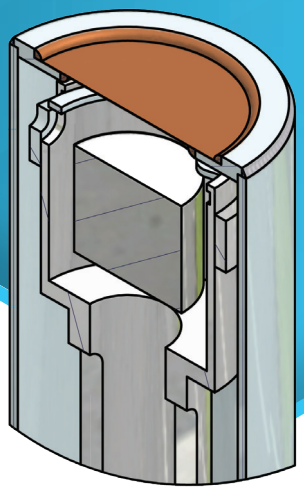
MIRION TECHNOLOGIES



DETECTORS

U-LEGe™

Ultra-Low Energy Germanium Detectors

FEATURES

- Spectroscopy from 300 eV to 300 keV
- High efficiency compared to Si(Li) and SDD
- Excellent resolution up to very high count rates
- High peak/background ratio

APPLICATIONS

- XRF
- XAS (XAFS, EXAFS, XANES)
- X-ray spectroscopy

DESCRIPTION

The Mirion Ultra-LEGe detector extends the performance range of Ge detectors down to a few hundred electron volts, providing resolution and peak-to-background ratios once thought to be unattainable with semiconductor detectors. The Ultra-LEGe detector retains the high-energy efficiency intrinsic to germanium detectors because of the high atomic number (Z), combined with a relatively high thickness (5-10 mm), and thus covers an extremely wide range of energies. The graph in Figure 2 below compares the efficiency on the high-energy side of the X-ray spectrum of a 5 mm thick germanium detector to typical silicon based detectors.

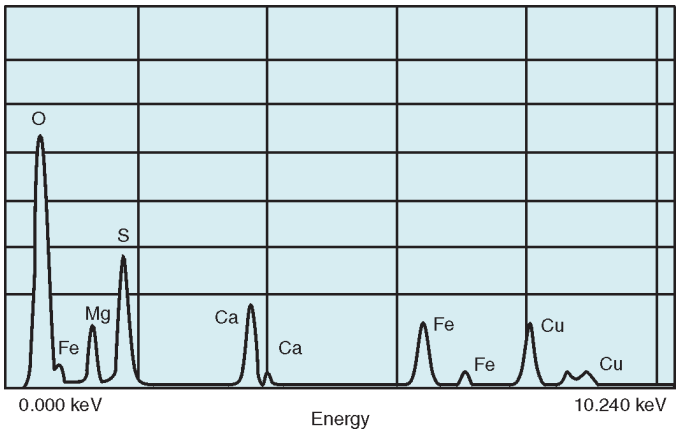
Conventional Ge detectors, including those made especially for low energies, suffer from poor peak shape and efficiency below 3 keV. This characteristic, once thought to be fundamental to Ge, prohibited use of Ge detectors in most analytical x-ray applications. Mirion has developed detector fabrication techniques which have eliminated these problems. The resulting Ultra-LEGe detector, delivers the intrinsic efficiency and resolution advantages of germanium without the disadvantages of the conventional germanium detector.

PERFORMANCE

Because of the detector structure pioneered by Mirion and employed in all LEGe™ detectors, the Ultra-LEGe detector offers excellent performance over a wide range of detector sizes. The resolution, for example, of a 100 mm^2 Ultra-LEGe detector is less than 150 eV (FWHM) at 5.9 keV. The very best Si(Li) detectors of this size have resolution in excess of 160 eV (FWHM). A major advantage of the Ultra-LEGe detector structure is its low capacitance, which means that the detector maintains good energy resolution performance even at very short shaping times. For example, the resolution at 5.9 keV of a 50 mm^2 detector at 0.1 microseconds shaping time and 100 kcps count rate is typically 300 eV (FWHM). This makes the Ultra-LEGe detector ideally suited for high-count rate XRF and synchrotron applications.

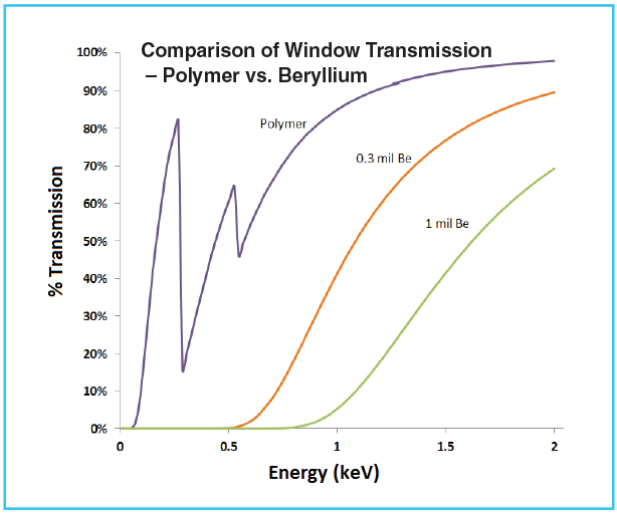
The Ultra-LEGe detector exhibits an excellent peak-to-background ratio (P/B). The P/B-ratio, defined as the height of the peak at 5.9 keV divided by the average number of counts in the energy range from 1-4 keV, of an Ultra-LEGe detector is typically 2000:1.

