Miniature Electrically Cooled Germanium Detector for High Flux and Ultimate Resolution X-ray Spectroscopy

Vlad Marian, Jean-Baptiste Legras, Damian Ralet, Pascal Quirin, Benoit Pirard

In recent years, the trend in Synchrotron has been towards upgrading the various x-ray beamlines to increasingly higher flux intensities. This allows for faster availability of statistics necessary to analyse the samples, increased sensitivity and has opened the way to new types of applications. At the same time, this has also generated a need for detectors capable of analysing higher photon fluxes while maintaining good energy resolution.

Silicon Drift Detectors (SDD) have adapted to these requirements by using new generation ASICs. They are however limited in energy range to about 20keV. For higher energies, Germanium is typically used. Mirion Technology has developed and introduced a new generation of germanium x-ray detectors exhibiting greatly improved characteristics compared to the former generation:

- Throughput increased by a factor of 10, up to several Mcps
- FWHM divided by a factor of 2 at 6keV and short shaping time (0.125µs)
- Signal rise time divided by a factor of 5

These detectors can be designed in single or multi-channel configuration with a high degree of customization. A specific variant of this technology is the microGe-X (Figure 1). The microgel-X is a miniature electrically-cooled germanium X-ray spectrometer designed for handheld, remote or OEM applications. The new device clearly distinguishes itself by its compact design and cooldown time (20 minutes), while maintaining excellent energy resolution. The device can be operated in high-flux areas that would otherwise saturate a normal HPGe detector. The detector is based on a hardened vacuum technology allowing for partial thermal cycles. Low power consumption (<10W) and low weight (1.5kg) makes the new device compatible with remote autonomous operation and integration in larger systems in a OEM approach, making it similar in form-factor, weight and usability to single channel SDD, while extending the energy range from 0.3keV to 100keV and beyond.

Detailed characteristics and performance of the new detector will be presented with comparison with state-of-the-art SDD detectors.

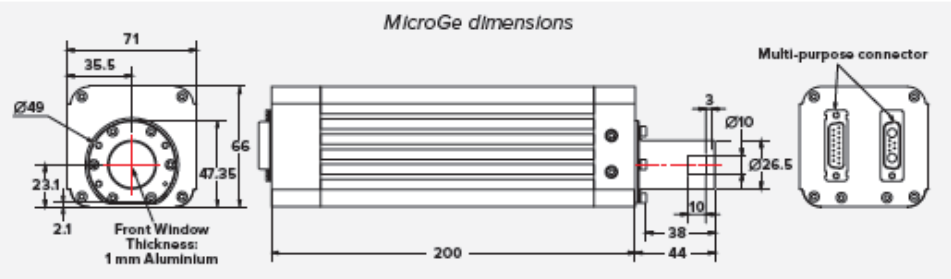

Figure 1. Miniature HPGe X-ray spectrometer