News on Silicon Drift Detectors for High-Speed and High Resolution XRF spectroscopy closed to Room Temperature

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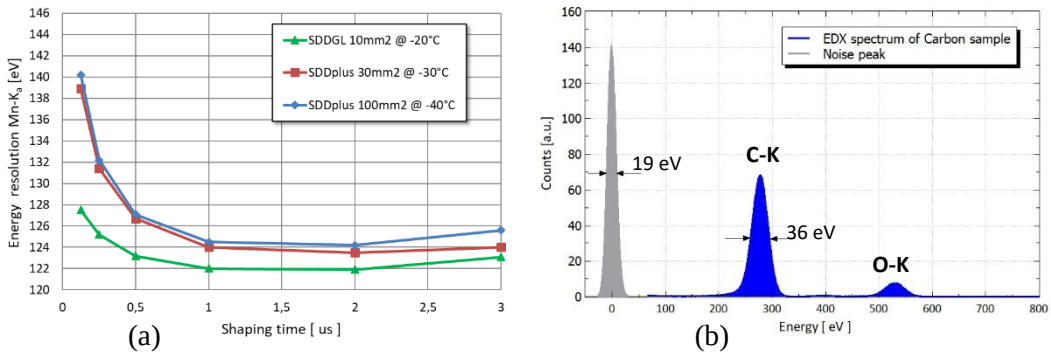
Introduced into the Xray spectroscopy applications more than 15 years ago, Silicon Drift Detectors (SDD) fabricated by PNDetector have established themselves as state-of-the-art detectors in many of the EDX systems for XRF Spectroscopy and Microanalysis.

Since 2015 the SDD fabrication takes place in our own, newly built silicon detector fabrication facility in Munich Neuperlach. This facility is dedicated to sensor manufacturing and allows us a full control of all relevant detector parameters such as detector leakage current, detection efficiency at light elements or radiation hardness. On the other side it gives us the full manufacturing flexibility in terms of detector types and numbers for the serial production, as well as the convenience of quickly testing new designs, new geometries and new features.

With the new fabrication facility, the SDD performance was brought to a new level not only in terms of noise and energy resolution, but also with regard to other features which are of great importance for the applications such light element performance in the case of EDX Microanalysis or radiation hardness for XRF applications. Fig1. shows the typical spectroscopic performance for three representative detector types and sizes. Whereas the SDD^{GL} type offers the best energy resolution (Fig.1a, green curve) and light element performance (Fig. 1b) due to its special FET and anode design featuring the smallest achievable input capacitance of about 50 fF, SDDs of larger sizes, e.g. 100 mm^2 also are capable of reaching energy resolution values very close to the physical limits (119 eV for Mn-Ka).



(a) (b)

Figure 1. Spectroscopic performance of SDDs of different types and sizes.

Irradiation tests performed on selected devices demonstrate that the radiation hardness of the detectors fabricated in the new facility could be improved by a factor of 3 compared to the old facility. The degradation in Carbon resolution is less than 10% up to almost 10^{13} photons, whereas for the Mn-Ka line there is no sign of degradation up to more than 10^{13} photons.

Another important parameter of a silicon detector is the detector leakage current, which usually has to be cooled off in order to insure best detector performance. Owing to the ultra-pure fabrication technology in our detector manufacturing line, leakage current levels of down to 10pA/ 10mm^2 at RT are being achieved, which insures excellent spectroscopic performance close to room temperature, e.g. < 140 eV @ +20°C, making the Peltier cooling of the detector almost obsolete.