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High Performance Silicon Drift Detectors

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KETEK offers a large variety of Silicon Drift Detectors for X-ray fluorescence analysis with collimated areas starting at 7 mm² up to 150 mm² (active area 12 to 170 mm²). All detectors are available in different configurations (FET/CUBE, Beryllium/Polymer windows) and KETEK also offers complete electronics to operate the detectors.

Silicon Drift Detectors are used in a wide field of different instruments and applications. In many applications like mining or geology the instrument is used in harsh environments with high ambient temperatures of 40-50 °C. These applications ask for very reliable detectors with efficient cooling techniques to maintain a stable cold side temperature that is mandatory to get a good spectroscopic performance of the chip. With the latest detector technology the detector cooling capacity improved by more than 15 K compared to standard technologies. These detectors were tested in ambient temperatures up to +50°C still achieving chip temperatures down to -55°C. Even for large area detectors (50 mm² and larger) the performance at such operating temperatures is not affected by leakage current anymore. So the optimum detector performance can be guaranteed even at ambient temperatures of +50°C.

The maximum Peltier power could be further reduced by up to 50% compared to the current thermoelectric coolers. Long term stability tests revealed that the vacuum integrity of the new SDD modules is given even at storage temperatures of 80°C. This is important as the vacuum needs to be stable for many years to avoid any convection inside the module. There are many internal components that can contribute to outgassing and therefore would degrade the vacuum level over time. Encapsulated modules have been stored at +80°C for 200 days without any degradation of cooling performance.

KETEK has developed a new detector window made of graphenic carbon. Both a Beryllium replacement as well as a low energy polymer window alternative has been tested. The transmission for both types of graphenic carbon windows is superior compared to the established Beryllium (Figure 2) and polymer windows.

The Beryllium replacement consists of 1 µm graphenic carbon without any support grid. The window itself is light tight and there is no necessity to use any additional light blocking layers such as aluminium. The burst pressure of the new windows has been tested. To prove the reliability of the new windows pressure cycle tests have been performed - first prototypes can stand over 10 million cycles (vacuum to one atmosphere) without any degradation of the window performance (Figure 3).

The low energy polymer alternative consists of a 150 nm graphenic carbon layer supported by a silicon grid. Up to 10,000 pressure cycles have been performed without any degradation in window performance.

References

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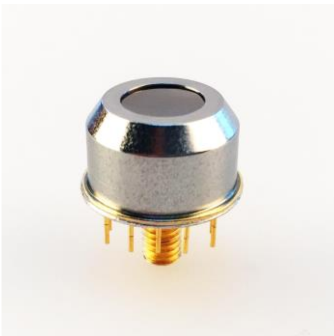

Figure 1. Detector module with metal cap and 1 μm graphenic window.

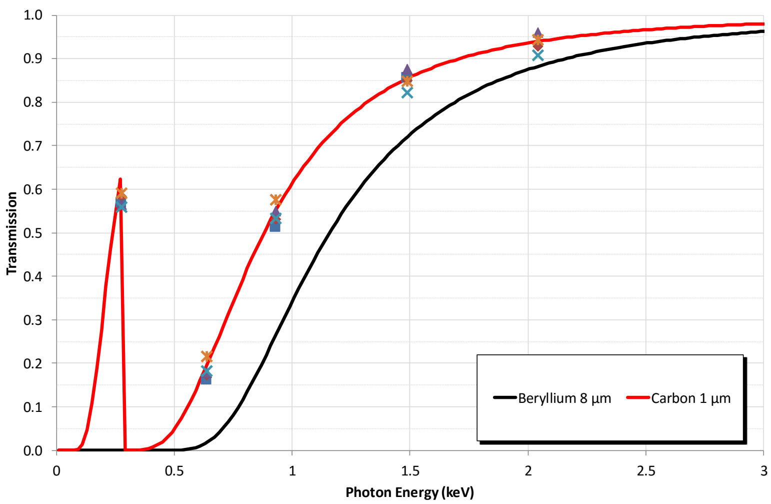

Figure 2. Transmission of 1 μm graphenic window in comparison with 8 μm Beryllium.

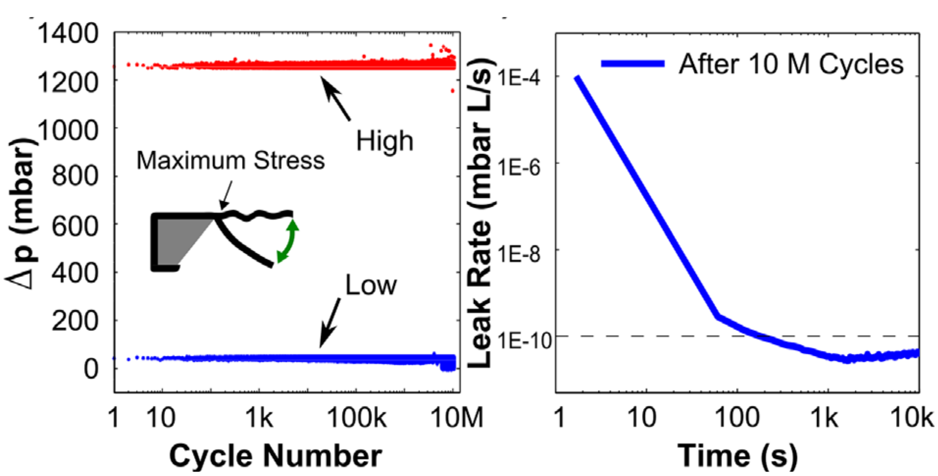

Figure 3. Pressure cycle tests of 1 μm thick graphenic carbon windows (6.9 mm open diameter). The leak test after 10 million cycles shows the integrity of the structure.

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