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Large Area Silicon Drift Detectors for EDS in Microbeam Analysis

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Silicon Drift Detectors (SDDs) with integrated first amplification step are fabricated by the Semiconductor Laboratory of the Max-Planck-Institute in Munich in cooperation with PNSensor. They are used for EDS in Microbeam and XRF Analysis with active areas of 5 mm^2 and 10 mm^2.

Larger active area devices are of interest for many applications as they enhance quantum efficiency and reduce throughput time.

For these needs two courses are followed: on one side, large area single SDDs with sizes of 20 and 30 mm^2 are fabricated and qualified; on the other side multielement devices comprising overall active areas of 40 mm^2 up to 5 cm^2 and cell sizes between 5 and 15 mm^2 have been developed and operated (see Fig.1).

For a scientific experiment at the e^+e^- collider DAΦNE in Frascati, Italy the two approaches have been combined leading to detectors of 1 cm^2 size monolithically assembled into strips with an overall sensitive area of 200 cm^2 (see Fig.2). Read out of the chips will be performed by means of ASICs operated in CSA mode.

It is the main objective in large area SDD production to keep the good performance of the device close to room temperature, easily to be achieved with single or double stage peltier cooling. Therefore a new fabrication technology has been developed improving leakage current control. Fig.3 shows the excellent performance of the as-produced detectors demonstrating energy resolution values better than 135 eV at -30° C for 20 and 30 mm^2. Tab.1 summarizes the measurement results:

Type	Active Volume Chip Format	Energy Resolution @ -20°C Energy Resolution @ -30°C	Peak-to-Background Ratio
SDD-20-150	20.0 mm^2 x 450 µm	145 eV - 150 eV	typ. 3.000-5.000
	8 x 8 mm²	135 eV - 140 eV	
SDD-30-160	30.0 mm^2 x 450 µm	155 eV - 160 eV	typ. 3.000-5.000
	9 x 9 mm²	140 eV - 145 eV	
PSD-20-135 new technology	20.0 mm^2 x 450 µm	typ. 135 eV	typ. 3.000-5.000
	8 x 8 mm²	typ. 133 eV	
PSD-30-145 new technology	30.0 mm^2 x 450 µm	typ. 140 eV	typ. 3.000-5.000
	9 x 9 mm²	typ. 135 eV	

We present various large area detectors and analyse their behaviour. The relevant detector parameters as signal capacitance and transistor conductances determining the electronic noise level are deduced from the measured performance and put into context with technical data. The results are discussed comparing single large area and multichannel devices and SDDs without integrated transistor.

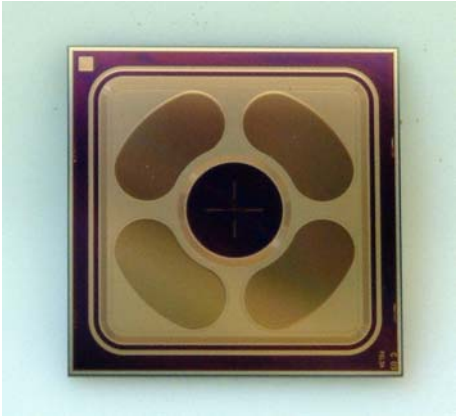

Fig. 1. A four element multichannel SDD with an overall area of 60 mm^2 active area has been developed for large area high resolution purposes with an energy resolution of 130 eV at -20^o C. A hole cut in the middle of the device allows penetration of the exciting beam and a very close arrangement of probe and detector.

