

Karl Goser · Peter Glösekötter · Jan Dienstuhl

Nanoelectronics and Nanosystems

Springer-Verlag Berlin Heidelberg GmbH



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Nanoelectronics and Nanosystems

From Transistors to Molecular and Quantum Devices

With 254 Figures



Springer

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Cataloging-in-Publication Data applied for
Bibliographic information published by Die Deutsche Bibliothek
Die Deutsche Bibliothek lists this publication in the Deutsche Nationalbibliografie;
detailed bibliographic data is available in the Internet at <<http://dnb.dd.de>>

ISBN 978-3-540-40443-9 ISBN 978-3-662-05421-5 (eBook)
DOI 10.1007/978-3-662-05421-5

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Originally published by Springer-Verlag Berlin Heidelberg New York in 2004

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Typesetting: Digital data supplied by authors
Cover-Design: Design & Production, Heidelberg
Printed on acid-free paper 62/3020 Rw 5 4 3 2 1 0

Preface

In recent years nanoelectronics has been rapidly gaining in importance and is already on the way to continuing the outstanding success of microelectronics. While most literature dealing with nanoelectronics is concerned with technology and devices, it has been nearly impossible to find anything about the circuit and system level. The challenges of nanoelectronics, however, are evident not only in the manufacture of tiny structures and sophisticated nanodevices, but also in the development of innovative system architectures that will have to orchestrate billions of devices inside future gadgets. This book's objective is to bridge that gap.

The topic of this book has actually been offered as a student's lecture at the University of Dortmund. Since the lecture has been held at the faculty of engineering, the main focus lies on electronics and on the basic principles of the essential physical phenomena.

This book represents an introduction to nanoelectronics, as well as giving an overview of several different technologies and covering all aspects from technology to system design. On the system level, various architectures are presented and important system features - namely scalability, processing power and reliability - are discussed. A variety of different technologies are presented which include molecular, quantum electronic, resonant tunnelling, single-electron and superconducting devices and even devices for DNA and quantum computing. Additionally, the book encompasses a comparison between nanoelectronics and the present state of silicon technologies, a discussion of the nanoelectronic limits, and a vision of future nanosystems in terms of information technologies.

This book is intended for those people who have not lost sight of the system as a whole. It not only covers nano-technology and its devices, but also considers the system and circuit level perspective, indicating the applications and conceivable products. The overview is written for electronic engineers, computer scientists, marketing people and physicists, and offers an initial orientation for students, beginners and outsiders alike.

Several EU projects and various EU initiatives form the scientific basis for the current research activities in the fields of nanoelectronics. We would therefore like to thank the co-ordinator in Brussels, Romano Compano, for his helpful undertakings. In addition we would like to thank our partners at Infineon Research Laboratory in Munich for our many fruitful discussions. Thanks are also due to the Deutsche Forschungsgemeinschaft, especially for the support of the Collaborative Research Center 531, which deals with the design and management of complex technical processes and systems by means of Computational Intelligence methods.

We also thank the assistants and colleagues who coached the lecture: C. Burwick, A. Kanstein, G. Wirth, M. Rossmann and C. Pacha. Thanks are also due to the assistants who drew the diagrams: T. Kliem, G. Sapsford, K. Möschke, B. Rückstein. Last, but not least, thanks go to Karin Goser who corrected the German and English versions.

Dortmund,
July 2003

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