

Customised Single & Multi-sensor SDD detectors for high resolution X-ray spectroscopy

Design, development and production of high performance Silicon Drift Detectors

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 Gresham Scientific Instruments, e2v scientific instruments and SGX Sensortech, RaySpec 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.

Range of Solutions

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, many of the detectors that SGX Sensortech builds are customised at various levels.

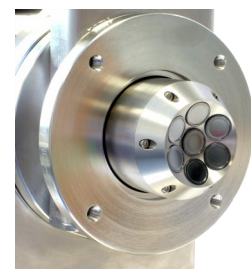
Design options for single sensor solutions from SGX include sensor size, window material and probe length. A major design consideration for multi-sensor SDD detectors is sensor geometry relative to the target and SGX offers complete customisation in this respect, from planar to focused arrays, relative sensor positions and numbers of sensors. All other mechanical features are designed to fit uniquely with each experimental station. SGX offers full UHV compatibility with a range of flanging and support options.

Examples of RaySpec solutions

- Single sensor SDD Detector up to 170mm² active area
- Multi-sensor SDD Detector
- Planar Array
- Focused Array
 - Circular
 - Vertical



4 sensor vertical focused array SDD



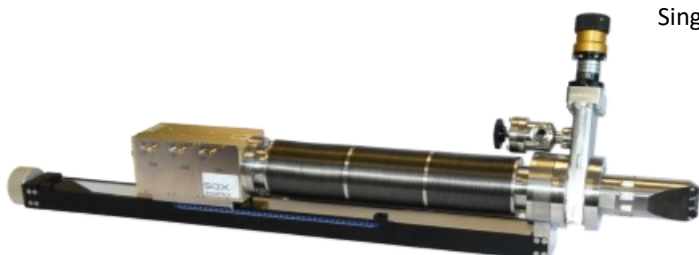
7 sensor circular focused array SDD



Single SDD Detector



Modular SDD Detector



3 sensor vertical focused array SDD—UHV



4 sensor circular through hole focused array SDD

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
- Geometry: Fixed / manual slide / adapted for translation tables
- Detector materials (low fluorescence)

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 (μ XRF)
- X-Ray Fluorescence (XRF)

RaySpec Design Criteria

Sensors Sizes

RaySpec offers a variety of sensors depending on the application, geometry and budget.

Sensors are available from 10mm² up to 170mm² and with resolutions from 128eV to 139eV.

Detector Windows

Depending on the customers application, RaySpec is able to design the SDD detector with a variety of window materials. For applications >2keV a Be window is typically used. Below 2keV, the detectors could use windows of more x-ray transparent materials. For the ultimate low energy performance, RaySpec offers windowless SDD detectors, usually with bellows and often a gate valve, to operate in UHV environments.

Additional Design Considerations

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.

Sensor Geometry – Focused or Planar Array

RaySpec pioneered the design of detectors with focused sensor arrays and detectors with this technology are in use on many beamlines around the world. The focused array optimises the detector for operation at close working distances, while maintaining similar entry angles at longer distances. For a source at the nominal focus distance, entry angles are normal to each sensor and the solid angle subtended by each sensor is the same.

High Rate Performance

Many X-ray spectroscopy applications, especially on synchrotrons, require detectors which perform well at very 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. RaySpec SDD detectors are equipped with either a low capacity FET or a MOS ASIC ('CUBE') device.