

Application of Microsystems Technology in the Fabrication of Thermoelectric Micro-Converters

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1. Introduction

The use of thin-film deposition techniques with microsystems technologies renewed the interest in the thermoelectricity in the last years. Integration of efficient solid-state thermoelectric (TE) microdevices with microelectronics is desirable for local cooling and, since they can be used to stabilise the temperature of devices, decrease noise levels and increase operation speed. Their use in thermoelectric microgeneration (energy harvesting) can also supply energy to low power consumption electronic devices. In this chapter, the fabrication of thermoelectric microconverters is compared, both on materials from thin-film composites to superlattice structures, and on its fabrication techniques.

Various materials can be used for this type of converters. However, for room temperature application, Bi/Sb/Te compounds are still the most efficient thermoelectric materials. Recently, efforts were made to apply quantum confinement to thermoelectric materials, and the results are thin-film superlattice structures and nanowires and even more recently, bulk nanocomposites. Some of these materials proved the ability to double efficiency of current thermoelectric devices. Several deposition techniques can be used for the fabrication of Bi/Sb/Te thin-films: co-sputtering, electrochemical deposition, metal-organic chemical vapor deposition or flash evaporation are some examples compared here.

The patterning process must use photolithography techniques to create the small dimensions of these devices. Despite these techniques are commonly used in microelectronic devices, mainly with silicon based substrates, its application in other thermoelectric alloys is still under development.

The patterning of thermoelectric structures for the fabrication of thermoelectric microconverters can be done using common microsystems technologies. Techniques used in MEMS fabrication, namely wet-etching, lift-off (with SU-8 photoresist), Reactive Ion Etching (RIE) and Lithography-Electroplating-Molding (LEIGA) are here compared for the fabrication of thermoelectric microsystems.

2. Theory behind thermoelectric devices

There are two groups of applications for thermoelectric materials based on Seebeck and Peltier effects respectively. In the Seebeck effect, a temperature difference between the junctions of two different materials produces an electric voltage (figure 1), and an electric

Source: Solid State Circuits Technologies, Book edited by: Jacobus W. Searl,
 ISBN 978-953-307-045-2, pp. 462, January 2010, INTECH, Croatia, downloaded from SCIYO.COM

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An Introduction

Yih-Fang Huang



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Microsystems Technology for Multimedia Applications Bing Jay Sheu, 1995 Current interest in NAD Nicotinamide adenine dinucleotide in biological systems focuses on its role in ADP ribose transfer reactions These appear to be fundamentally involved in the regulation of many physiological processes The contributions in this monograph thus represent the range of research in the very active investigation of niacin metabolism The major topics covered are Enzymology of ADP Ribosylation ADP Ribosylation and Chromatin Function Carcinogenesis and Differentiation NAD Metabolism and Chemotherapy ADP Ribosylation and Signal Transduction Molecular Genetic Approaches to *Electrochemical Technology* Tetsuya Osaka, 1997-10-29 The electronics industry underwent a rapid evolution from thick to thin films during the last decade Electrochemical technology played an important and often decisive role in the direction of this evolution Applications include plating through mask technology plating for thin film heads plating for high density magnetic thin film selective etching technology etc New electrochemical approaches have also been developed which will play key roles in the electronics industry This book reports on the latest progress in electrochemical processes including fundamentals and applications Additional volumes dealing with more specific applications of electrochemistry are also planned *Proceedings*, 1998

Emerging Multimedia Computer Communication Technologies Chwan-Hwa Wu, J. David Irwin, 1998 The most complete reference covering every type of emerging technology in multimedia computer communications *Proceedings of the IECON...International Conference on Industrial Electronics, Control, and Instrumentation*, 1997 [Whitaker's Books in Print](#), 1998

