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Pressure Sensor Using Polycrystalline Silicon Thin Film Strain Gauge with Hybrid IC Amplifier

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A pressure sensor using polycrystalline silicon thin film as a strain gauge with an amplifier miniaturized by introducing a hybrid IC has been developed. We have succeeded in obtaining a polycrystalline silicon thin film with a gauge factor of from 12 to 20 and temperature coefficient of resistivity of nearly 0 ppm/°C. The amplifier is a miniscule 10 mm in diameter and less than 2 mm in thickness as a result of placing elements on both faces of a ceramic plate to create a hybrid IC amplifier. The features and performance of the pressure sensor are excellent.

1. Introduction

Strain gauges for pressure sensors can use either semiconductors or metal substances. Due to the piezoresistive effect, semiconductors have a higher gauge factor than metals and are widely used as strain gauges in pressure sensors. The use of single-crystalline silicon and polycrystalline silicon is typical. While its gauge factor is higher than 100,(1) single-crystalline silicon has a temperature coefficient of resistivity (TCR) of −2000 ppm/°C and hence has poor temperature characteristics. On the other hand, although polycrystalline silicon has a gauge factor of 10 or above,(2,3) i.e., it is lower than that of the single crystal, it is still better than metal which has a gauge factor of 2 and has excellent temperature characteristics with a TCR of ±200 ppm/°C. Therefore, there are high expectations for polycrystalline