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Impact of a magnetic field on integrated low-temperature photoluminescence of quenched silicon

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An acceptor removal phenomenon (ARP) appears in irradiated low-gain avalanche detectors (LGAD) and reduces their functionality for higher irradiation fluences. The underlying defect mechanisms are still not fully understood. Recently, acceptor-interstitial silicon (A_{Si}-Si$_i$)-defects [1] were proposed to be responsible for the gain loss in LGADs. This defect category seems to be relevant for silicon solar cell and silicon-based quantum technology, as well. [2] To further investigate possible defect mechanisms responsible for the ARP we report on first experiments related to changes of the integrated low-temperature photoluminescence (PL) due to application of magnetic fields. Silicon samples with and without indium doping were treated by a temperature quenching step to generate A_{Si}-Si$_i$-defects. The A_{Si}-Si$_i$-defect generation was done using a local laser quenching method as well as a Bunsen burner with subsequent water quenching. The integrated PL intensity increased after this generation process as expected. The application of magnetic fields to the samples changes the integrated PL intensity significantly. Differences between samples with and without indium doping will be discussed.

[1] K. Lauer, K. Peh, D. Schulze, T. Ortlepp, E. Runge, and S. Krischok, 'The A_{Si}-Si$_i$ Defect Model of Light-Induced Degradation (LID) in Silicon: A Discussion and Review', Phys. Status Solidi A, vol. 219, no. 19, p. 2200099, 2022, doi: 10.1002/pssa.202200099.
[2] K. Lauer et al., 'Examining the properties of the A_{Si}-Si$_i$-defects for their potential as qubits', presented at the GADEST, Bad Schandau: ResearchGate, May 2024. doi: 10.13140/RG.2.2.18793.51048.

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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