Silicon Carbide Microsystems for Harsh Environments Muthu Wijesundara, Robert Azevedo, 2011-05-17 Silicon Carbide Microsystems for Harsh Environments reviews state of the art Silicon Carbide SiC technologies that when combined create microsystems capable of surviving in harsh environments technological readiness of the system components key issues when integrating these components into systems and other hurdles in harsh environment operation The authors use the SiC technology platform suite the model platform for developing harsh environment microsystems and then detail the current status of the specific individual technologies electronics MEMS packaging Additionally methods towards system level integration of components and key challenges are evaluated and discussed based on the current state of SiC materials processing and device technology Issues such as temperature mismatch process compatibility and temperature stability of individual components and how these issues manifest when building the system receive thorough investigation The material covered not only reviews the state of the art MEMS devices provides a framework for the joining of electronics and MEMS along with packaging into usable harsh environment ready sensor modules *Microelectronics Education* B. Courtois, N. Guillemot, G. Kamarinos, G. Stéhelin, 2013-03-09 This is the third edition of the European Workshop on Microelectronics Education EWME A steady state regime has now been reached An international community of university teachers is constituted they exchange their experience and their pedagogical tools They discuss the best ways to transfer the rapidly

changing techniques to their students and to introduce them to the new physical and mathematical concepts and models for the innovative techniques devices circuits and design methods The number of abstracts submitted to EWME 2000 about one hundred enabled the scientific committee to proceed to a clear selection EWME is a European meeting Indeed authors from 20 different European countries contribute to this volume Nevertheless the participation of authors from Brazil Canada China New Zealand and USA shows that the workshop gradually attains an international dimension th The 20 century can be characterized as the century of electron The electron as an elementary particle was discovered by J J Thomson in 1897 and was rapidly used to transfer energy and information Thanks to electron universe and micro cosmos could be explored Electron became the omnipotent and omnipresent almost immaterial angel of our W orld This was made possible thanks to electronics and for the last 30 years to microelectronics Microelectronics not only modified and even radically transformed the industrial and the every day landscapes but it also led to the so called information revolution with which begins the 21 st century

Microsystem Technology and Microrobotics Sergej Fatikow,Ulrich Rembold,2013-04-17 Microsystem technology MST integrates very small up to a few nanometers mechanical electronic optical and other components on a substrate to construct functional devices These devices are used as intelligent sensors actuators and controllers for medical automotive household and many other purposes This book is a basic introduction to MST for students engineers and scientists It is the first of its kind to cover MST in its entirety It gives a comprehensive treatment of all important parts of MST such as microfabrication technologies microactuators microsensors development and testing of microsystems and information processing in microsystems It surveys products built to date and experimental products and gives a comprehensive view of all developments leading to MST devices and robots

QoS Guarantees in Wireless/mobile Networks Sunghyun Choi,1999

Proceedings of the ... International Symposium on Microelectronics ,2000 1995

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Sensors in Household Appliances Guido Tschulena,Andreas Lahrmann,2006-03-06 Taken as a whole this series covers all major fields of application for commercial sensors as well as their manufacturing techniques and major types As such the series does not treat bulk sensors but rather places strong emphasis on microsensors microsystems and integrated electronic sensor packages Each of the individual volumes is tailored to the needs and queries of readers from the relevant branch of industry A competent and comprehensive survey of current and future sensors applied in electronic household devices Engineers and scientists will find here reports of an increase in product safety efficiency and consumer comfort coupled with a decrease in power consumption and water wastewater The book also looks at the customer appeal of advanced intelligent appliances showing the heightened need for comprehensive information on their potentials and limitations

Low-Voltage/Low-Power Integrated Circuits and Systems Edgar Sánchez-Sinencio,Andreas G. Andreou,1999-01-13 Electrical Engineering Low Voltage Low Power Integrated Circuits and Systems Low Voltage Mixed Signal Circuits Leading experts in the field present this collection of original contributions as a

practical approach to low power analog and digital circuit theory and design illustrated with important applications and examples Low Voltage Low Power Integrated Circuits and Systems features comprehensive coverage of the latest techniques for the design modeling and characterization of low power analog and digital circuits Low Voltage Low Power Integrated Circuits and Systems will help you improve your understanding of the trade offs between analog and digital circuits and systems It is an invaluable resource for enhancing your designs This book is intended for senior and graduate students It is also intended as a key reference for designers in the semiconductor and communication industries Highlighted applications include Low voltage analog filters Low power multiplierless YUV to RGB based on human vision perception Micropower systems for implantable defibrillators and pacemakers Neuromorphic systems Low power design in telecom circuits

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