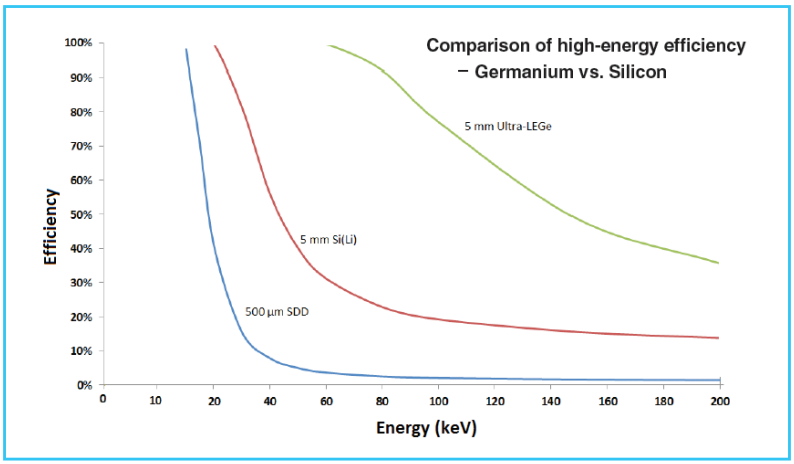
In Figure 1, a spectrum of X-rays from NIST 2063 Thin Film Standard Glass illustrates the excellent resolution, peak shape and low background noise of the Ultra-LEGe detector. This spectrum was taken with an Ultra-LEGe detector equipped with a polymer window using electron beam excitation in a Scanning Electron Microscope.



Spectrum from NIST 2063 Thin Film Standard Glass

To take full advantage of the low energy response of the Ultra-LEGe detector, Mirion offers the option of a thinner window or even a windowless cryostat. A 1/3 mil thick Be window is available on the 30 and 50 mm² models. The polymer window, available on all Ultra-LEGe models, is a multilayer film which is supported by a ribbed silicon support structure. The film spans silicon ribs that are about 100 µm apart and 0.3 mm thick and act as a collimator accordingly. On horizontal cryostats, the support rib orientation can be chosen by designating the appropriate window model-number suffix: V for vertical ribs and H for horizontal ribs. The support structure is 75% open. The total film thickness is about 340 nm, 40 nm of which is an aluminum layer which reduces sensitivity to ambient light. Note that the curves do not show the effect of the support structure but of the window film itself. More information on windowless cryostats can be found under the 'Cryostats and Cryostat Options' section.





PREAMPLIFIER

The standard type preamplifier on Ultra-LEGe detectors is the Mirion I-TRP model. This “Integrated-Transistor Reset Preamplifier” has replaced the former Pulsed-Optical Reset (POR) preamplifier. An integrated transistor resets the preamplifier instead of a LED. This makes the I-TRP notably free from the spurious effects seen in POR preamplifiers such as long recovery time associated with illumination of the FET. The short recovery lends itself better to high count rate applications and the FET itself contributes less noise, resulting in better resolution, especially with short amplifier or pulse processor time constants.

GENERAL SPECIFICATIONS AND INFORMATION

Model Number	Area (mm^2)	Thickness (mm)	Be Window Thickness mm (mils)	Guaranteed energy resolution (eV FWHM)*	
				5.9 keV	122 keV
GUL0035	30	5	0.025 (1)	140	550
GUL0055	50	5	0.025 (1)	140	550
GUL0110	100	10	0.025 (1)	150	550

*Resolution: FWTM less than or equal to 2 X FWHM.

The above specifications apply for the standard configurations and for optimum amplifier settings. For special applications, like multi-element array detectors, other specifications may apply.

ENDCAPS AND CRYOSTATS

Ultra-LEGe detectors will come in a 1 in. diameter by 4 in. long stainless steel endcap on a flanged-style or retractable cryostat. The Dewar or electric cooler can be chosen from our wide range of available options.

Note that Polymer windows are not light tight. Detectors equipped with this window should be used in a darkened environment. Be and Polymer windows are not warranted against damage caused by, among others, abuse or harsh environments.

$100mm^2$ Ultra-LEGe detector in windowless retractable cryostat

MULTI-ELEMENT ARRAYS

All Ultra-LEGe models are also available in the Mirion discrete multi-element array detectors. Their thin side contact and full-area front window make them very well suited for these applications as it allows close-packing of the array pattern to minimize dead space between the elements. More information is available in our Germanium Array Detector documentation.

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