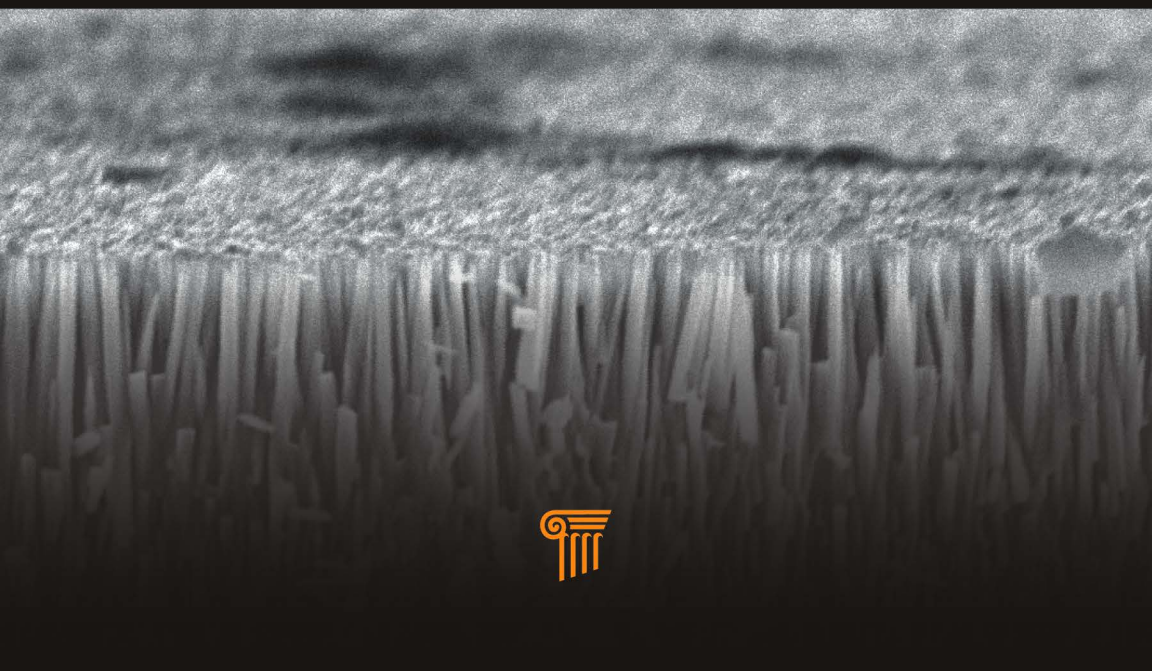


ZnO Nanostructures and Their Applications

Xiao Wei Sun and Yi Yang





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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.

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ISBN 978-981-4267-46-5 (Hardcover)

ISBN 978-981-4303-91-0 (eBook)

Printed in the USA

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Preface

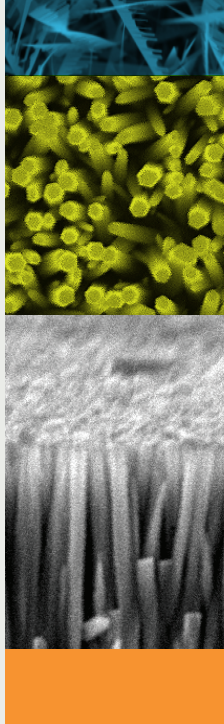
One-dimensional zinc oxide (ZnO) nanostructures have attracted wide research interest in the last ten years, because of their unique physical properties and potential device applications. ZnO is a wide-bandgap semiconductor with an unusually large exciton binding energy. The growth of ZnO has been widely explored over the years, and various nanostructures are already available commercially. As for the applications, research worldwide has demonstrated various new applications such as field emitters, light-emitting diodes, chemical sensors, biosensors, and solar cell. Our research group at Nanyang Technological University, Singapore, and Tianjin University, China, has conducted intensive research since 2002 with a focus on devices and published over 140 peer-reviewed papers in this dynamic field in international journals. Our publications in this area also received over 3000 citations. This book provides a comprehensive and coherent review about the development of one-dimensional ZnO-based applications directly derived from our research. The book is organized as follows: Chapter 1 reviews basic physical properties of ZnO. Chapter 2 reviews the prominent photoluminescence properties of ZnO nanowire, such as radiative lifetime and surface-related emissions. Chapter 3 reviews excitonic lasing emission from ZnO nanostructures. Device applications in homojunction light-emitting diodes, field emissions, electronic display, gas detection, biochemical detection, solar cell, and transistors are summarized in Chapters 4–10, respectively, and the performance of our nanostructure-based devices has been evaluated. Finally Chapter 11 concludes the book with outlook and highlights in this research area.

