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Properties of Silicon Semiconductor; 2.1 Structure and Growth of Silicon Crystals; 2.1.1 Imperfections and Defects in Crystals; 2.2 Energy Band Structure and Energy Gap; 2.2.1 Energy Gap Dependence on Temperature and Pressure in Silicon; 2.2.2 Effective Mass; 2.2.2.1 Conductivity and Density-of-States Effective Masses in Silicon; 2.3 Carrier Concentration and Fermi Level; 2.3.1 Effective Density-of-States 2.3.1.1 Degenerate and Non-Degenerate Semiconductors 2.3.1.2 Intrinsic Fermi-Level and Concentration of Carriers; 2.3.2 Donors and Acceptors; 2.3.2.1 Extrinsic Semiconductors and Fermi Level; 2.3.2.2 Compensated Semiconductors; 2.3.2.3 Maximum Temperature of Operation of Extrinsic Semiconductors; 2.3.2.4 Quasi-Fermi Levels; 2.3.3 Largely Doped and Degenerate Semiconductors; 2.3.3.1 Bandgap Narrowing in Heavily Doped Semiconductors; 2.3.3.2 Reduction of the Impurity Ionization-Energy in Heavily Doped Semiconductors; 3. Transport Phenomena in Semiconductors 3.1 Thermal and Drift Motion in Semiconductors 3.1.1 Drift and Mobility; 3.1.1.1 Mobility in Silicon at High Electric Fields or Up to Large Doping Concentrations; 3.1.2 Resistivity; 3.2 Diffusion Mechanism; 3.2.1 Einstein's Relationship; 3.3 Thermal Equilibrium and Excess Carriers in Semiconductors; 3.3.1 Generation, Recombination Processes, and Carrier Lifetimes; 3.3.1.1 Bulk Processes in Direct Semiconductors; 3.3.1.2 Bulk Processes in Indirect Semiconductors; 3.3.1.3 Surface Recombination; 3.3.1.4 Lifetime of Minority Carriers in Silicon; 3.4 The Continuity Equations 3.4.1 The Dielectric Relaxation Time and Debye Length

Sommario/riassunto

This book addresses the fundamental principles of interaction between radiation and matter, the principles of working and the operation of particle detectors based on silicon solid state devices. It covers a broad scope in the fields of application of radiation detectors based on silicon solid state devices from low to high energy physics experiments, including in outer space and in the medical environment. This book also covers state-of-the-art detection techniques in the use of radiation detectors based on silicon solid state devices and their readout electronics, including the latest develo
