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Design, Simulation and Metrological Characteristics of Piezoresistive Humidity Sensors

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In this paper we report on the design and simulation of humidity sensors based on a novel operating principle. Whereas the currently most popular thin-film humidity sensors are based on the humidity-dependent permittivity change of thin films, here in our case, the humidity-induced volume change of a thin polymer layer and the resultant strain represent the precise measuring effect. This humidity-induced strain is increased by bending of the bimorph and is converted into an output voltage by piezoresistors which are integrated into a silicon diaphragm. We describe the working principle and the design of the developed piezoresistive sensors. Furthermore, theoretical and experimental results achieved by FEM simulation and metrological investigations will be compared.

1. Introduction

As a requirement of the sensor market and as a result of new possibilities of micromachining technologies, many novel humidity sensors have been developed in the last few years. The demand for miniaturized humidity sensors with high accuracy, good long-term stability and low costs has strongly increased. Despite many efforts to improve the reliability and accuracy of humidity transducers, the problems have not been completely solved to date because of the well-known difficulties of humidity measurement as a substance-concentration measurement within a diffusion process.

Taking these aspects into consideration, a piezoresistive humidity sensor with a novel measuring principle and a new sensor design will be presented. In contrast to capacitive thin-film sensors, the operation principle of the new sensor is based on the humidity-