

Design & Finite Element Analysis of Micro Electro Mechanical Capacitive Temperature Sensors

N. Z. Khan¹

¹Rutgers University, New Brunswick, NJ, USA

Abstract

This paper presents the design and simulation of novel micrometer-scale capacitive temperature sensors, which could serve as a component for miniaturized wireless sensor nodes for the internet of things requiring structural flexibility and optical transparency. The proposed sensor design employs a conventional, planar interdigitated capacitor structure, explores the thermo-mechanical property (thermal expansion coefficient) of various sensing materials including a conductive polymer, and can be easily implemented using double-layer surface micromachining process. The operating characteristics of prototype sensors comprising different sensing electrodes are investigated as a function of various physical design parameters using COMSOL Multiphysics® software. Electromechanics Physics Interface was employed for modeling. FEM simulation results show that the prototype sensor that utilizes a conductive polymer for the sensing electrode exhibits a reasonably good linearity and sensitivity ($\sim 0.31 \text{ fF}/^\circ\text{C}$) over a relatively wide temperature range (between 7 and 127°C). The dimensions and electrode materials (e.g., Au, Cr and W) of the proposed sensor can be readily customized for different temperature ranges required for different applications.

Figures used in the abstract

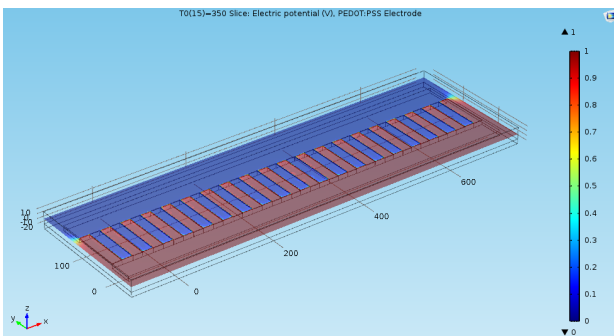


Figure 1: Potential at Electrode top edge