

Highly sensitive detectors for electron radiation

Semiconductor detectors for electron radiation are used in various applications in research, medical technology, industry, and security technology. Measuring low-energy electron beams (< 1 keV) poses a particular challenge for sensors, as these beams only penetrate the detector material to a very shallow depth. The sensor must therefore be extremely surface-sensitive, which requires innovative technologies.

As part of the “eLGAD” research project, the CiS Research Institute developed such technologies for low-energy electron detectors that have an integrated amplification zone. Optimized implantation processes generate a strong internal electric field even at moderate operating voltages, which triggers an avalanche process when an irradiated electron arrives. The incoming electron triggers a cascade of further electron excitations in the semiconductor, significantly amplifying the measurable current signal. The principle corresponds to that of a “low gain avalanche detector” (LGAD), which is also used in sensors for low-light effects - in this case, however, for incoming electrons that penetrate less deeply into the semiconductor. The particular challenge at < 1 keV is therefore to create this zone very close to the surface without electrical short circuits or parasitic interference effects impairing its function. For the first time, the project was able to achieve demonstrators with a gain factor > 10 and resulting quantum efficiencies $> 500\%$ for electrons with 1 keV at operating voltages between 20 and 30 V - parameters that are unique worldwide for semiconductor detectors of this type.

The CiS Research Institute focuses on the development and manufacture of innovative silicon components with a high degree of manufacturing maturity. The demonstrators realized in the project are available for sampling by users and transfer companies.

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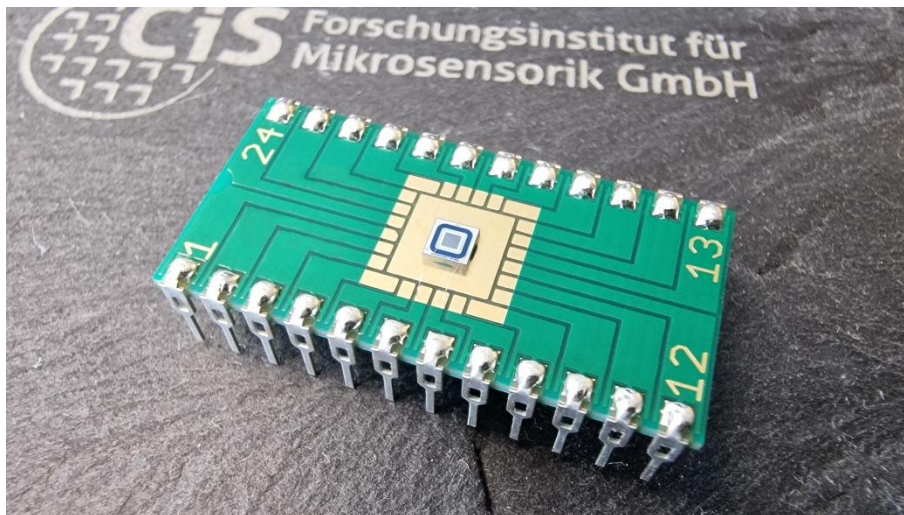


Image 1: Demonstrator of an electron detector with integrated avalanche amplification of signals © CiS

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