*Sensors and Materials*, Vol. 6, No. 4 (1994) 225-234
MYU Tokyo

LETTERS

S & M 0166

# Modeling of Encapsulation Stress Effects on Output Response of Hall Sensors

Tajinder Manku†, Arokia Nathan, Nixon O, Koorosh Aflatooni and Walter Allegretto[1]

Department of Electrical & Computer Engineering, University of Waterloo
Waterloo, Ontario N2L 3G1, Canada
[1]Department of Mathematics, University of Alberta
Edmonton, Alberta T6G 2G7, Canada

(Received November 15, 1993; accepted February 15, 1994)

***Key words***: offsets, encapsulation stresses

Simulation results of the output response of Hall sensors are presented, taking into account the effect of encapsulation stresses. Two types of Hall structures are considered, *viz.*, the classical Hall and split-electrode devices. The output response is based on a numerical solution to the piezo-Hall current equation using stress distributions obtained with the finite-element simulation package, ANSYS. The corresponding offset voltages or currents and the magnetic response have been obtained for various device (or current flow) orientations, substrate orientations, and micromachined packaging configurations.

## 1. Introduction

The encapsulation of a silicon die induces significant mechanical stresses on active devices on the chip surface. In magnetic field sensors, the stress manifests itself in the form of device offset. Offsets are undesirable when detecting low-frequency magnetic fields because the offset voltage (or current) and the useful magnetic output signal become indiscriminatory.[1,2] The stress induces change in material parameters, and in particular, the resistivity which becomes highly direction-dependent, this being referred to as the piezoresistance effect.[3] The stress created during encapsulation is due mainly to the

†presently at MITEL Corp., 360 Legget Drive, P. O. Box 13089, Kanata, Ontario K2K 1X5, Canada