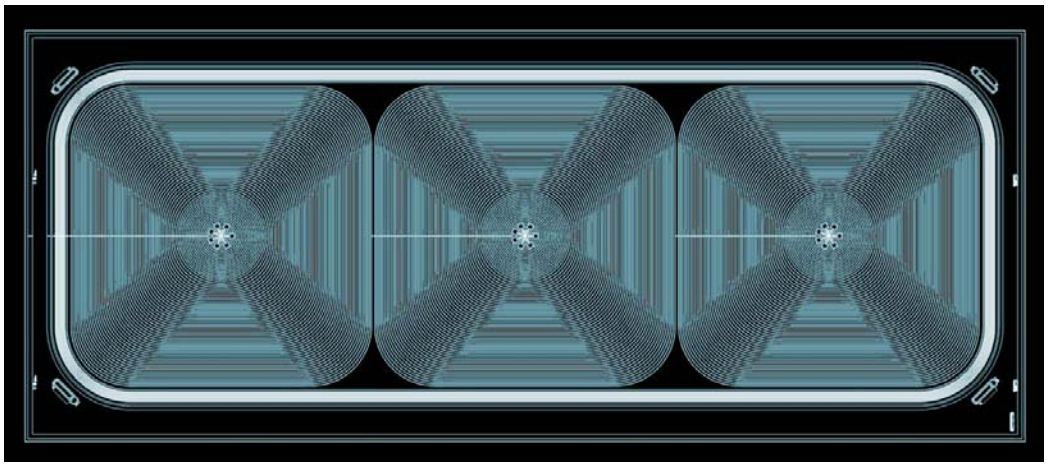

Fig.2. For the SIDDHARTA experiment in Frascati, Italy 70 SDD arrays with 3 x 1 cm^2 area are assembled to a barrel geometry to investigate the X-ray transitions of exotic atoms.

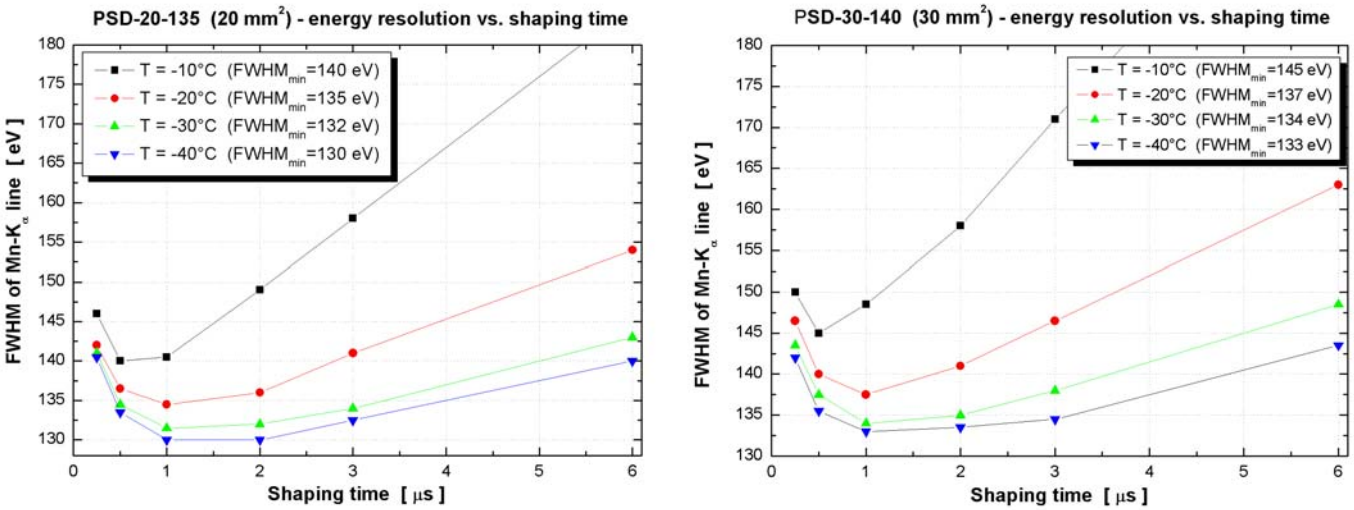

Fig.3. Energy Resolution of 20 and 30 mm^2 SDDs.

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