	DuraBeryllium[3] - 12.5µm	-	-	Standard	-	-
	DuraBeryllium[3] - 25µm	-	-	-	Standard	Standard

Sensor Arrangement	Planar	Designed for optimum performance
	Focused	

Options	Vacuum Compatible	Designed to suit customer requirements
	UHV Compatible	
	Gate Valve	
	Bellows	
	Slide	
	Collimation	
	Operating Position /Attitude	
	Probe Length	50mm to 500mm

Operating Temp (°C)		15—30
Cooling	Single Sensor	Peltier and fan-free air cooling
	Multi-sensor	Peltier and closed cycle chiller

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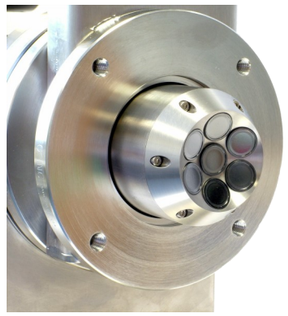
Single and multi-sensor SDD detectors for beam-line applications

- **Customised detectors**
- **Up to 19 sensor elements**
- **Optimised for high rate applications**



Applications include:

- Extended X-ray Absorption Fine Structure (EXAFS)
- X-ray Absorption Near Edge Structure (XANES)
- Total Reflection X-Ray Fluorescence (TXRF)
- Particle Induced X-Ray Emission (PIXE)
- Micro X-ray Fluorescence (µXRF)
- X-Ray Fluorescence (XRF)

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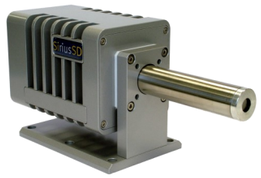
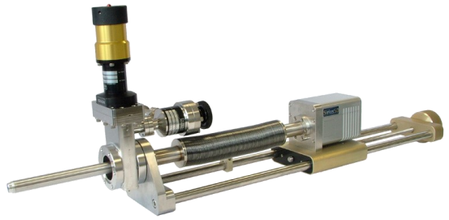
RaySpec, located in the UK since 1995, has a long history in producing Silicon based energy dispersive x-ray detector systems for x-ray spectroscopy applications using synchrotron radiation, conventional x-ray tube or charged particle beam excitation. Previously known as SGX Sensortech, e2v scientific instruments and Gresham Scientific Instruments, SGX produces detectors from standard designs through customised assemblies to complex multi-element detectors. All detectors are designed to deliver the highest specifications in energy resolution, peak to background ratio and throughput in addition to meeting our own exceptional standards of engineering quality.



Single element SDD



Single SDD windowless detector with gate valve, bellows and manual slide

Detector customisation

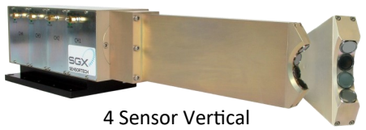
All beam-lines are different, especially in today's environment of multi-technique end stations. Space is more and more limited and the requirements of the detectors are increasingly specialised.

For these reasons, most of the detectors that RaySpec builds are customised at various levels. Sensor geometries relative to the target are most important and RaySpec offers complete customisation in this respect, from planar to focused arrays, relative sensor positions and numbers of sensors. All other mechanical features are designed to fit uniquely with each experimental station. RaySpec offers full UHV compatibility with a range of flanging and support options.

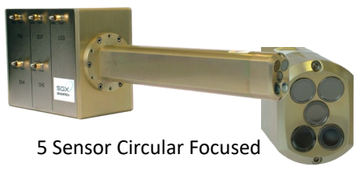
Customisable features for Beam-line SDDs

- Number of sensors
- Sensor size
- Window material and thickness
- Energy Resolution
- High Rate optimisation
- Focused or planar sensor arrays
- Collimation
- UHV compatibility

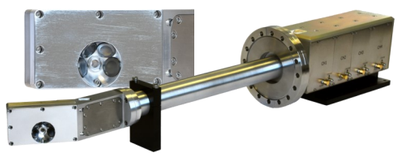
Other features which may be important include additional collimation and the selection of detector materials to reduce the effects of scattered primary beam and secondary fluorescence x-rays. RaySpec will work with end station designers to achieve the best solution.



