

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

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Microsystems Technology For Multimedia Applications An Introduction

**Wolfgang Tölle, Jason Yasner, Michael
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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 Smart Adaptive Systems on Silicon Maurizio Valle, 2004-10-18 Intelligent smart systems have become common practice in many engineering applications On the other hand current low cost standard CMOS technology and future foreseeable developments makes available enormous potentialities The next breakthrough will be the design and development of smart adaptive systems on silicon i e very power and highly size efficient complete systems i e sensing computing and actuating actions with intelligence on board on a single silicon die Smart adaptive systems on silicon will be able to adapt autonomously to the changing environment and will be able to implement intelligent behaviour and both perceptual and cognitive tasks At last they will communicate through wireless channels they will be battery supplied or remote powered via inductive coupling and they will be ubiquitous in our every day life Although many books deal with research and engineering topics i e algorithms technology implementations etc few of them try to bridge the gap between them and to address the issues related to feasibility reliability and applications Smart Adaptive Systems on Silicon though not exhaustive tries to fill this gap and to give answers mainly to the feasibility and reliability issues Smart Adaptive Systems on Silicon mainly focuses on the analog and mixed mode implementation on silicon because this approach is amenable of achieving impressive energy and size efficiency Moreover analog systems can be more easily interfaced with sensing and actuating devices **Neuromorphic Systems** Leslie S. Smith, Alister Hamilton, 1998 Neuromorphic systems are implementations in silicon of sensory and neural systems whose architecture and design are based on neurobiology This growing area proffers exciting possibilities such as sensory systems that can compete with human senses and pattern recognition systems that can run in real time The area is at the intersection of neurophysiology computer science and electrical engineering This book brings together recent developments in Europe and the US so that researchers in both academia and industry can find out about the state of the art As well as elementary material on what neuromorphic systems are and why they are growing in importance the book contains details of current work There are articles on aspects of implementing sensory neuromorphic systems as well as articles on neuromorphic hardware **Circuits and Systems Tutorials** Chris Toumazou, Nick Battersby, Sonia Porta, 1995-12-11 Available for the first time in paperback this ground breaking industry textbook is heralded as a first in its state of the art coverage of the most important areas emerging in circuits and systems It is compiled from course material used in a suite of one day tutorials

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