Piezoelectric ZnO thin film based Film Bulk Acoustic wave Resonator (FBAR)

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ABSTRACT

Piezoelectric ZnO thin film based Film Bulk Acoustic wave Resonators (FBAR) designed, fabricated and tested. Low stress (~20MPa) ZnO thin films are utilized for device fabrication. Minimal stress films are highly desirable for reliable MEMS devices because of long term reliability. ZnO films were deposited by reactive magnetron sputtering on SiO2/Si wafers at room temperature. The residual stress of ZnO films was measured by measuring the curvature of wafer using laser scanning method. It is found that unique combination of process parameters results to stress free (~20MPa) thin films. The crystalline structure of ZnO films was confirmed by X-ray diffraction and films are highly c-axis oriented with FWHM of 0.26°.

ZnO thin film based Film Bulk Acoustic wave Resonator (FBAR) resonator designed using finite element method (FEM). As per the simulation results the resonance and anti-resonance frequency of the structure were fr ~ 1.39 GHz and fa ~ 1.45 GHz respectively with quality factor of Q ~ 923 and effective coupling coefficient of ~8.6%. Analytical and Simulated results of FBAR has been compared. The mechanical resonance frequency was measured by Laser Doppler Vibrometer (LDV) and found 1.59MHz.

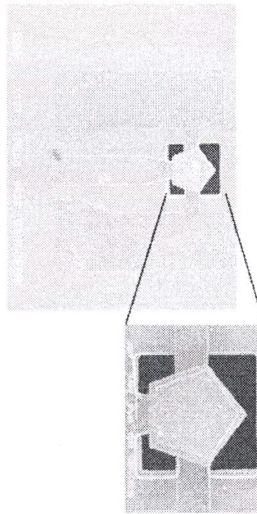

Fig.1: SEM image of fabricated and measured Film Bulk Acoustic wave Resonator (FBAR).