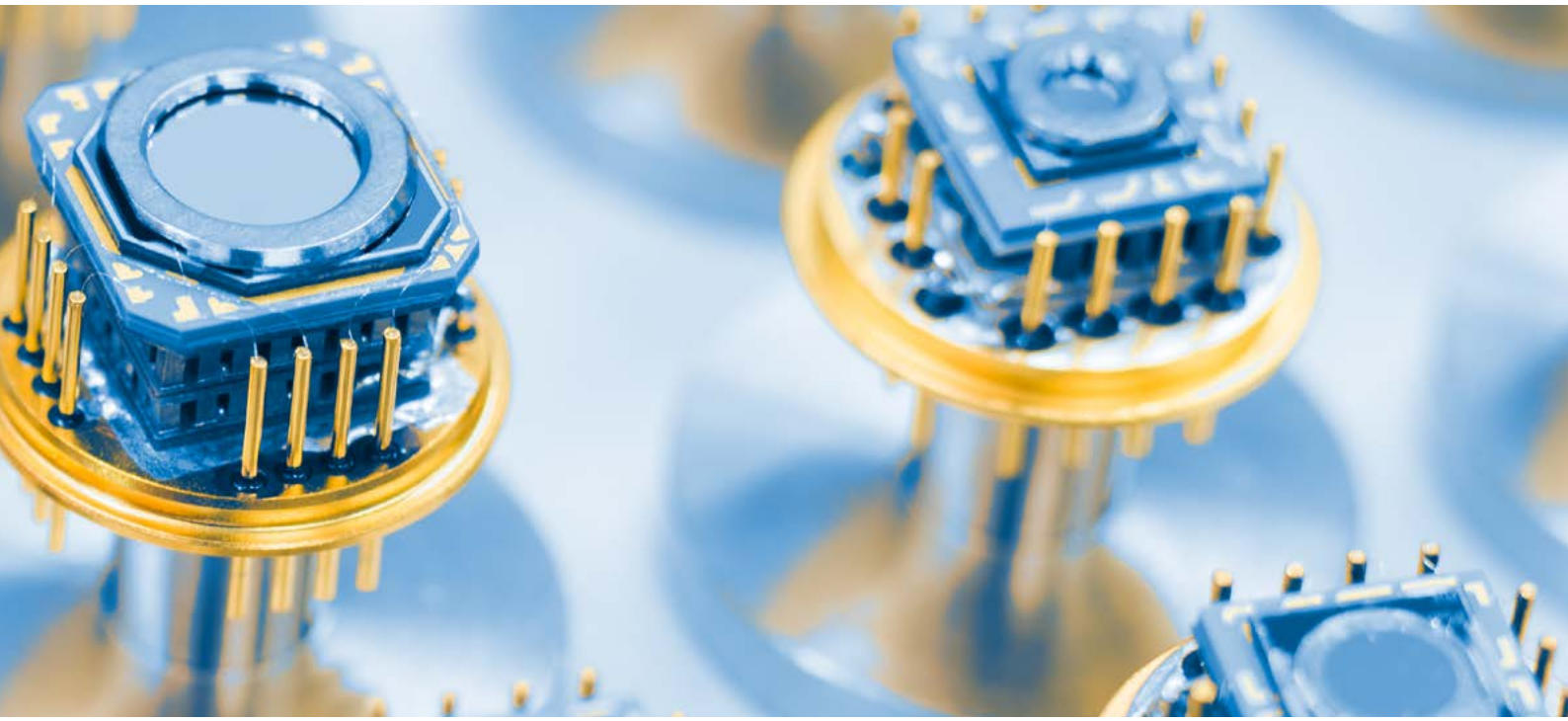