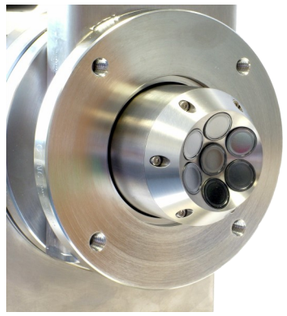
4 Sensor Vertical Focused Array SDD



5 Sensor Circular Focused Array SDD



4 Sensor Circular Beam Through Hole Detector Focused Array SDD



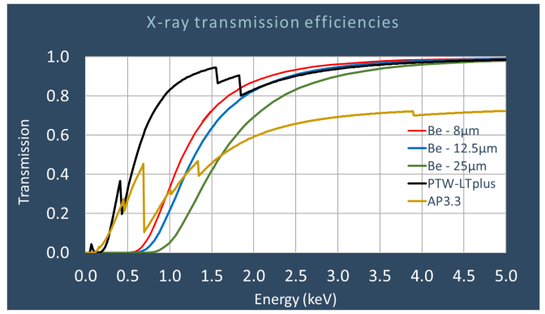
5 Sensor Circular Focused Array SDD—UHV

Detector Window Transmission

Entrance windows are used to protect the SDD sensor. In the soft X-ray region, up to 1.5keV, the choice of window will significantly affect the transmission. For energies below 1keV, polymer windows (Moxtek AP3.3) provide improved low energy sensitivity compared to the thicker and more robust Beryllium windows. However, at energies over 1.4keV the support grid required by the polymer film limits transmission and Beryllium becomes the best option (see figure, right)

Sensor area is a factor which influences the window choice. As larger areas are required, the window must be thicker in order to support the differential pressure. Minimum window thicknesses are detailed for each sensor type in the table on the back page of this brochure.

Detectors are also available with windowless construction.



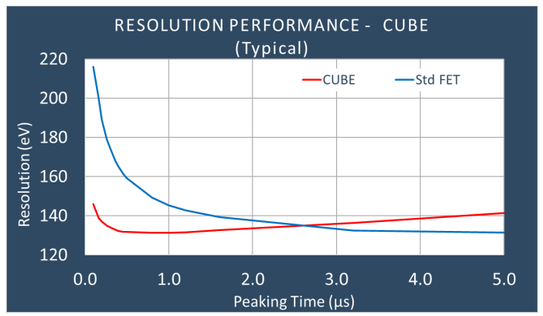
X-Ray transmission efficiencies of UTW and Be windows

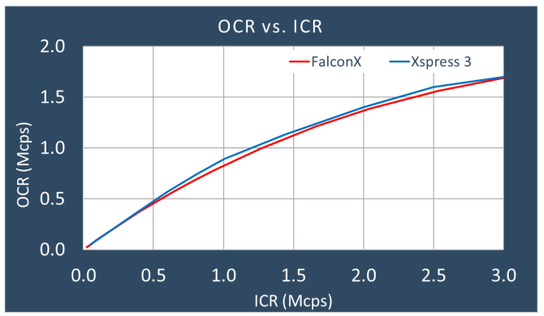
Focused sensor arrays

As more elements are added to an array of sensors, the total area occupied by the array increases. At close working distances, the outer sensors present a poor geometry to the beam-spot. Entry angles can be large and shadowing may occur from window mounts and on-chip collimators. To counter these problems, RaySpec developed the 'focused array' whereby each sensor is mounted such that its plane lies tangential to a sphere of radius equal to the optimum source distance. In this design each sensor has optimum geometry with x-rays entering along the axis and all subtend the same solid angle at the target. Although there is one optimised source position, the detector may be used over a wide range of working distances with the geometry remaining improved

High Rate Performance

Many X-ray spectroscopy applications, especially on synchrotrons, require detectors which perform well at high count rates (several Mcps). As well as being a fundamental feature of SDD design, high rate capability is dependent on the whole detector system, including the pulse processor. A low capacitance charge collection and integration stage is very important to enable the detector system to be operated successfully in the high rate regime. SGX SDD detectors are equipped with either a low capacity FET or a MOS ASIC ('CUBE') device.





The figures above show the improved resolution at short Peaking Times (conventional pulse processors) offered by the CUBE ASIC device compared to a JFET (same SDD sensor) and the throughput up to 3Mcps ICR using a Falcon-X processor (XIA LLC) and Xspress 3 processor (Quantum Detectors).

All RaySpec detectors are fully compatible with the latest generation of ultra-fast digital pulse processors.