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Application of van der Pauw Test Structure in Assessing Doping Removal in Silicon Detectors

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Doping removal is a well-known consequence of radiation damage in silicon detectors and has likely become the primary effect since the introduction of Low-Gain Avalanche Diodes (LGADs). In standard n-in-p LGADs, acceptor removal degrades the timing performance after irradiation by decreasing the effective acceptor concentration in the gain implant. Furthermore, in next-generation LGADs—such as resistive LGADs and compensated LGADs—donor removal is also expected to be significant. In resistive LGADs, the resistive layer that enables high spatial resolution, even with large pixel sizes, is made by donor doping. In compensated LGADs, a valuable candidate for performing 4D tracking up to extreme fluence (above 10^{17} 1 MeV n_{eq}/cm^2), the gain implant is realised through a carefully balanced compensation of acceptor and donor doping. As a result, understanding and characterising doping removal is crucial.

In this contribution, we showcase how variations in sheet resistance due to irradiation, assessed through van der Pauw test structures, can be used to evaluate doping removal. Typically, these test structures consist of the layer under study implanted onto a substrate of the opposite conductivity type to reduce parasitic effects. However, we will demonstrate that through comparison with simulations, insightful information can also be gained from structures where the layer under investigation shares the same conductivity type as the substrate.

Type of presentation (in-person/online)

online presentation (zoom)

Type of presentation (I. scientific results or II. project proposal)

I. Presentation on scientific results

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