FINITE ELEMENT THERMAL ANALYSIS OF A LATERAL MICROELECTROTHERMAL ACTUATORS

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ABSTRACT

Nowadays, MEMS is an enabling technology allowing the development of smart products, augmenting the computational ability of microelectronics with the perception and control capabilities of microsensors and microactuators and expanding the space of possible designs and applications. Microelectrothermal actuators are one of the most attractive micro-moving actuators as they can deliver large forces and displacements compared to other types of actuators such as piezoelectric and electrostatic actuators. These thermal actuators are used to move micro device, such as ratchets and gear trains. Array of thermal actuators can be connected together at their blade tips to multiply the effective force. This study reports on the investigation to design, and characterize a lateral Microelectrothermal actuator using ANSYS in order to simulate. The aim was to compute and compare the blade tip displacement for an applied potential difference across the electrical connection pads, obtain the total current and heat flow performance of the differences material at the same operation conditions. The simulations reported here were performed with the best available data. It is important to note that a slightly different material property data will change the behavior of the devices slightly. However, with a suitable modification of the shape, the same performance for example displacement can be achieved with the new material property data.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Micro-electro-mechanical systems(MEMS) is a process technology used to create tiny integrated devices or systems that combine mechanical and electrical components. They are fabricated using integrated circuit(IC) batch processing technique and can range in size from a few micrometers to millimeters. These devices have the ability to sense, control and actuate on the micro scale, and generate effects on the macro scale. MEMS, an acronym that originated in the United States, is also referred to as Microsystems

Technology (MST) in Europe and Micromachines in Japan. Regardless of terminology, the uniting factor of a MEMS device is in the way it is made. While the device electronics are fabricated using IC technology, the micromechanical components are fabricated by sophisticated manipulations of silicon and other substrates using micromachining processes. Processes such as bulk and surface micromachining, as well as high-aspect-ratio micromachining (HARM) selectively remove parts of the silicon or add additional structural layers to form the mechanical and electromechanical components. While integrated circuits are designed to exploit the electrical properties of silicon, MEMS takes advantage of either silicon's mechanical properties or both its electrical and mechanical properties [1].