We would like to thank those PhD students and post-doctoral fellows who have contributed to the works we described in this book, and without whom the book would not have been possible. They are Dr. Chunxiang Xu, Dr. Ang Wei, Dr. Jianxiong Wang, Dr. Changyun Jiang, Dr. Junliang Zhao, Dr. Swee Tiam Tan, Miss Bo Ling, Mr. Ko Ko

Kyaw Aung, Miss Jing Chen, Dr. Chen Li, and Mr. Chi Li. We would also like to thank Prof. Wei Lei from Southeast University for some collaborative works on field emissions, Dr. Xinhai Zhang and Dr. Lin Ke from Institute of Materials Research and Engineering for some optical characterizations; Prof. Jian Xu from Penn State University for some collaborative works on characterizing lasing properties; and Profs. Ting Yu and Ze Xiang Shen from Nanyang Technological University for some collaborations in making nanowire transistors.

Xiao Wei Sun

Yi Yang



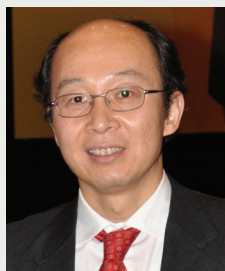
"This is a concise, well-written, and well-illustrated book on the fundamentals and the latest development of the technological applications of ZnO nanostructures. It is based on the authors' excellent work as well as over 450 major literature references. The book is a must-read for students and researchers involved in photovoltaics, (opto)nanoelectronics, and sensing devices."

Dr Lionel Vayssieres

National Institute for Materials Science, Japan

As a multifunctional oxide semiconductor, ZnO has attracted substantial interest for a wide range of applications, including transparent conductors, UV light-emitting diodes (LEDs) and laser diodes, chemical and biochemical sensing, field-emitting devices, dye-sensitized solar cells, and host for diluted magnetic semiconductor. On the other hand, nanostructures made of various materials, including ZnO, such as nanowires, nanobelts, and nanoribbons, are an emerging class of one-dimensional and quasi-one-dimensional materials that have been extensively studied as fundamental building blocks for nanoscale science and technology.

This book focuses on the various functional properties and potential applications of one-dimensional ZnO nanostructures, from basic principles to the most recent discoveries. It comprises the experimental analysis of various properties of ZnO nanostructures, as well as their preparation techniques, research methods, and some promising applications. The areas of focus include ZnO-based gas/biochemical sensing devices, field emitters, solar cells, light-emitting diodes, e-papers, and single-nanowire-based transistors.



Xiao Wei Sun received his BEng, MEng, and PhD, all in photonics, from Tianjin University, China (1986–1994), and his second PhD in electrical and electronic engineering from the Hong Kong University of Science and Technology (1994–1998). In 1998, he joined the Division of Microelectronics at the School of Electrical and Electronic Engineering of Nanyang Technological University as an assistant professor and was promoted as an associate professor in October 2005. In 2010, he was invited to serve as the Dean of College of Science, Tianjin University. Prof. Sun has (co-)authored more than 250 peer-reviewed journal publications in the area of photonics and microelectronics, with more than 4,500 citations. He is a Fellow of the Society for Information Display, SPIE, and Institute of Physics (UK). He is also the founder and director of SID Singapore and Malaysia Chapter and was awarded the Nanyang Award for Research and Innovation 2009 for his research in ZnO nanodevices.



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V122
ISBN-13 978-981-4267-46-5



9 789814 267465