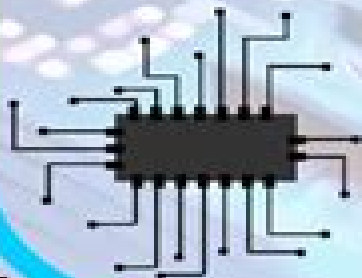


# Radiation effects on semiconductor devices

- Radiation can degrade the performance of semiconductor devices by creating defects within their crystal lattice
- This damage affects charge carrier mobility and can lead to increased leakage current and changed threshold voltages
- Devices most susceptible include CCDs, transistors, and memory cells
- Shielding and careful material selection are common mitigation strategies in radiation-prone environments like space

## Practical example: Electronics

- Radiation can significantly affect the performance of semiconductor devices found in everyday electronics like smartphones and computers
- When semiconductor materials are exposed to radiation, it can alter their electrical properties, leading to disruptions in device operation
- This is particularly critical in environments with high radiation levels, such as space or near nuclear plants, where electronics require special shielding to function reliably
- Understanding radiation effects is crucial for designing durable and stable electronic systems



# Effects Of Radiation On Semiconductors

**O García**

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## Effects Of Radiation On Semiconductors:

*Radiation Effects in Advanced Semiconductor Materials and Devices* C. Claeys, E. Simoen, 2013-11-11 In the modern semiconductor industry there is a growing need to understand and combat potential radiation damage problems Space applications are an obvious case but beyond that today's device and circuit fabrication rely on increasing numbers of processing steps that involve an aggressive environment where inadvertent radiation damage can occur This book is both aimed at post graduate researchers seeking an overview of the field and will also be immensely useful for nuclear and space engineers and even process engineers A background knowledge of semiconductor and device physics is assumed but the basic concepts are all briefly summarized Finally the book outlines the shortcomings of present experimental and modeling techniques and gives an outlook on future developments

*Radiation Effects in Semiconductors* Krzysztof Iniewski, 2018-09-03 Space applications nuclear physics military operations medical imaging and especially electronics modern silicon processing are obvious fields in which radiation damage can have serious consequences i.e. degradation of MOS devices and circuits Zeroing in on vital aspects of this broad and complex topic *Radiation Effects in Semiconductors* addresses the ever growing need for a clear understanding of radiation effects on semiconductor devices and circuits to combat potential damage it can cause Features a chapter authored by renowned radiation authority Lawrence T Clark on Radiation Hardened by Design SRAM Strategies for TID and SEE Mitigation This book analyzes the radiation problem focusing on the most important aspects required for comprehending the degrading effects observed in semiconductor devices circuits and systems when they are irradiated It explores how radiation interacts with solid materials providing a detailed analysis of three ways this occurs Photoelectric effect Compton effect and creation of electron positron pairs The author explains that the probability of these three effects occurring depends on the energy of the incident photon and the atomic number of the target The book also discusses the effects that photons can have on matter in terms of ionization effects and nuclear displacement Written for post graduate researchers semiconductor engineers and nuclear and space engineers with some electronics background this carefully constructed reference explains how ionizing radiation is creating damage in semiconducting devices and circuits and systems and how that damage can be avoided in areas such as military space missions nuclear applications plasma damage and X ray based techniques It features top notch international experts in industry and academia who address emerging detector technologies circuit design techniques new materials and innovative system approaches

*Radiation Effects on Semiconductor Devices* Los Alamos Scientific Laboratory, 1961 *Effects of Radiation on Semiconductors*, Translated by A Tybulewicz, 1965 *Radiation Effects in Semiconductors and Semiconductor Devices* V. S. Vavilov, 2012-12-06 *Effects of Radiation on Semiconductors* Viktor S. Vavilov, 2013-12-14 The effects of electromagnetic radiation and high energy particles on semiconductors can be divided into two main processes a) the excitation of electrons the special case is internal ionization i.e. the generation of excess charge carriers and b) disturbance

of the periodic structure of the crystal i.e the formation of structural radiation defects Naturally investigations of the effects of radiation on semiconductors cannot be considered in isolation Thus for example the problem of radiation defects is part of the general problem of crystal lattice defects and the influence of such defects on the processes occurring in semiconductors The same is true of photoelectric and similar phenomena where the action of the radiation is only the start of a complex chain of nonequilibrium electron processes Nevertheless particularly from the point of view of the experimental physicist the radiation effects discussed in the present book have interesting features several types of radiation may produce the same result for example ionization by photons and by charged particles or one type of radiation may produce several effects ionization and radiation defect formation The aim of the author was to consider the most typical problems The subjects discussed differ widely from one another in the extent to which they have been investigated

**Ionizing Radiation Effects in Electronics** Marta Bagatin, Simone Gerardin, 2018-09-03 Ionizing Radiation Effects in Electronics From Memories to Imagers delivers comprehensive coverage of the effects of ionizing radiation on state of the art semiconductor devices The book also offers valuable insight into modern radiation hardening techniques The text begins by providing important background information on radiation effects their underlying mechanisms and the use of Monte Carlo techniques to simulate radiation transport and the effects of radiation on electronics The book then Explains the effects of radiation on digital commercial devices including microprocessors and volatile and nonvolatile memories static random access memories SRAMs dynamic random access memories DRAMs and Flash memories Examines issues like soft errors total dose and displacement damage together with hardening by design solutions for digital circuits field programmable gate arrays FPGAs and mixed analog circuits Explores the effects of radiation on fiber optics and imager devices such as complementary metal oxide semiconductor CMOS sensors and charge coupled devices CCDs Featuring real world examples case studies extensive references and contributions from leading experts in industry and academia Ionizing Radiation Effects in Electronics From Memories to Imagers is suitable both for newcomers who want to become familiar with radiation effects and for radiation experts who are looking for more advanced material or to make effective use of beam time

