Sensors and Materials, Vol. 6, No. 4 (1994) 193-209
MYU Tokyo

S & M 0164

Review of Modeling Silicon Microsensors and Actuators

Farzad Pourahmadi

IC Sensors, 1701 McCarthy Blvd. Milpitas, CA 95035, U.S.A

(Received June 21, 1993; accepted August 3, 1993)

Key words: silicon microstructures, finite-element modeling (FEM), silicon microsensor, microactuator

Modeling as an integral part of the design for development of silicon microsensors and microactuators is discussed. Various modeling methods, finite-element modeling in particular, used as tools for device design, device packaging and process design are discussed, and the related results are presented. The typical applications for silicon piezoresistive and resonant beam pressure sensors, as well as silicon microaccelerometers, are included. Modeling packaging effects for thermal stress, as well as for shock and vibration are also discussed.

1. Introduction

The increasing demand in recent years from the marketplace for high-performance silicon microstructure devices has been the main motivation for evolution and introduction of a variety of highly innovative, and yet technically complex, microdevices to the market. In addition, further market demands such as cost-effectiveness and high reliability have compounded such complexity. The design process for realization of such devices has, to some degree, defined and established the important role of modeling for development of silicon microstructures in its entirety from device design and fabrication to packaging and assembly.

Implementation of modeling in the design of silicon micromachined sensor and actuator devices has shown its effectiveness in many different ways. On one hand the most immediate commercial impact of device modeling has been to reduce the number of iterations in a typical design cycle to a minimum with considerable savings in time and resources. On the other hand, implementation of modeling in understanding microdevice