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New Design and Measurements with 60 mm^2 Rococo2 SDD Detectors

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The introduction of the Silicon Drift Detectors (SDD) several years ago has been revolutionized the EDS instrumentation for Microanalysis in SEMs, STEMs or TEMs, setting new milestones for this type of instrumentation. Combined with the improvements of the microscope itself, the EDS detector is facing new challenges in terms of energy resolution, collection angle or measurement time.

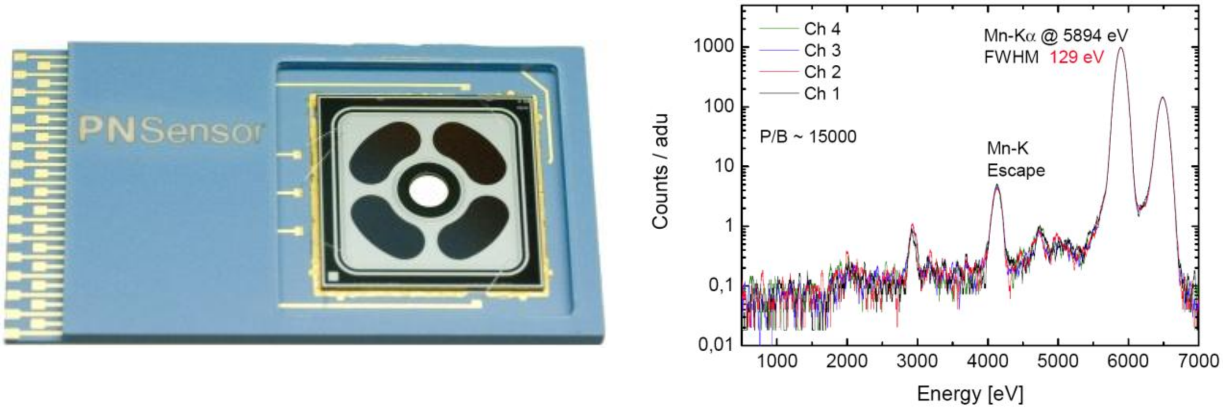
The SDD detector with integrated FET fabricated by the companies PNSensor and PNDetector in Munich is the ideal detector for EDS-Microanalysis applications requiring energy resolution close to the theoretical limit, excellent light element performance and ultra high count rate capabilities. Due to the ultra-pure fabrication technology, these devices show a very low level of leakage current, insuring operation with optimum performance already at temperature values close to the ambient temperature (-10 to -20°C). This advantage makes possible the integration of the SDD sensor very close to analyzed sample and hence, greatly increasing the collection angle of the characteristics X-ray photons emitted by the sample.

A very interesting detector geometry for microanalysis application is the 4x15 mm^2 active area SDD detector called Rococo2-SDD. The detector consists of four kidney-shaped cells (see Fig.1a) arranged around a central hole, therefore allowing the positioning of the detector underneath the microscope pole shoe with the primary electron beam travelling trough the detector hole. The detector cells have been built as droplet-shaped SDDs, taking profit from the excellent energy resolution and peak-to-background performance values of this SDD topology (see Fig.1b)

Fig.2 shows schematically how the detector is integrated into a spectrometer head with a Peltier element for moderate cooling down to -20°C. Thereby several details have to be optimized especially the minimization of the thickness of the cooling plate is an issue. A collimator with different types of windows is attached to the detector. The choice of the window type is dependent on the application and measurement condition. One important aspect which has to be taken into account is the fact that the back-scattered electrons will also impinge onto the detector, therefore a separation of the electrons and the X-ray photons is needed.

In this work, we present results from new measurements performed with the detector arrangement described above in an optimized format. The influence of the back-scattered electrons as well as the efficiency of the methods to avoid their effect on the detector performance by means of hardware filers (use appropriate detector windows) and software filters (separate the electrons from the photon signals in the acquired spectrum) will be also discussed.

Finally, a new detector concept which monolithically integrates the BSE detector and the ESD detector onto the same detector chip (see Fig.3) will be presented.



(a) (b)

Fig 1. (a) Geometry of the Rococo2 SDD detector with four cells arranged around a central hole; (b) Spectra from a Fe-55 radioactive source measured with a Rococo2 SDD

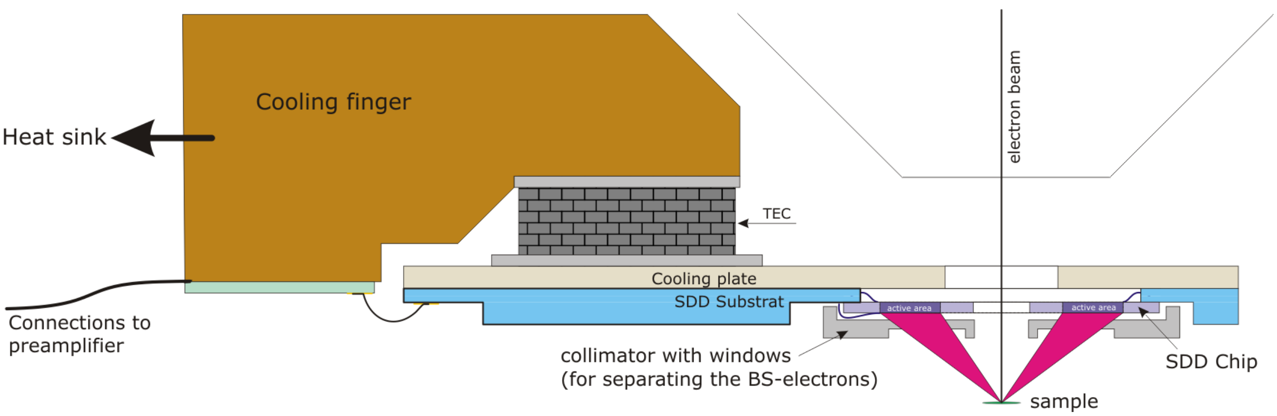


Fig 2. Schematic for the mechanical integration of the 4-channel Rococo2 SDD into an SEM.

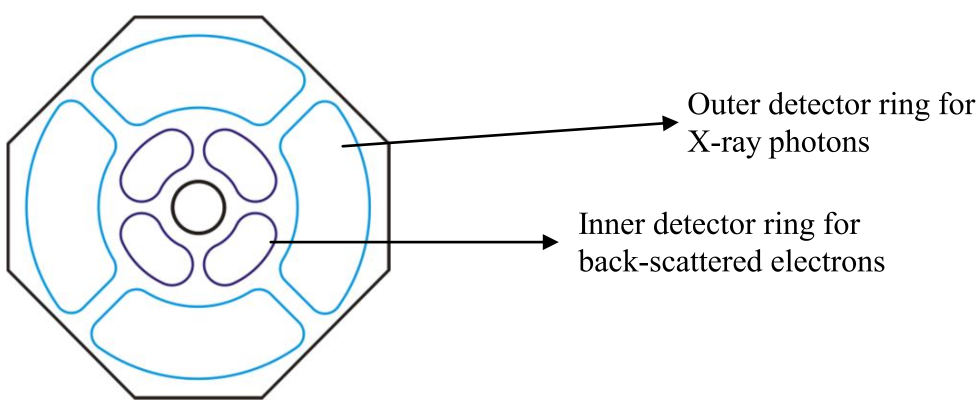


Fig. 3. Concept of a dual detector for back-scattered electrons and X-ray photons

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