Type of presentation: Poster

IT-5-P-3289 Ultra-Fast, High-Resolution Silicon Drift Detectors for Accurate EDS Microanalysis in Electron Microscopes

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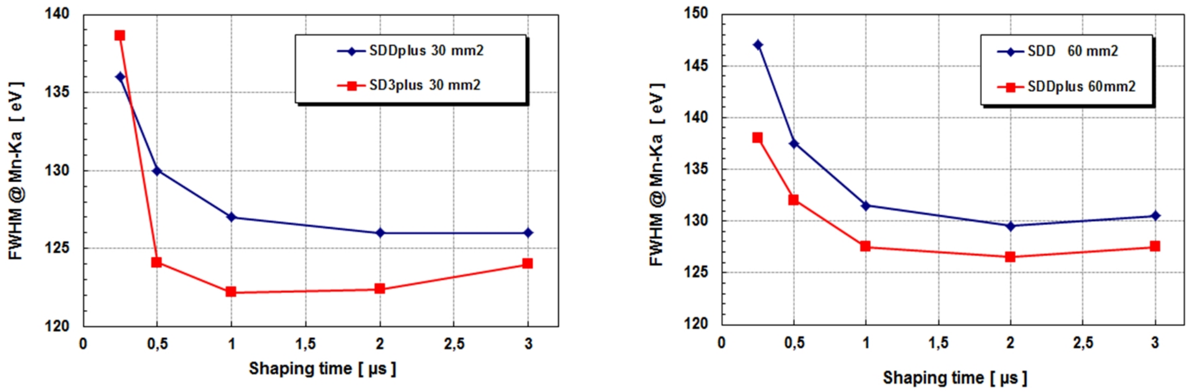
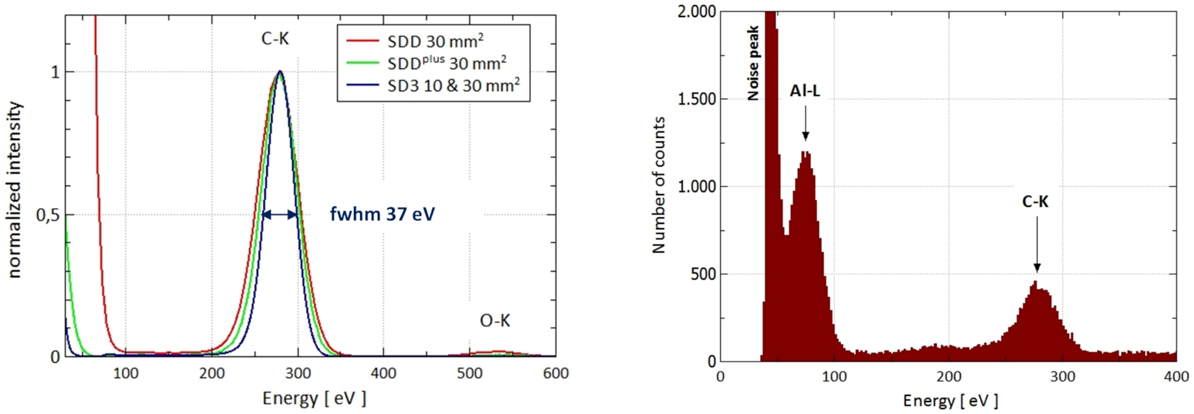
In the recent years significant advances have been done in electron microscopy instrumentation with respect to electron beam intensity and spot size, pushing for higher energy resolution and faster EDS detectors. High-resolution, ultra-fast EDS microanalysis applications require detectors with extremely low input capacitance, insuring optimum detector operation at very short processing times. A substantial development work has been done in the past years in this direction at PNDetector by remodeling the geometry of the anode and of the integrated FET with the goal of reducing all the parasitic capacitances related to the detector anode. This led to a new generation of Silicon Drift Detectors – the so-called SDD^{plus} series.
The low capacitance anode/FET can be adopted for all SDD types (round or droplet shape) and sizes (from 5 and 10 mm^2 up to 100 mm^2 or multichannel devices). Fig.1a and 1b show spectroscopic performances measured with the 30 mm^2 and the 60 mm2 SDD^{plus} detectors. Whereas energy resolution values of 126 eV are achieved with the round-shape SDD^{plus} devices, when applied to the droplet-shaped SD3 devices, the low capacitance FET drives the energy resolution below 122 eV at shaping times as short as 1 us. With the detector operated at 0.5 us shaping time (maximum input count rate of 400 kcps) the energy resolution is still below 125eV. Further measurements with SDD^{plus} devices of various sizes and shapes will follow.
The improved spectroscopic performance of the SDD^{plus} devices becomes much more visible when it comes to detection of light elements. Combined with a high-performance, loss-free detector entrance window, the SDD^{plus} devices demonstrate their excellent light element detection capabilities. Measured spectra from carbon samples in SEM are shown in Fig. 2a with an achieved energy resolution of 37 eV FWHM for a 10 mm^2 SD3^{plus} detector. Even energy lines well below 100 eV (Si-L, Al-l or Li-K) can still be well distinguished from the noise peak (see Fig2b).
When analyzing thin samples or biological probes with a low photon yield the measurement time is directly related to the detector collection angle. Another important development direction is moving toward smaller, more compact detector packages and therefore increasing the solid angle coverage of the detector with respect to the analyzed sample. An example here is the new large area 100 mm^2 SDD detector which has been mounted onto a very compact package of 18.5 mm diameter only (see Fig. 3a). The spectroscopic performance is similar to that obtained with smaller size detectors (Fig. 3b) and this at moderate cooling temperature of -30°C. Selected measurements will be presented and the results will be discussed.



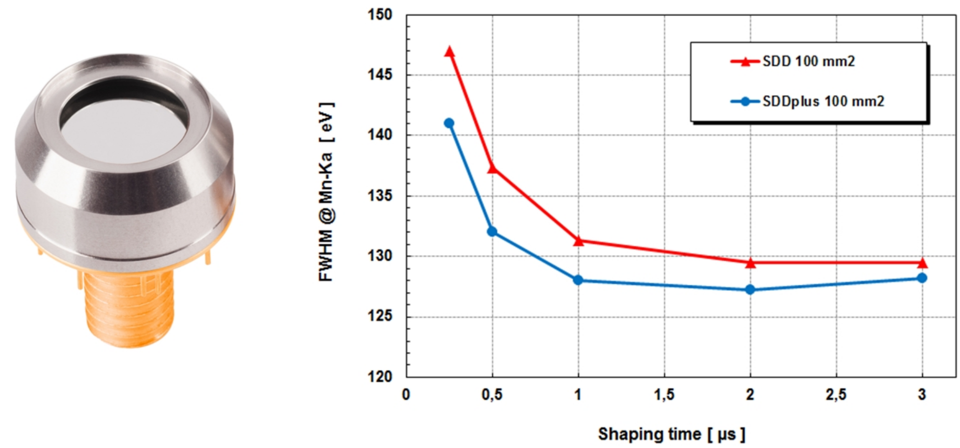
(a) (b)

Fig. 1: Energy resolution vs. shaping time measured at -30°C with: (a) 30 mm² SDD^plus/SD3^plus detectors; (b) 60 mm² SDD^plus/SDD detector



(a) (b)

Fig. 2: Light element spectra of SDD^plus devices: (a) C-K line (277 eV) and (b) Al-L line (70 eV)



(a) (b)

Fig. 3: (a) 100 mm² SDD in ultra-slim line package (b) energy resolution vs. shaping time at -30°C for the 100 mm² SDD^plus/SDD detectors