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Abstract:
This paper will focus on design, fabrication and characterization of a new MEMS capacitive microphone with the perforated diaphragm supported by Z- shape arms using SOI wafer. The aim is to fabricate a new microphone with the smallest size, simple and low cost. The novelty is making Z- shape arms around of diaphragm on SOI wafer using only a mask to decrease diaphragm stiffness and air damping and thus improve microphone performances. The fabricated structure has a diaphragm thickness of 5µm, a diaphragm size of 0.3mm×0.3mm, and an air gap of 1µm. The results show that the pull-in voltage is 10.3 V, open circuit sensitivity of 2.46 mV/Pa, and resonance frequency of 60 kHz. The fabrication process uses minimal number of layers and masks due to using SOI wafer to reduce fabrication time and cost. The specific geometry of the proposed diaphragm causes the new fabricated microphone has low bias voltage, good sensitivity and smallest size compared with previous works.

Keywords: MEMS, capacitive microphone, SOI wafer, Z- shape arms, the smallest size.

1. Introduction

Since the demand for smaller telecommunication devices is increasing, it is necessary to reduce the size and cost of components with high performance. Many researchers are studied on capacitive microphones because of great performance, such as high sensitivities, low power consumption, suitable frequency responses, stability and reliability [1-5]. Many capacitive microphones were fabricated by processing two separate wafers and then bonding them together [6-8], but SOI wafers would be able to offer the microphone using one wafer and eliminate the alignment problems. SOI wafer is a sandwich structure, includes a silicon layer (active layer) on top, a buried oxide layer (insulating SiO_2 layer) in the middle, and a handle layer (bulk silicon) in the bottom as a substrate [9-12]. Single crystal silicon diaphragms can be built approximately stress- free, and then it is suitable for diaphragm material. According to today's world requirements, the microphones with low bias voltage, low power consumption, high sensitivity, low cost and easy fabrication process are needed. The expensive fabrication process can be avoided by making holes in the diaphragm.

This paper presents the possibility of fabricating capacitive microphones using SOI wafers. The aim is to create a novel MEMS capacitive microphone with specific geometries, simple and low cost fabrication process with good performance. Comparing with previous works, this