Finite Element Analysis of BAW Sensor

M. Hashiguchi[1], Y. Sumiyoshi[1]

[1]Keisoku Engineering System Co.,Ltd., Tokyo, Japan

Abstract

Introduction: BAW(Bulk Acoustic Wave) resonators which can be connected to frequency selective filters on a chip are promising components for wireless communication systems.

Due to the finite lateral dimension of the resonator structure, lateral acoustic waves can propagate and become evident in the form of spurious resonances. Various methods such as apodization, thickened border frame and air-edge reflector for spurious resonance suppression have been introduced (e.g. [1]).

In this paper, a kind of thickened border frame technique for spurious resonance suppression of BAW is examined numerically based on finite-element analysis. COMSOL Multiphysics®, commercial finite-element analysis software, is utilized here.

Method of approach: MEMS module of COMSOL is utilized to obtain numerical solution of structural deformation and resonance performance such as admittance of this model configuration.

Results: First, the present computation was validated by comparing with [2] where Al-ZnO-Al with no border frame is treated. Secondly we investigated Al-ZnO-Al and Al-AlN-Al sandwich structures with/without a border frame. Figure 1 shows the two-dimensional Al-ZnO-Al sandwich structure of BAW with/without the border frame. It was found that the height of thickened border frame t is an important parameter for the spurious resonance suppression as shown in figs.2 and 3; the spurious resonances are strongly suppressed for Al-ZnO-An with t=0.4[um] and for Al-AlN-Al with t=0.6[um] by comparing with no border frame case(ref) when we changed t within a range of 0.2[um] to 0.6[um].

Conclusion: Spurious mode suppression of the BAW based on the thickened border frame is investigated numerically by using COMSOL. The present study elucidated that the modification of the upper electrode configuration is a key for the spurious resonance suppression of the BAW.

Reference

[1] R.Aigner,"Bringing BAW Technology into Volume Production: The Ten commandments and the deadly sins," IEEE Int.Symp. Acoust. Wave. Dev. for Future Mobile Communication Syst., 2007.

[2] T.Makkonen and others,"Finite element simulations of thin-film composite BAW resonators," IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control, vol.48, no.5, September 2001.

Figures used in the abstract

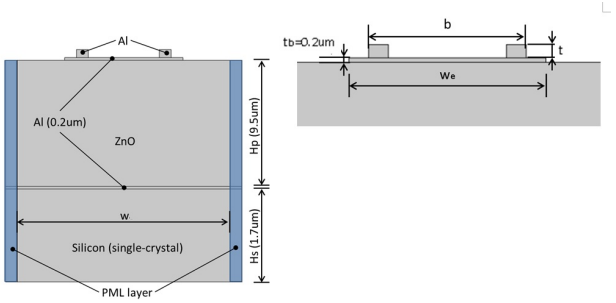

Figure 1: Analysis model for Al-ZnO-Al sandwich structure.

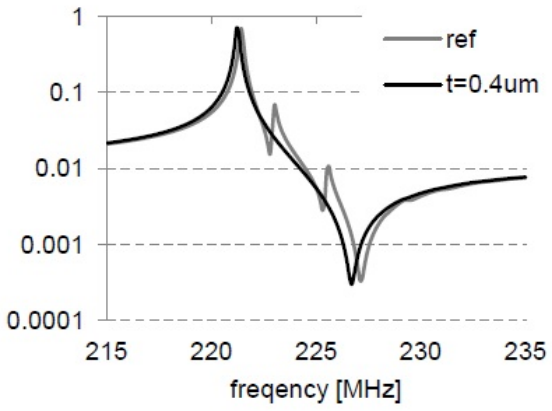

Figure 2: Admittance curve for Al-ZnO-Al.

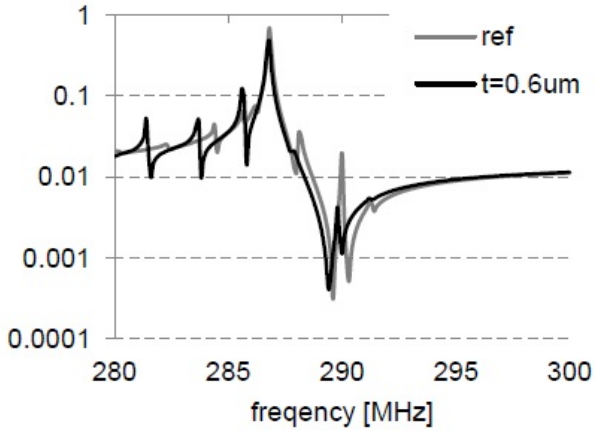

Figure 3: Admittance curve for Al-AlN-Al.