**Radiation Effects in Semiconductors and Semiconducting Devices** V. S Vavilov, 1995-12-31 **Radiation Effects in Semiconductors**, 1967

**The Effects of Radiation on Electronic Systems** George Messenger, Milton S. Ash, 1992-05-14 **The Effect of Nuclear Radiation on Semiconductor Devices** F. J. Reid, 1960 Data are presented on investigations of standard silicon and germanium transistors diodes rectifiers and such devices as unipolar transistors Esaki diodes and SiC GaP and selenium rectifiers The data are intended to be sufficiently inclusive to make it valuable as a guide on effects which can be anticipated from nuclear radiation on electronic components utilizing semiconductor devices Author *Integrated Circuit Design for Radiation Environments* Stephen J. Gaul, Nicolaas van Vonno, Steven H. Voldman, Wesley H. Morris, 2019-12-31 A practical guide to the effects of radiation on semiconductor components of electronic systems and techniques for the designing laying

out and testing of hardened integrated circuits This book teaches the fundamentals of radiation environments and their effects on electronic components as well as how to design lay out and test cost effective hardened semiconductor chips not only for today s space systems but for commercial terrestrial applications as well It provides a historical perspective the fundamental science of radiation and the basics of semiconductors as well as radiation induced failure mechanisms in semiconductor chips Integrated Circuits Design for Radiation Environments starts by introducing readers to semiconductors and radiation environments including space atmospheric and terrestrial environments followed by circuit design and layout The book introduces radiation effects phenomena including single event effects total ionizing dose damage and displacement damage and shows how technological solutions can address both phenomena Describes the fundamentals of radiation environments and their effects on electronic components Teaches readers how to design lay out and test cost effective hardened semiconductor chips for space systems and commercial terrestrial applications Covers natural and man made radiation environments space systems and commercial terrestrial applications Provides up to date coverage of state of the art of radiation hardening technology in one concise volume Includes questions and answers for the reader to test their knowledge Integrated Circuits Design for Radiation Environments will appeal to researchers and product developers in the semiconductor space and defense industries as well as electronic engineers in the medical field The book is also helpful for system layout process device reliability applications ESD latchup and circuit design semiconductor engineers along with anyone involved in micro electronics used in harsh environments

**Radiation effects in semiconductors: proceedings,**

**ed** Santa Fe Conference on Radiation Effects in Semiconductors, 1967, Report on Transient Radiation Effects on Electronic Components and Semiconductor Devices D. C. Jones,1963

**Reliability And Radiation Effects In Compound**

**Semiconductors** Allan H Johnston,2010-04-27 This book focuses on reliability and radiation effects in compound semiconductors which have evolved rapidly during the last 15 years It starts with first principles and shows how advances in device design and manufacturing have suppressed many of the older reliability mechanisms It is the first book that comprehensively covers reliability and radiation effects in optoelectronic as well as microelectronic devices It contrasts reliability mechanisms of compound semiconductors with those of silicon based devices and shows that the reliability of many compound semiconductors has improved to the level where they can be used for ten years or more with low failure rates

Radiation Effects and Soft Errors in Integrated Circuits and Electronic Devices Ronald Donald Schrimpf,Dan M.

Fleetwood,2004 This book provides a detailed treatment of radiation effects in electronic devices including effects at the material device and circuit levels The emphasis is on transient effects caused by single ionizing particles single event effects and soft errors and effects produced by the cumulative energy deposited by the radiation total ionizing dose effects Bipolar Si and SiGe metal oxide semiconductor MOS and compound semi conductor technologies are discussed In addition to considering the specific issues associated with high performance devices and technologies the book includes the background

material necessary for understanding radiation effects at a more general level      Radiation Effects in Semiconductor Devices Frank Larin,1968      Radiation Effects in Silicon Carbide A.A. Lebedev,2017 The book reviews the most interesting research concerning the radiation defects formed in 6H 4H and 3C SiC under irradiation with electrons neutrons and some kinds of ions The electrical parameters that make SiC a promising material for applications in modern electronics are discussed in detail Specific features of the crystal structure of SiC are considered It is shown that when wide bandgap semiconductors are studied it is necessary to take into account the temperature dependence of the carrier removal rate which is a standard parameter for determining the radiation hardness of semiconductors The carrier removal rate values obtained by irradiation of various SiC polytypes with n and p type conductivity are analyzed in relation to the type and energy of the irradiating particles The influence exerted by the energy of charged particles on how radiation defects are formed and conductivity is compensated in semiconductors under irradiation is analyzed Furthermore the possibility to produce controlled transformation of silicon carbide polytype is considered The involvement of radiation defects in radiative and nonradiative recombination processes in SiC is analyzed Data are also presented regarding the degradation of particular SiC electronic devices under the influence of radiation and a conclusion is made regarding the radiation resistance of SiC Lastly the radiation hardness of devices based on silicon and silicon carbide are compared      *Effects of Radiation on Semiconductor Materials and Devices* D.K. Wilson,1968      Radiation Effects in Electronics ,1965

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