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Design Consideration for Silicon Rectangular Diaphragm Pressure Sensor with Single-Element Four-Terminal Strain Gauge

Young-Tae Lee, Hee-Don Seo[1], Ryoichi Takano, Yoshinori Matsumoto, Makoto Ishida and Tetsuro Nakamura

Department of Electrical and Electronic Engineering
Toyohashi University of Technology, Tempaku-cho, Toyohashi 441, Japan
[1]Department of Electronic Engineering, Yeungnam University, Gyongsan, 712-749, Korea

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For optimization of the pressure sensor design using a rectangular diaphragm with a single-element four-terminal strain gauge, we simulated shear stress distribution as a function of the aspect ratio of the diaphragm, b/a, by finite-element method (FEM) analysis, and the results were compared with experimental values obtained for the fabricated pressure sensor. The strain gauges are placed at the center, the long edge and short edge of the diaphragm, where the shear stress concentrates. The sensitivities at the center, the long edge and the short edge of the diaphragm reached their maximum values when $b/a = 2.5$, 2 and 1.5, respectively. The sensitivity at the center reached its maximum value as a function of b/a more slowly than that at the edges. The sensitivity variation with the position of the strain gauge at the center was less than those at the long edge and the short edge, because the shear stress near the center changed slowly with the position. The sensitivity of the fabricated pressure sensor at the center of the diaphragm when $b/a = 3$ was 18.4 mV/V kgf cm^{-2} for the 1 kgf cm^{-2} full-scale pressure range.

1. Introduction

Pressure sensors using shear stress have been investigated by many authors.[1-3] They are usually realized by a single-element four-terminal strain gauge, such as a Hall device.[4]