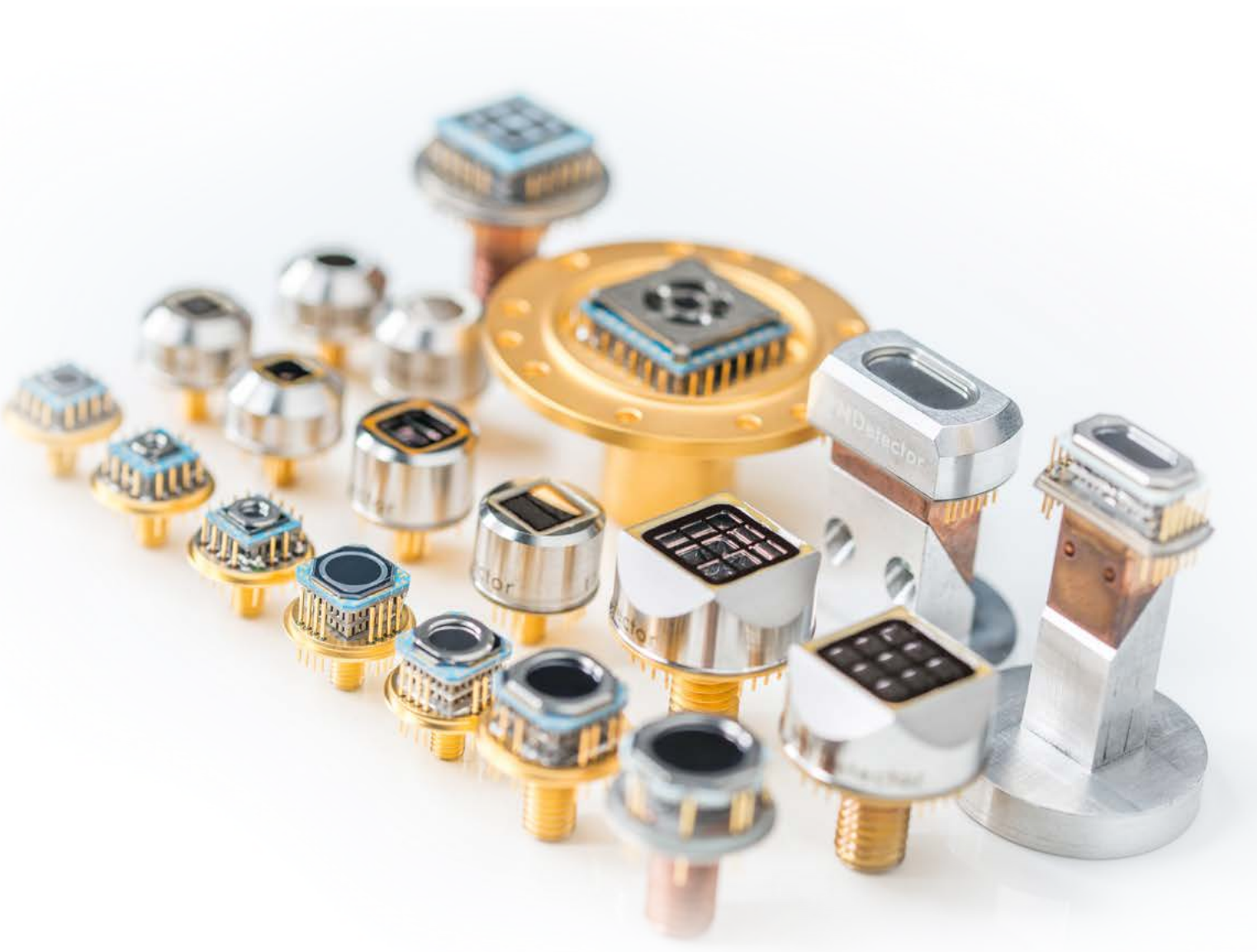
# SILICON DRIFT DETECTORS



