

# Semiconductor Physics

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Karlheinz Seeger

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# Semiconductor Physics

An Introduction

Eighth Edition  
With 326 Figures



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# Preface

This book, now in its eighth edition, still has the character of a textbook with the emphasis on “Physics”. I have refrained from sacrificing topics such as the Seebeck, Thomson, Peltier and quantum Hall effects although they do not have a large-scale practical application. The various kinds of field effect transistors such as HBT, HEMT, MODFET and the chip technology have not been considered because going into details would necessarily end up with referring the interested reader to commercially available computer programs, i.e. to the Big Business world.

What is new compared with the previous edition? In Chap. 1 you will now find a short description of production processes of pure single crystal silicon which is nearly free of lattice defects. In Sect. 4.14 the calculation of current in a sample subject to combined dc and high-frequency ac fields is based on quantum mechanics rather than classical physics (called “photon assisted tunneling”). The calculation is applied to charge transport in quantum wires and dots in Chap.14. This chapter includes production methods for quantum dots in their regular arrangement and a dot laser which operates at room temperature. In Chap. 15 there is a new section on doped Fullerenes in view of a field effect transistor based on this material. There are two more appendices: One provides a calculation of the potentials in quantum wells, and the other is a table of 38 semiconductors and semimetals with their characteristic data.

The system of units preferred here is the SI system. If you want to convert e.g. the magnetic field  $B$  to its Gaussian unit you have to divide it by the velocity of light  $c$ . Vectors are typed boldface. A vector product is put in [brackets], a scalar product in (parenthesis). Notation of the form (5.7.7, 8) is used to refer to both equation (5.7.7) and equation (5.7.8) while [5.7] refers to reference 5.7.

A basic prerequisite for the existence of this book is (and always was) the excellent cooperation with Hofrat Dr.Wolfgang Kerber and his crew at the library of the Institute of Physics, University of Vienna, Austria. I am grateful to Prof. Dr. H. Stetter, Technical University of Vienna, for providing help with installing LATEX on my computer and for introducing me to this method of doing the type - setting work, (today’s general request by publishers), and to Prof. Dr. H. Kühnelt for providing very helpful computer programs. Dr. Hubertus von Riedesel, managing editor at Springer - Verlag, Heidelberg, and his assistant Dr. Angela Lahee deserve my heartfelt thanks for their cooperation. Last but not least my wife suffered from my occasional mental absences during this period of both writing and taming an unwilling computer, with remarkable good humour and I would like to express my appreciation for her support.

Vienna, 2002

K.S.

To Instructors who have adopted the text for classroom use, a solutions manual is available free of charge by request on departmental letterhead to Dr. A. Lahee, Springer-Verlag, Tiergartenstr. 17, 69121 Heidelberg, Germany.

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