Ultra-thin X-ray window for detector applications

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Broker Company Name: Turku Science Park Ltd
Broker Name: Timo Huttunen
Telephone: +358-40-7192335
Email: timo.huttunen@turkusciencepark.com

Abstract:

A Finnish company has developed a new technology based on Silicon Nitride films (SiN) for the fabrication of ultra-thin X-ray windows. These windows are used in various industrial and scientific detectors such as Solid State Detectors, X-ray tubes and flow counters. Technology offers advantages such as enhanced optical performance, non-toxicity and endurance to pressure changes and vibration. Company is looking for commercial agreements and joint R&D projects.

Description:

Many instrument applications require the detector to be shielded, either to prevent unwanted radiation or to allow the detector to operate cooled. In this situation, a window or filter is required that, while blocking the unwanted radiation, provides minimal attenuation of the signal to be measured.

Over the last two decades shielding solutions has been restricted to traditional polymer and beryllium based X-ray window and filter components. Beryllium is however highly toxic, and moreover, in some material analysis applications the limited performance of X-Ray windows limits the operational efficiency and range of the whole detector device.

A Finnish start-up company has developed and patented a new technology based on Silicon Nitride films (SiN) for the fabrication of ultra-thin X-ray windows. The benefit of this technology is significantly improved transmission for low energy X-rays. The technology offers significant benefit compared to conventional polymer based ultra-thin X-ray windows. New approaches have been developed for using traditional ceramic and crystalline materials from semiconductor industry in X-ray windows. These high quality ultra pure materials combined with company’s innovative X-ray window structure design and developed fabrication methods make it possible to fabricate ultra-thin X-ray windows with outstanding performance in various application areas.

The technology can be used in several traditional applications where beryllium or polymer based windows have been used before:

- Solid state detectors (SSD) where toxic beryllium X-ray windows have been the main choice in the past. The technology offers both high transmission for X-ray wavelengths and high attenuation for unwanted radiation wavelengths (UV, visible, infrared).

- Applications that require the best transmission of low-energy X-rays.

- Proportional counters
- Windows for both sealed and flow counters (because it is based on vacuum tight technology)
- X-ray tubes

Innovations and advantages of the offer:

The advantages of the technology come from novelties in the material solutions, fabrication processes and X-ray transmission properties. The technology provides a completely toxic free material family, the best available transmission for low energy X-rays and large acceptance angle of the incoming X-rays. The design enables improved vacuum tightness, pressure tolerance and tolerance to vibration, acceleration and secondary impacts by hits outside the open window foil area. The temperature range in further processing is also wider than in other technologies available.

X-ray window is of special relevance to cryogenic measurement instruments. Offered X-ray windows tolerate cooling and heating between room temperature and cryogenic temperatures. X-ray windows tolerate also significantly higher temperatures than polymer based windows, which make them useful also for measurement applications at elevated temperatures.

Further Information:

All basic windows are vacuum tight, non-toxic and they tolerate temperatures between -55 °C – +140 °C. Different window types are available as a standard sizes with 20 mm2 and 30 mm2 open area. Customized windows with different open area are also available.

Application:

Detectors where ultra-thin X-ray windows could be applied can be found in various industrial sectors, such as aerospace, automotive, marine, industrial & scientific instrumentation and imaging. This product has high industrial potential, because there is an increasing demand to improve the sensitivity of light element analysis.

Space Heritage:

X-Ray detectors are widely used in many scientific space instruments and development of optical filters have thus long space heritage. Development of this particular x-ray window dates back to earlier version of Spectrum Rontgen Gamma instrument (Spectrum-X-Gamma, SRG, SXG) – Russian High energy astrophysics laboratory. Development of an early version of Spektr-RG was started in mid-1990s but was cancelled in 2002.

Window development has however continued in also other missions, such as BeppoSAX – Italian scientific mission, which has expanded our understanding in gamma-ray burst science. Window technology has been transferred from company that participated in above mentioned missions to spin-off company. This company has continued to develop the SiN structure also in Innovation Triangle Initiative projects A and B, funded by European Space Agency. In these projects commercial and technical feasibility has been demonstrated and developed further for both space and non-space applications.
Company possesses technology, which can be used in multiple applications. The development of customized versions of standard products is also possible through a joint development project with the customer. Company is experienced in fabricating ultra-thin X-ray windows with different geometries and properties on various mounting platforms.

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