

catalysts, nanostructured carbon materials, and doped nanostructured materials. Chapters 7 and 8 give interesting examples of the chemical reactions on the surface of nanostructured carbon material supported catalysts, such as heterogeneous and photocatalytic reactions. Chapter 9 introduces applications of carbon nanostructured materials for energy conversion and storage such as its applications in fuel cells, solar cells, super capacitors, and lithium batteries. The authors end the book with an interesting chapter regarding

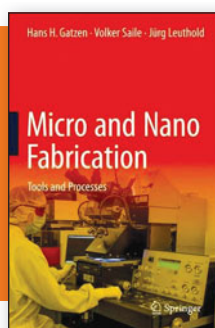
the use of carbon nanomaterials on the industrial scale as in micro- and large-scale reactors and environmental and safety considerations, such as short-term inhalation, cytotoxicity, bioactivity, and possible enzymatic degradation of nanostructured materials. The authors support the textbook with recent and up-to-date references and useful figures.

In conclusion, the authors have succeeded in explaining the fundamentals of different types of carbon nanomaterials and their properties and applications

in the field of surface chemistry and catalysis. This approach will make the book useful for many years.

I can recommend without hesitation this book to all who are interested in nanomaterials, and particularly to those entering the fields of surface chemistry and catalysis. It is written at a level appropriate to someone with a chemistry, molecular structure, and materials background.

Reviewer: Walid M. Daoush of Helwan University, Egypt.



Micro and Nano Fabrication: Tools and Processes

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Springer, 2015

519 pages, \$99.00 (e-book \$69.99)

ISBN 978-3-662-44394-1

Used to make pressure sensors, microphones, accelerometers, and gyroscopes, microelectromechanical systems (MEMS) reached a global market of USD\$12 billion in 2014, with an expected growth of 20% in the next four years. Future MEMS challenges will be strong price reduction coupled to system size shrinkage, thus the field heads toward the development of nanoelectromechanical (NEMS) systems. With these characteristics, it is easy to understand why MEMS are currently one of the most exciting topics on which to learn.

Current MEMS fabrication technologies rely on somewhat standard semiconductor device processing, although new technological prospects are envisaged to overcome the current limitations. This book is designed to give an overview of all these technologies.

The first chapter is a historical background of these systems taking a broad look at some of the milestones that have contributed to the development of MEMS as we know them today. The second chapter, after an overview on gas properties and gas-flow basics, reviews

several vacuum systems presently used and issues related to vacuum measurements and leak detection. Chapter 3 is dedicated to deposition technologies, such as physical and chemical vapor deposition, thermal and plasma-based, and hybrid processes. Alternative cost-effective methods from liquid and sol-gel phases are also treated. The fourth chapter is a compact exposition of the etching methods required to define the structures inside the devices, basically divided into wet and dry processes. Chapter 5 deals with the doping of silicon, the main material discussed in the book, explaining the different approaches used so far, such as solid, liquid, and gas sources, together with the theoretical background on atomic diffusion. As highlighted by the authors, doping is used in MEMS on a smaller scale than in the semiconductor industry. A paragraph on thermal oxidation as a protection from contamination is also inserted. Lithography is the subject of chapter 6, covering the standard optical technology to the most innovative and spatially resolved techniques. Techniques used to fabricate high-aspect-ratio

structures based on lithography are discussed in chapter 8. Innovative approaches for nanolithography based on self-assembling mechanisms are reviewed in chapter 9. Planarization, wafer bonding, and contaminant reduction are presented as enabling technologies, while an example of MEMS fabrication is described in the last chapter.

The book is clearly written and easy to read. The various topics are balanced and well organized. For each of the approaches, the technology is presented together with the theoretical background. The numerous figures and schematics are the most useful tools of the book. At the end of each chapter, a list of exercises is offered. The references are adequate. It is useful to students and newcomers, but also experts may find it a good reference because there are some useful aspects not easily found in other books, such as the leak detection in the vacuum technology chapter, the liquid-phase deposition in the third chapter, photoresist and ink characteristics explained in the lithography chapter, and equipment and consumables suggested for the planarization processes. Even if the reader does not plan to work on this topic, the book offers a good opportunity to go through the basic semiconductor fabrication technologies.

Reviewer: Rosaria A. Puglisi of the Institute for Microelectronics and Microsystems, National Research Council, Italy.