PRODUCT BROCHURE

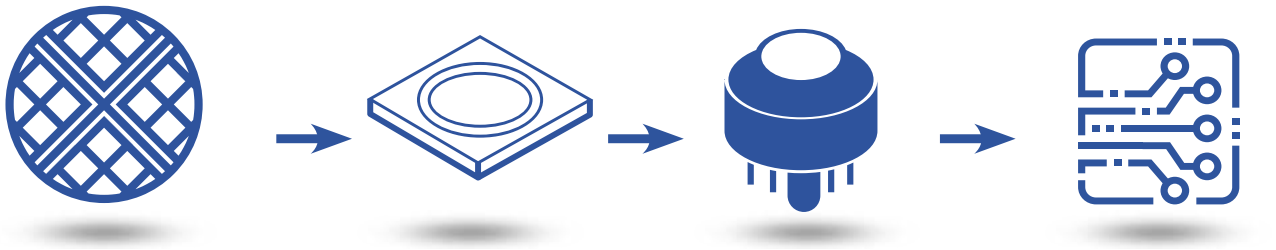
PNDetector



# About PNDetector

PNDetector is well-known as a manufacturer of high performance radiation detectors for microanalysis, quality assurance and material science. The company was founded 2007 and is situated in Munich, on the Siemens Technology Campus. Our facilities consist of our own silicon fabrication line as well as a new packaging and qualification area. Our talented teams are specialists in simulation and design, electronics, mechanics, and semiconductor technology. All our tools are state-of-the art.
PNDetector´s focus is on standard and advanced detectors for X-ray and electron spectroscopy and imaging, such as p-i-n diodes, pad detectors, Silicon Drift Detectors (SDDs) and pnCCD camera systems.

# From Wafer to Chip... to Module... to System



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# PND's Silicon Drift Detectors - Introduction

## Working Principle

The working principle of the Silicon Drift Detector (SDD) is based on the concept of sideward depletion invented by Pavel Rehak and Emilio Gatti in 1983 [1]. It allows the depletion or electrical activation of a large volume of high-resistivity silicon absorber material by a small anode receiving a minimum signal capacitance. By that, the SDD overcomes the major problem of a classical p-i-n diode detector where the input capacitance is direct proportional to the active area. Figure 1 shows a schematic view of the SDD in its standard configuration [2]:

While the back contact is made up by a homogeneous, shallow $p^+n$ junction on the side where the incoming radiation enters the detector, the opposite side is characterized by a structure of circular $p^+$ drift rings and eventually an integrated first FET for on-chip amplification. By applying a negative voltage on the radiation entrance window and an increasingly negative voltage on the drift rings, a potential field distribution is created such that the electrons generated by the ionizing radiation drift towards the small sized collecting anode situated in the center of the device. In the case of an integrated FET, the signal is directly amplified without adding any additional noise or microphony problems by bond wires.

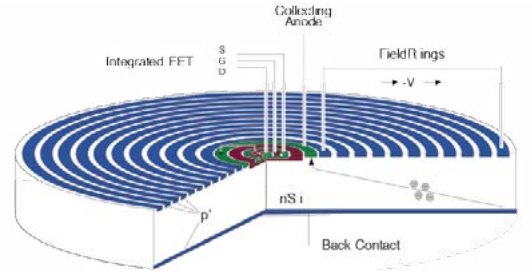



*Fig. 1 Schematic 3D view of a round silicon drift detector.*

## Types

The SDDs of PNDetector vary with the targeted application:

- For **standard application,** the best value, the best relation between performance and price, is our goal.
- For the **high end customer,** the best performance on the market is our target.
- Where **large solid angles** are required, we push to over 1sr and achive areas of 200 mm².

## Modules

The SDDs come as packaged Module Solutions offered in an **add-on system**. Our new **Product Catalogue** gives a complete overview of the choices. It comprises:

- Standard configurations with Beryllium window
- Our **Complete series** with hermetically closed modules for harsh environments
- Open configurations and various types of **ultrathin windows** for optimum light element detection down to Lithium
- Sensors for special applications as our unique oval shaped SDD series and the 4 element Rococo.

## Systems

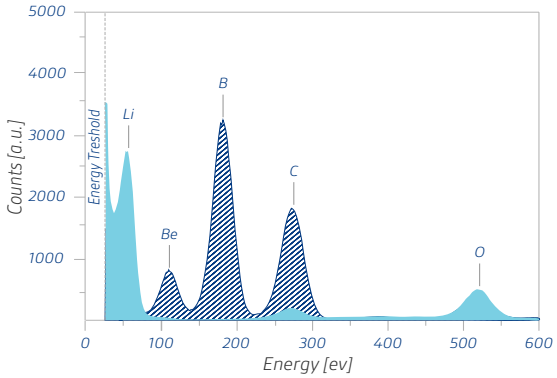
For all our customers looking for **SDD systems** we have expanded our product portfolio to systems comprising SDD, preamplifier, main amplifier, supply unit and DPP.

