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Simulation and Technology Study of Shallow Doping Profiles

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In silicon detectors, a fraction of the highly-doped region represents a dead layer, where the generated charge carriers are lost. By minimising the dead layer, this charge loss is minimised as well. This is important when the determination of the exact generated charge is crucial: e. g. in case of isotope identification with the ΔE-E method or energy resolution measurements of alpha-particles emitted by decaying nuclei. It is especially important when the penetration depth is very small: for example for low energy x-rays, UV-radiation and low energy electrons.

For an upgrade of the T-Rex detector at the Miniball experiment at ISOLDE, the demanding processing of a large, double-sided AC-strip sensor is under way. Besides a sensor thickness of 70 µm, a dead layer of less than 100 nm within the silicon is requested; therefore a very shallow and homogeneous doping profile of the boron implantation is needed.

Several test runs have been produced to explore how shallow the boron profiles can get, especially when an isolating oxide is favoured. Plenty parameter variations of the Plasma Immersion Ion Implantation (PIII) and the Rapid Thermal Annealing (RTA) have been tested. The samples are analysed by SIMS and resistivity measurements. The results are compared to TCAD simulations. A further innovative, promising technology which is under development is the co-implantation with solid phase epitaxial growth (SPER).

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