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"Nanofabrication and its Application in Renewable Energy"

Edited by Gang Zhang (Peking University, P.R. China) and Navin Manjooran (Siemens AG, USA), RSC Nanoscience & Nanotechnology Series, No. 32, Royal Society of Chemistry, Cambridge, UK, 2014, 290 pages, ISBN: 978-1-84973-640-4, £145.00, US$240.00

Reviewed by Greg Agar
Johnson Matthey Gold and Silver Refining Inc,
4601 West 2100 South, Salt Lake City, Utah, 84120, USA

Email: greg.agar@matthey.com

Introduction

"Nanofabrication and its Application in Renewable Energy" offers a broad overview of current nanoparticle technologies available for renewable energy. This particular title is the latest in a 32 title series that emphasises nanotechnology and offers details of graphene fabrication, photovoltaics, thermoelectric materials and energy storage systems. Researchers, specialists and graduate students appear to be the desired audience based on the level of technical detail in the book. The editors Gang Zhang and Navin Manjooran are both highly decorated in their respective fields. Zhang received both his Bachelor of Science degree and PhD in physics from the world renowned Tsinghua University, China. During his career Zhang has authored and co-authored more than 100 articles. Manjooran has 11 patents/disclosures, 5 books and 37 publications; Manjooran is also a member of the US Technology Advisory Board.

This selective review focuses on two chapters of particular interest, namely microelectromechanical systems (MEMS) and energy storage.

Microelectromechanical Systems

Energy capture and storage is paramount to many industries with various applications such as mobile electronics and biomedical devices. The research authors Bin Yang and Jingquan Liu (Shanghai Jiao Tong University, China) discuss MEMS in detail in Chapter 3 "Micro/nano Fabrication Technologies for Vibration-Based Energy Harvester". MEMS utilise electrodes as variable capacitors in two primary formats, i.e. comb finger electrodes and parallel-plate electrodes, which are clearly defined by the authors. These two types are then split into three sub-categories: in-plane overlap varying, in-plane gap closing and out-of-plane gap closing (**Figure 1**). The authors further explain the functionality and features of each type. The application of such machines to biomedical and electrical engineering is promising, medical implants and all electronic devices could benefit from applications of this technology. Prior biomedical devices often required an external power source making them difficult to implant. The advantage of the energy harvesters is continuous power from an internal power supply which can be steadily charged by simple vibration thereby eliminating the need for external batteries.

Chapter 3 stays true to its title and clearly explains several techniques in nanofabrication. Techniques such as photolithography, deep reactive-ion etching (DRIE), sol-gel, aerosol deposition and bulk bonding processes are explained, although the explanations are limited to an overview of each technique and omit the exact details of the procedures. The reader will need to look elsewhere for such details and ample references are provided.