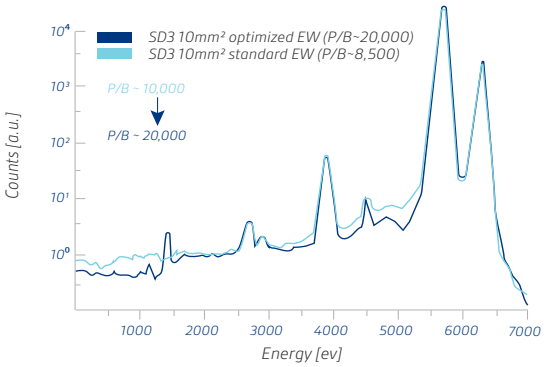
We are looking forward for an ongoing and expanding perspective with our customers.

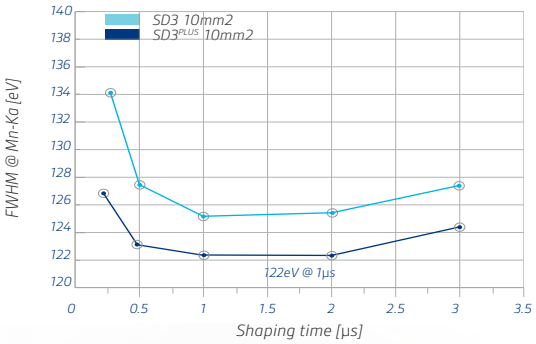
High resolution, high throughput Energy Dispersive Spectroscopy (EDS) applications in electron microscopy require detectors with extremely low input capacitance, providing optimum detector performance at very short processing times. At the same time they must provide large solid angles while fitting to challenging spatial restrictions. PNDetector's Silicon Drift Detectors show superior performance in all these criteria.

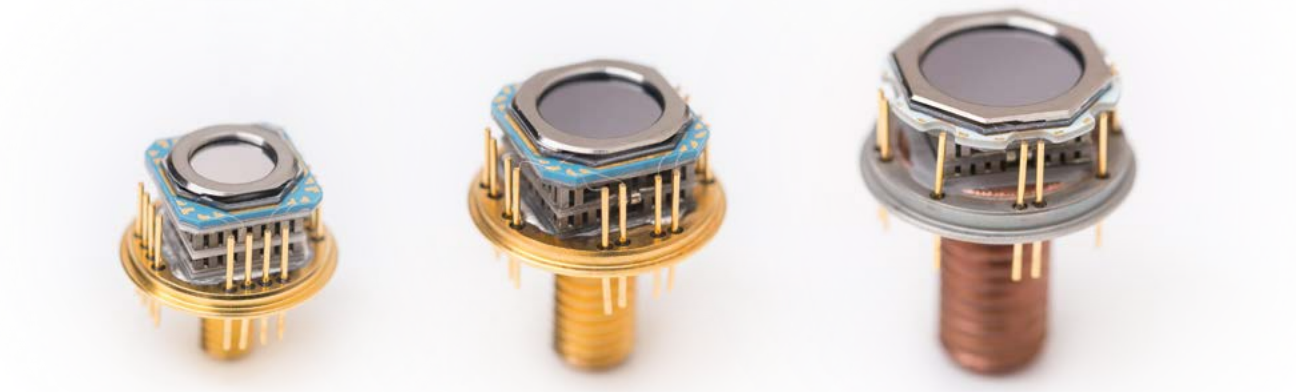
## Key Features

- **Best energy resolution**
  down to 121 eV @ Mn-$K_\alpha$, -30°C
- **Polysilicon technology**
  for ultralow leakage current values < 100 pA/cm², enabling high performance spectroscopy close to room temperature
- **pnWindow**
  for the best light element detection and optimum P/B ratio up to 20 000
- **Wide selection of chip sizes and detector housings**
  5, 10, 20, 30, 60, 80, 100, 200, 300, 600 mm²
- **Unique shapes**
  like our Oval Series and the Rococo Detectors
- **High count rates**
  up to 1 Mcps with single cells and several Mcps with our monolithic Multi-Element SDDs
- **Radiation hardness**
  > $10^{14}$ photons/cm²



