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Modeling of Microelectromechanical Systems Diaphragm Based Acoustic Sensor

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Abstract : Acoustic sensors are extensively used in recent days not only for sensing and condition monitoring applications but also for small scale energy harvesting applications to power wireless sensor networks (WSN) due to their inherent advantages. The natural frequency of the structure plays a major role in energy harvesting applications since the sensor key element has to operate at resonant frequency. In this paper, circular diaphragm based MEMS acoustic sensor is modelled by Lumped Element Model (LEM) and the natural frequency is compared with the simulated model using Finite Element Method (FEM) tool COMSOL Multiphysics. The sensor has the circular diaphragm of 3000 µm radius and thickness of 30 µm to withstand the high SPL (Sound Pressure Level) and also to withstand the various fabrication steps. A Piezoelectric ZnO layer of thickness of 1 µm sandwiched between two aluminium electrodes of thickness 0.5 µm and is coated on the diaphragm. Further, a channel with radius 3000 µm radius and length 270 µm is connected at the bottom of the diaphragm. The natural frequency of the structure by LEM method is approximately 16.6 kHz which is closely matching with that of simulated structure with suitable approximations.

Keywords : acoustic sensor, diaphragm based, lumped element modeling (LEM), natural frequency, piezoelectric
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