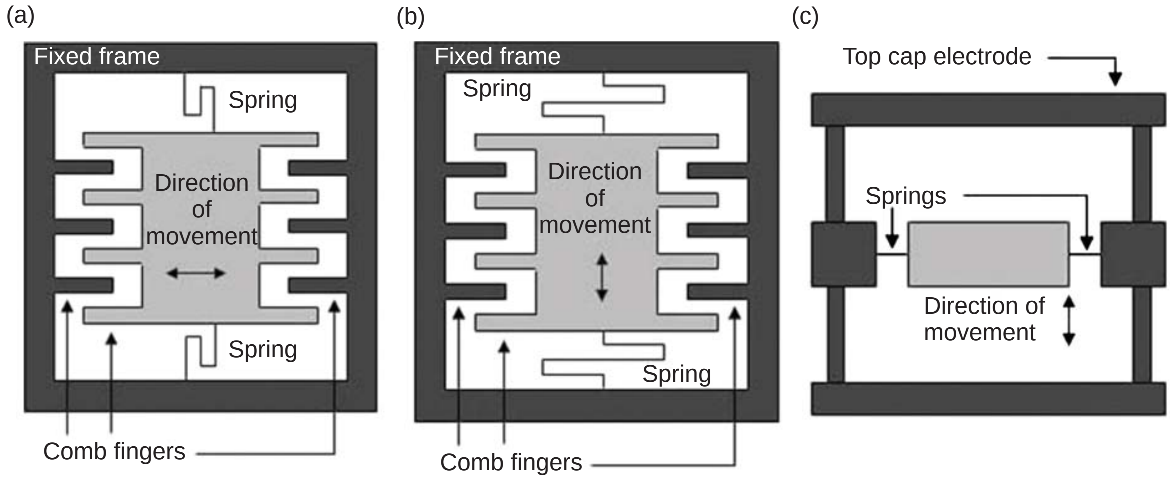


Fig. 1. Three types of electrostatic energy harvester: (a) in-plane overlap varying; (b) in-plane gap closing; (c) out-of-plane gap closing (Reproduced by permission of The Royal Society of Chemistry)

Energy Storage

Challenges in energy production and its subsequent storage threaten the overall sustainability of some energy sources such as fossil fuels, coal, solar and hydrogen. In Chapter 5 "Nanotubes for Energy Storage" research author Hui Pan (University of Macau, China) outlines concerns and explains possible solutions to difficulties that current energy storage technologies face (**Figure 2**)

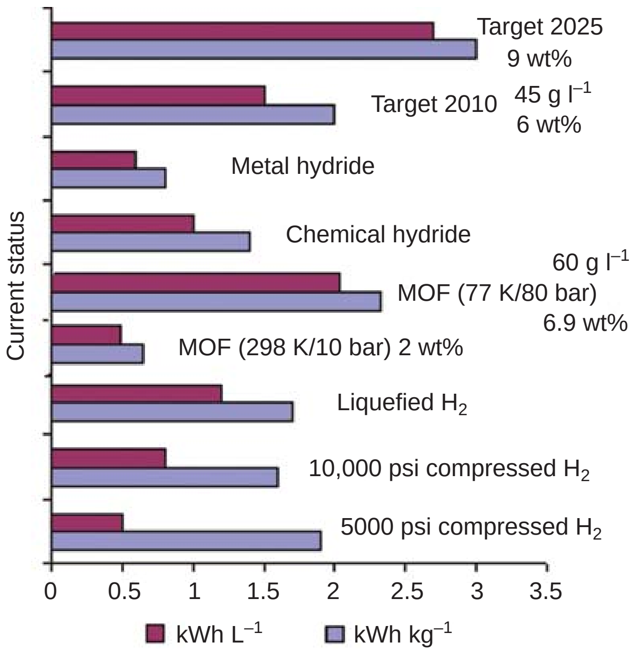


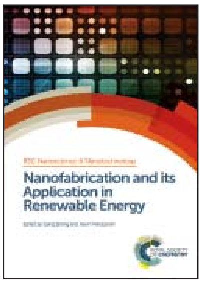
Fig. 2. The current status of today's hydrogen storage technologies in volumetric and gravimetric terms (Reproduced by permission of The Royal Society of Chemistry)

and how innovation in the field of nanotechnology may be able to rectify the situation. The role of nanomaterials in supercapacitors and lithium battery energy storage systems is also discussed.

Storage of hydrogen by nanomaterials is explained in great detail but it is made quite apparent that a significant amount of variability exists within current technologies. The chapter covers topics such as carbon nanotubes, functionalised/doped carbon nanotubes, inorganic nanotubes, boron nanotubes, silicon carbide nanotubes, tungsten nanotubes and graphite nanotubes. The chapter also discusses the functionality and design of each nanotube type as well as their applications in energy. The amount of information provided in Chapter 5 is substantial and markedly useful in selecting nanotube types for a particular research application.

Conclusion

"Nanofabrication and its Application in Renewable Energy" is a useful introduction for a reader relatively new to the topic. The scope of the title gives the reader a fair idea of how new technologies can be applied and what their current state is. I would highly recommend the title to graduate students and new researchers. There is a high level of technical detail but the simple presentation makes it accessible to both researchers and students alike.



"Nanofabrication and its Application in Renewable Energy"

The Reviewer

Greg Agar is currently a graduate student at the Department of Physics, University of Utah, USA, and a refinery supervisor for Johnson Matthey Gold and Silver, Salt Lake City, USA. His research interests include nanomedicine and nanosensors.