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# Section
# Semiconductor Devices

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# Selected Papers

## Numerical Simulation and Optimization of Dark Current Performance Through a Quaternary Barrier in InAs/GaSb Superlattice Photodetectors

**Authors:** Zhejing Jiao, Gaoyu Zhou, Xin Jin, Yi Gu, Bowen Liu, Tao Li and Xue Li

**Abstract:** In this work, a high-performance mid-wave infrared (MWIR) photodetector (PD) utilizing an InAs/GaSb Type-II superlattice absorber and a quaternary AlGaAsSb barrier is designed and analyzed based on numerical simulations aimed at determining an optimized detector structure. Through these simulations, the composition of the AlGaAsSb barrier is carefully designed to achieve lattice matching, high conduction band offset and zero valence band offset. By optimizing the barrier thickness and doping concentration, the depletion region is effectively shifted from the narrow-bandgap absorber to the wide-bandgap barrier; additionally, at 150 K and a reversed bias of 0.05 V, the dark current density in the PD with the barrier (pBn) is reduced to $1.83 \times 10^{-5}$ A/cm$^2$, about two orders of magnitude lower than that of the PD without the barrier. Furthermore, the effect of the barrier on the generation–recombination (G-R) and the trap-assisted tunneling (TAT) currents are analyzed and compared in detail, and it is found that the barrier structure is much more effective in suppressing the TAT current at low reversed bias when the electric field is low in the absorber layer. These results demonstrate the efficacy of the proposed AlGaAsSb barrier design for realizing high-operating-temperature MWIR PDs. It also provides an insight into the physical mechanism that leads to the performance enhancement of InAs/GaSb PDs.

https://doi.org/10.3390/electronics15071355

## Comparative Study on Device Type Configurations of 2T0C DRAM for Compute-in-Memory Applications

**Authors:** Seonghwan Kong and Wonbo Shim

**Abstract:** In this article, we systematically analyze the electrical characteristics of 2T0C DRAM unit cells for compute-in-memory (CIM) applications, focusing on the on/off current ratio, coupling effects, and retention time, with respect to the NN (NMOS-NMOS), NP (NMOS-PMOS), PN (PMOS-NMOS), and PP (PMOS-PMOS) device types. We designed 65 nm CMOS-based 2T0C DRAM unit cells using Sentaurus 3D TCAD simulation, while keeping the physical parameters and doping concentrations of the NMOS and PMOS transistors identical to impartially compare their electrical characteristics. As a result, the NP- and PN-type 2T0C DRAM cells exhibited much shorter retention times for data '0' (<0.55 ns) and smaller on/off current ratios (<4.36) than the NN- and PP-type cells, clearly indicating that the NP- and PN-type cells are not favorable for CIM applications. Furthermore, we investigated the cause of the storage node voltage fluctuation immediately after a read pulse using the equivalent RC models of the NN- and PP-type cells. The origin of this fluctuation is attributed to three factors: the coupling effects between the storage node and the read transistor, the drain current in the read transistor, and the subthreshold leakage current in the write transistor.

https://doi.org/10.3390/electronics14234742

## Study of Gate Leakage Current and Failure Mechanism for Schottky-Type p-GaN Gate of GaN HEMTs

**Authors:** Cristina Miccoli, Marcello Cioni, Giacomo Cappellini, Alberto Millefanti, Alessio Pirani, Giansalvo Pizzo, Viviana Fezzi, Maurizio Moschetti, Maria Eloisa Castagna, Ferdinando Iucolano, Giovanni Giorgino and Alessandro Chini

**Abstract:** In this work, a novel understanding of the main failure mechanism of a Schottky p-GaN gate AlGaN/GaN HEMT subject to forward gate stress is reported. First an experimental characterization of the gate leakage current ($I_{GSS}$) at different temperatures is reported. Then, Technology Computer Aided Design (TCAD) simulations are used to reproduce the experimental IGSS thanks to the impact ionization model, also at different temperatures. Simulation results underline how the stressed regions for the Device Under Test (DUT) at high gate biases are the Schottky/p-GaN interface, the p-GaN/AlGaN barrier interface, and p-GaN sidewalls. Moreover, Time Dependent Gate Breakdown (TDGB) measurements were done, and the TEM analysis on the failed device showed the lattice crystal damage located at the p-GaN/AlGaN interface, in accordance with TCAD simulations' current density distribution at high voltage gate stress.

**https://doi.org/10.3390/electronics15081698**

## Space Photovoltaics: Materials, Device Concepts and Operational Challenges

**Authors:** Anna Drabczyk, Paweł Uss, Katarzyna Bucka, Wojciech Bulowski, Patryk Kasza, Grzegorz Putynkowski and Robert P. Socha

**Abstract:** Space photovoltaics remains the primary power source for satellites and spacecraft, where high efficiency, radiation resistance, and low mass are essential requirements. While conventional III–V multijunction solar cells currently represent the technological benchmark, recent advances in materials science and device architectures have significantly expanded the design space of space photovoltaic systems. This review provides a comprehensive overview of the fundamental physical principles, material platforms, and device concepts relevant to photovoltaic operation under space conditions, with particular emphasis on the AM0 spectrum, radiation effects, and thermal cycling. Special attention is devoted to advanced architectures, including inverted metamorphic multijunction solar cells, concentrator photovoltaic systems, and emerging tandem concepts such as perovskite/silicon and all-perovskite devices. The review highlights the growing importance of system-level metrics, particularly specific power and integration flexibility, which increasingly complement efficiency as key performance indicators. Although emerging technologies offer unprecedented opportunities for lightweight and high-efficiency photovoltaic systems, challenges related to long-term stability, defect control, and scalability remain critical for their practical implementation. Overall, the future of space photovoltaics lies in the development of application-specific solutions that balance efficiency, durability, mass, and cost, enabling next-generation space missions and energy systems.

**https://doi.org/10.3390/electronics15101978**

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**Editorial Office**
electronics@mdpi.com

MDPI
Grosspeteranlage 5
4052 Basel, Switzerland
Tel: +41 61 683 77 34
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