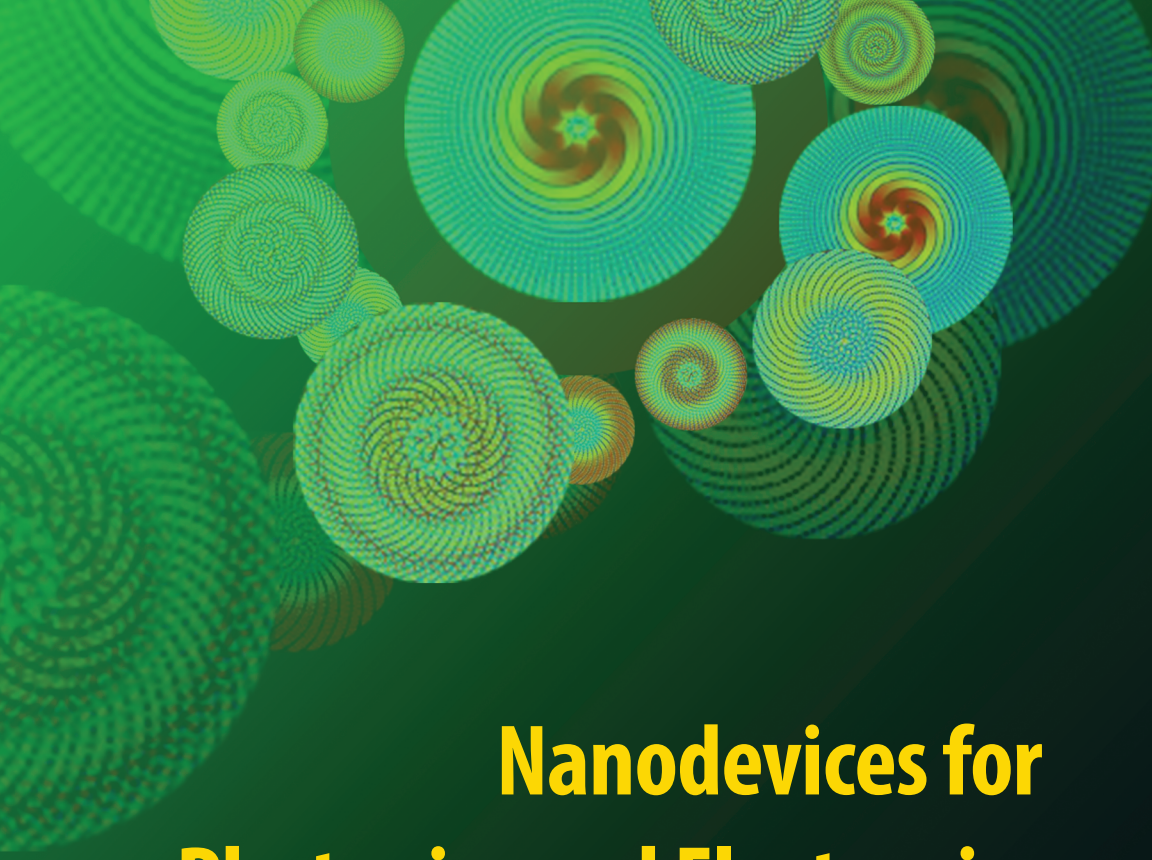

Nanodevices for Photonics and Electronics

Advances and Applications

edited by

Paolo Bettotti

Nanodevices for Photonics and Electronics

Nanodevices for Photonics and Electronics

Advances and Applications

edited by

Paolo Bettotti

PAN STANFORD PUBLISHING

Published by

Pan Stanford Publishing Pte. Ltd.
Penthouse Level, Suntec Tower 3
8 Temasek Boulevard
Singapore 038988

Email: editorial@panstanford.com
Web: www.panstanford.com

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

Nanodevices for Photonics and Electronics: Advances and Applications

ISBN 978-981-4613-74-3 (Hardcover)
ISBN 978-981-4613-75-0 (eBook)

Printed in the USA

Contents

Preface

The mastering of matter at the nanoscale level has enabled a completely new paradigm of scientific development. The possibility to tailor a material's properties by mastering its structure at the near-molecular level has greatly improved the overall quality of synthesized materials. Nowadays the link between the properties of a material and its structure is not only a way to describe the material's behavior but also a powerful tool to design improved and innovative devices.

Electronics has heavily exploited this knowledge to push the level of integration near the physical limit. But in the last two decades photonics has also shown a fast evolution toward miniaturized systems. It is reasonable to assume the two fields will somehow fuse together in the near future and will complement each other to overcome their own limits.

The field of nanostructured devices for photonics and electronics is extremely broad and it cannot be reviewed within a single monograph; thus this book addresses specific topics of particular relevance for their scientific novelty and for their importance in future technological development.

Chapters 2 to 4 describe the properties of photonic systems as they move from perfectly periodic systems (as in the case of photonic crystals in Chapter 2) toward aperiodic systems (as for the bioinspired aperiodic spirals in Chapter 3) and, ultimately, toward purely random systems described in Chapter 4. Each chapter contains an introductory part describing the main physics behind each topic, as well as applications of the photonic systems. Chapter 5 covers the topic of detectors for the terahertz (THz) region: this spectral range has a number of possible uses but it lacks both compact sources and detectors. The use of nanowires

to develop THz detectors is described here. Chapter 6 deals with the topic of optomechanics and demonstrates how optical and mechanical modes can exchange energy. In fact at the nanoscale the frequency of mechanical modes approaches the gigahertz and can be effectively coupled with optical modes. Nanodots are among the most investigated nanostructures and their peculiar properties are reviewed in Chapter 7, together with applications in optoelectronics and photonics. The lack of an efficient silicon-based light source has forced the development of hybrid integration of III–V materials in silicon photonics: this is the topic reviewed in Chapter 8. Chapter 9 describes one of most investigated photonics research area: optical biosensing using microresonators. Finally Chapter 10 describes some recent advances in the development of transistors based on organic semiconductors.

Writing a monograph treating such different types of correlated topics would be hardly realized by a single person: I am grateful to all the researchers who accepted the invitation to contribute to this monograph.

Paolo Bettotti
Povo