

# 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

**Guido Tschulena, Andreas Lahrmann**



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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 QoS Guarantees in Wireless/mobile Networks Sunghyun Choi,1999 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 **Proceedings of the ...**

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