Expanding the Detector Efficiency of Silicon Drift Detectors with Optimized Radiation Entrance Window

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Silicon Drift Detectors (SDDs) with integrated FET have been fabricated by PNSensor in cooperation with the Semiconductor Laboratory of the Max-Plank-Institutes in Munich since many years. With optimum spectroscopic performance values (123 eV @ Mn-K_α), excellent light element performance down to Be (42 eV @ C-K_α) and P/B values up to 20,000 the SDD is a state of the art detector for X-rays.

The detector efficiency is an important feature in any detection system. This is especially true for applications like analysis of trace elements requiring high throughput within a given time. There are three factors determinining the detector efficiency:

- detector performance (energy resolution, P/B ratio)
- quantum efficiency
- detector area and geometry

In this presentation we will analyze the quantum efficiency as a function of photon energy. The detector performance at lower energies has been greatly improved with the introduction of the optimized detector entrance window named *pnWindow*. Compared to standard entrance window, the quantum efficiency for this window type is slightly lower, which is a small price to be paid in view of an energy resolution for Boron of only 38 eV or 42 eV for Carbon. Concerning the detector performance in the higher energy range, some interesting possibilities for the improvement of the detection efficiency are presented. By combining the detector with modern scintillation materials the detection capability can be further extended into the Gamma range.

Larger areas SDDs become more and more attractive for applications requiring short measuring time. The spectroscopic performance of the 20 and 30 mm^2 SDDs will be shown. Besides a larger detection area, the detection efficiency can be enhanced by optimizing the detector geometry with respect to the probe. This is for example the case of the 4-channel SD3 detector with central hole for the exciting beam.

Owing their high count rate capability, SDDs are becoming very interesting as energy dispersive detectors for WDXRS applications. Multi-channel SDDs with special geometry adapted to the various WDS instruments (flat or curved optics geometries) are presented.