Faculty of Electrical Engineering & Computer Science
Master Degree Course Electronics Engineering, MSc EE

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Piezoresistive effect and micromechanical elements

ABSTRACT - Masterthesis

Piezoresistive pressure sensor is one of the first products of MEMS technology, it converts a change of the physical pressure into a modulation of electrical resistance. From this effect, the pressure can be measured through electrical instruments. As this pressure sensor is machined from several complicated process with strict condition in the clean room, it's a challenging work to simulate the pressure sensor through a numerical estimation or software constructing.

My first research task is to create an analytical model and calculate the piezoresistive effect in pressure sensor. I assume the membrane is subjected to a homogeneous pressure over the entire surface. Vertical deflection and stresses are caused due to the mechanical deformation. In order to measure the introduced pressure value from output voltage, four piezoresistors must be located in the parts of maximum stress through doping process. Wheatstone Bridge is then constructed to have obvious results of the resistance change value.

ANSYS software is used to modelling the pressure sensor and simulate the membrane deflection according to pressure. Voltage change ratio is measured in the laboratory with different membrane thickness. The results from the experiment are compared with numerical calculation and ANSYS simulation.

My second task is developing a new demonstration element. The main part of this element is a spring-mass unit. This element can create a deflection on the mass and a stress change on the spring through the capacitive forte. The stress then can be measured by the piezoresistors. ANSYS is also used to modelling this structure. The eigenfrequency of the spring-mass vibration is also numerically estimated and software simulated.