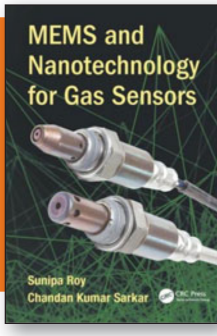


MEMS and Nanotechnology for Gas Sensors

Sunipa Roy and Chandan Kumar Sarkar

CRC Press, 2015
242 pages, \$103.96 (e-book \$90.97)
ISBN 9781498700122

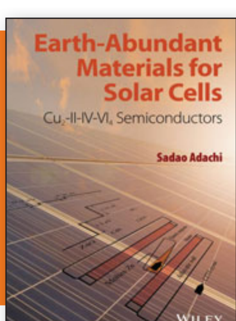
Basic concepts of microfabrication technology and nanocrystalline metal oxide-based gas sensors are discussed in detail in the 12 chapters of this book. It is written for research-level students in various disciplines such as physics, materials science, chemistry, and mechanical engineering.

Chapter 1 starts with a detailed introduction to clean room technology and concepts. A brief history with an introduction to microelectromechanical systems (MEMS) and materials used in MEMS is discussed with appropriate illustrations. Chapter 2 covers various substrates (Si, Ge, GaAs) used for MEMS. The effects of surface contaminants as well as various cleaning and etching (e.g., wet and dry etching) processes are discussed in detail. Chapter 3 discusses various physical (thermal evaporation, sputtering, molecular epitaxy) and chemical vapor (plasma-enhanced CVD) deposition methods with diagrams showing appropriate experimental setups. Different metallization processes are discussed briefly. Chapter 4 covers properties of photoresists and their different types, along with various photolithographic processes.

Chapter 5 starts with a brief introduction to micromachining for gas sensors and talks about bulk and surface micromachining. Illustrations explaining the etching process and patterns are very useful. Chapter 6 discusses microheaters for gas sensors: types, properties, and needs. Software used and the physical properties affecting the heater properties are also discussed, accompanied by models and equations. Chapter 7 is an introduction to semiconductor gas sensors, their fundamentals, and their classification with working principles and variable parameters. Different types of gas sensors such as resistive-type and metal oxide-type are briefly discussed. Thick and thin films and various growth processes employed for gas-sensor fabrication are discussed in detail. Chapter 8 talks about graphene, including its different physical, chemical, and mechanical properties. Growth and characterization of graphene and its application for gas sensors are well discussed. The high-quality scanning electron microscope and transmission electron microscope images are very useful. Chapter 9 covers nanocrystalline ZnO-based microfabricated gas sensors. ZnO-based device structures and different growth mechanisms at low and high temperatures are discussed in detail. Chapter 10 briefly discusses volatile organic compounds, their different nanostructures, and their fabrication processes. Chapter 11 explains signal processing and different interfacing techniques along with appropriate flow diagrams. Chapter 12 talks briefly about the applications of MEMS and nanotechnology. References at the end of each chapter are relevant and include recent works.

It would have been helpful if the authors had included some problems and solutions in each chapter in order to make the book more useful to students. However, this book is an outstanding, broad overview of basics, concepts, specific materials used for each sensing application, and techniques employed in current, emerging, and possible future MEMS applications. I strongly recommend this book to all research students interested in MEMS and gas sensors.

Reviewer: K. Kamala Bharathi *of the National Institute of Standards and Technology/University of Maryland, USA.*



Earth-Abundant Materials for Solar Cells: Cu_2-II-IV-VI_4 Semiconductors

Sadao Adachi

Wiley, 2015
528 pages, \$185.00 (e-book \$148.99)
ISBN 978-1-119-05277-7

The worldwide demand for energy may rise to 30 terawatts by 2050. To meet this demand, solar energy can contribute substantially: 120,000 terawatts come from the sun at any given time. However, materials must be developed that can efficiently convert solar radiation to electricity, are available in large quantities, inexpensive, and safe to handle. Current technology is based on silicon, which has a solar conversion efficiency of 25%, but processing it is expensive because (1) it requires high temperatures and (2) the material has to be thick to absorb light due to the small absorption coefficients. Alternative materials—gallium arsenide, cadmium telluride, and copper indium gallium selenide—contain elements that are much less abundant in the earth's crust than silicon, which is the second most abundant element and constitutes 28% of the earth's crust. Hence research on safer materials prepared from cheaper and more easily available materials such as perovskites and dye-sensitized solar cells is gaining importance.

This book focuses on inorganic semiconductors made of nontoxic and abundant materials. They contain copper and

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