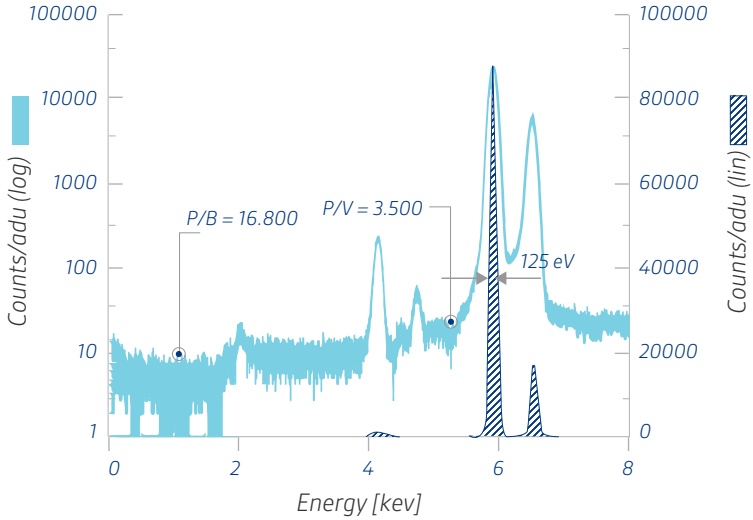
# SDDs for Standard Applications

Simplicity and high spectroscopic accuracy – that's what you get with our SDDs for standard applications. A variety of detector modules with energy resolutions of **127 eV FWHM** @ Mn-$K_\alpha$ and easy operation are available at excellent prices. They cover active areas ranging from 5 mm² to 30 mm². All detector modules are available with Beryllium windows or transparent windows for light element detection (see our product catalogue).

**Standard**

*5 mm² – 30 mm² active area*
*125 - 127 eV FWHM @ Mn-$K_\alpha$, -30 °C*
*45-49 eV FWHM @ C-K, -30 °C*
*7.500 - 15.000 P/B ratio*

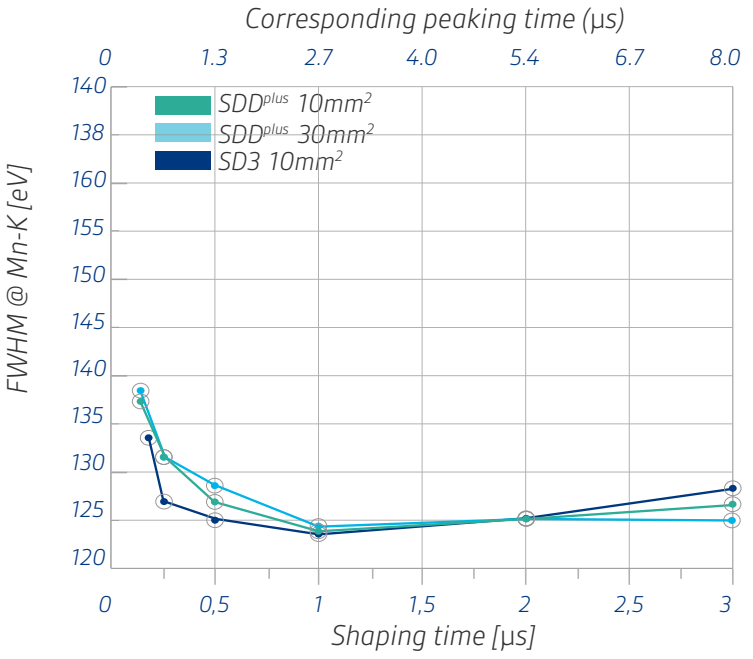
## Excellent Performance at Excellent Prices




*Fe55 spectra measured with a 10 mm² SD3 detector and analog shaper at 1 µs shaping time*

- High spectroscopic accuracy with energy resolution values down to **125 eV** FWHM @ Mn-$K_\alpha$
- Low spectral background with P/B values up to **20.000** and P/V values up to 4.000

## Throughput with Good Resolution




*Energy resolution of different SDDs for Standard Applications measured at -30 °C with analog shaper*

- Very good energy resolution even at shortest processing times, especially for our droplet shaped SD3 detectors
- Our **SDD$^{plus}$ detectors** are also available with larger active areas (see page 12)

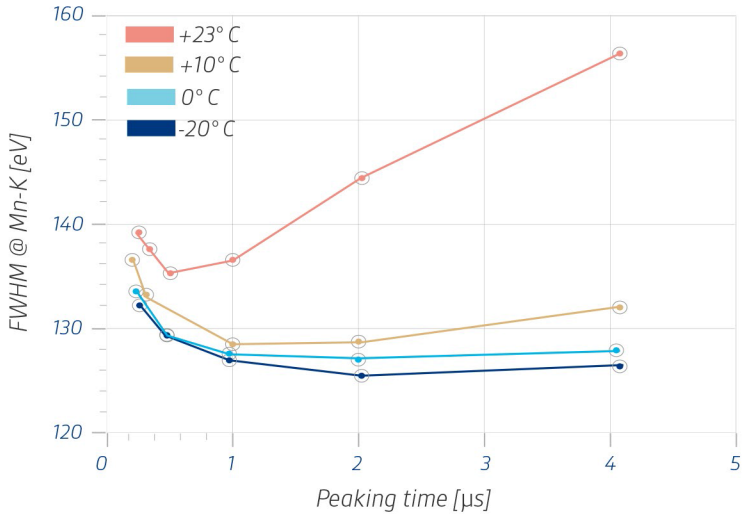
# SDDs with ASIC

Our SDD modules **with ASIC** preamplifier (SDX) are the perfect solution for any application where high count rate performance is the major goal. Due to the extremely low leakage currents levels of PNDetector's SDD fabrication, we are happy to provide the best energy resolution of SDDs with ASIC preamplifier on the market. They are the perfect candidate for demanding **industrial customers.**

**SDDs with ASIC**

*10 mm² – 60 mm² active area*
*127 eV FWHM @ Mn-$K_{\alpha}$, -30 °C*
*49 eV FWHM @ C-K, -30 °C*
*15.000 P/B ratio*

## Best SDDs with ASIC at All Operation Temperatures



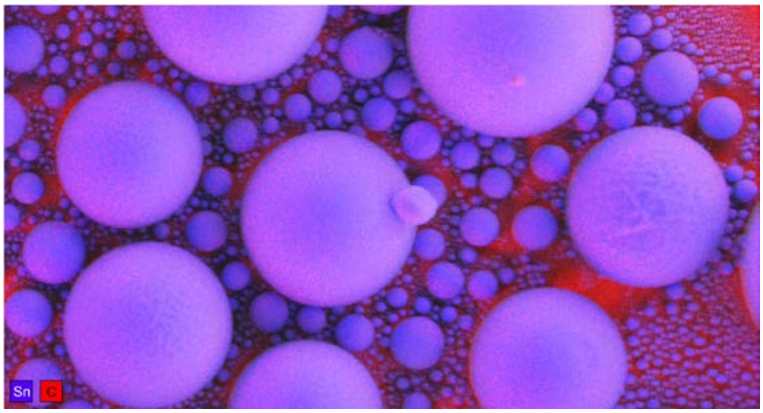

*Energy resolution of a 10 mm² SDX detector at different chip temperatures up to 23°C measured with DPP*

- Excellent energy resolution < **127 eV** FWHM @ Mn-$K_{\alpha}$ at optimum peaking time
- Extreme high temperature performance with resolution values < 140 eV at room temperature

# Get in Touch

Please study our new **Product Catalogue**. Get in contact with our sales team to receive further information or a quote for our products. We are happy to support you in finding the optimum detector solution for your applications. In case none of the standard products meets your requirements, we are happy to discuss your new and challenging ideas for customer specific solutions.

Please bear in mind – almost anything is possible with a **PNDetector SDD**.




*High resolution SEM-EDX mapping of Tin on Carbon obtained with our unique annular SDD „Rococo3" within 15 sec. The huge solid angle leads to high signal intensity and almost no shadowing in between the spheres.*

## Contact Information

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## References

[1] Rehak, P., Gatti, E. (1985) et al.: "Semiconductor drift chambers for position and energy measurements" Nucl. Instr. & Meth. A235 (1985), 224-234.
[2] Lutz, G. (1999): "Semiconductor Radiation Detectors", 237.