Optimization of BAW Resonator for Wireless Applications Using Taguchi's Orthogonal Array Method

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Introduction: Integrated Bulk Acoustic Wave(BAW) resonators with good selectivity and steep transition band are emergent in wireless domain inspite of fabrication challenges. Our study focuses on optimization of physical parameters using Taguchi's orthogonal array method to define resonator performance reducing the design effeorts cost factors involved.

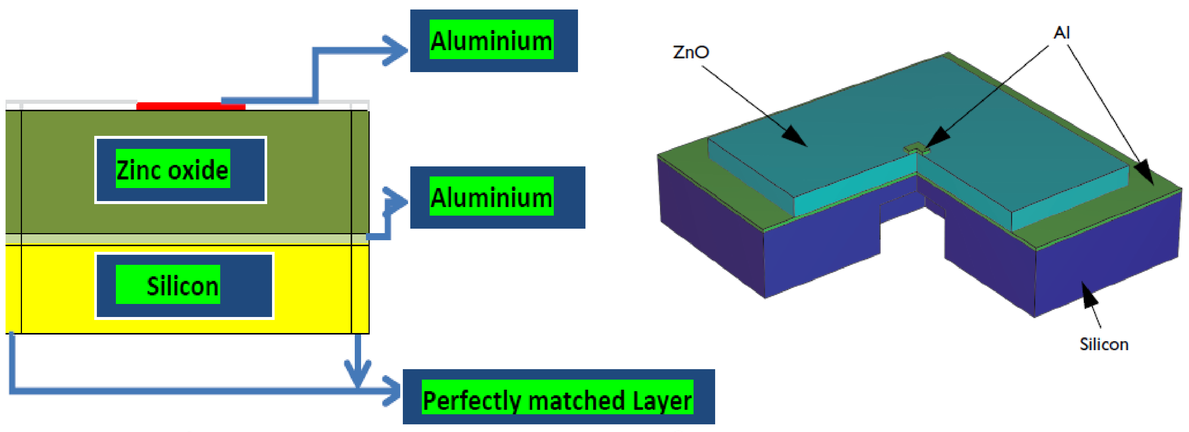

Figure 1. Basic Structure of BAW Resonator

Methodolgy : Orthogonal array of L4 and L9 was used towards optimization of thin film parameters. This includes thickness of Surficial Aluminum layer –A ranging from 0.1µm to 0.2 µm, Thickness of piezo layer –B ranging from 8 µm to 11 µm , Voltage applied to piezo ranging from 0.75 to 1.25 V and the width of resonator ranging from 800 µm to 1200 µm.

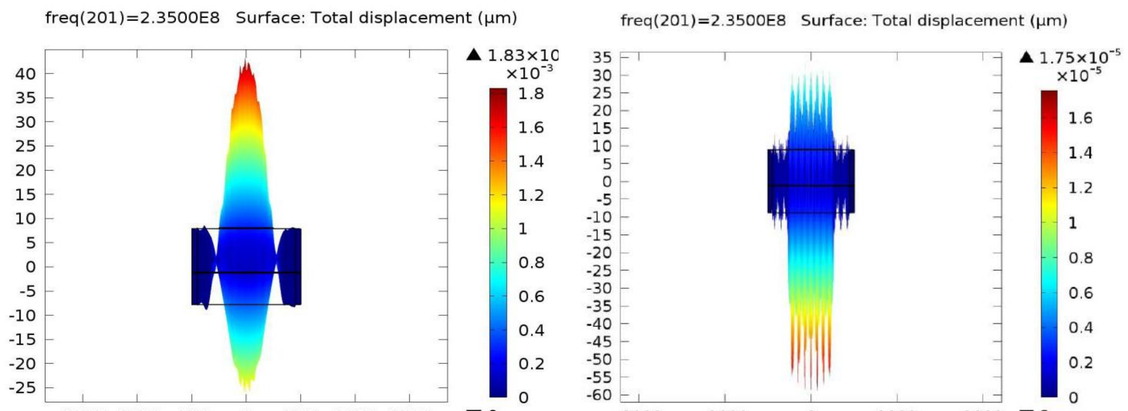

Figure 2. (a)Maximum and (b) Minimum displacement

Table 2. L9 array with parameters

Thickness of A (µm)	Thickness of B (µm)	Voltage applied (V)	Width of resonator (µm)	Displacement (µm)
0.175	8.5	0.75	900	$3.6x10^{-4}$
0.175	9.5	1	1000	$5.06x10^{-5}$
0.175	10.5	1.25	1100	$2.77x10^{-5}$
0.2	8.5	1	1100	$1.47x10^{-3}$
0.2	9.5	1.25	900	$6.55x10^{-5}$
0.2	10.5	0.75	1000	$1.75x10^{-5}$
0.225	8.5	1.25	1000	$1.83x10^{-3}$
0.225	9.5	0.75	1100	$4.36x10^{-5}$
0.225	10.5	1V	900	$2.45x10^{-5}$

Results: The optimization shows the highest Displacement when thickness of B is less and the lowest with maximum thickness B. The below graphs present the Q factor variations for lower and higher values of displacement which are in agreement with the optimized results.

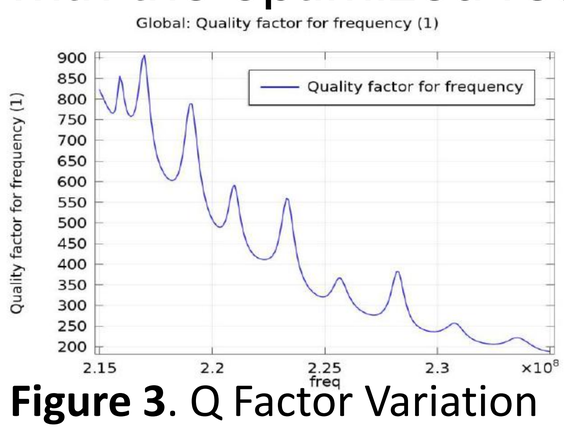

Figure 3. Q Factor Variation for experiment 6 in table

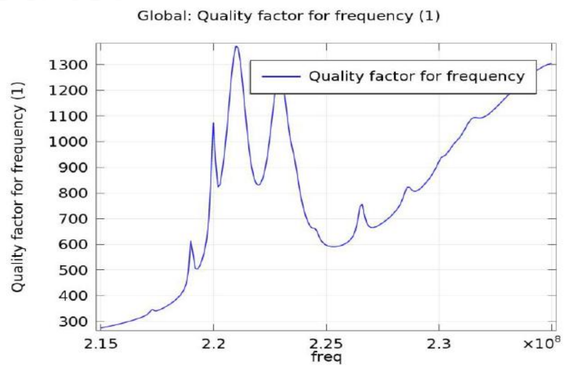

Figure 4. Q Factor Variation for experiment 7 in table

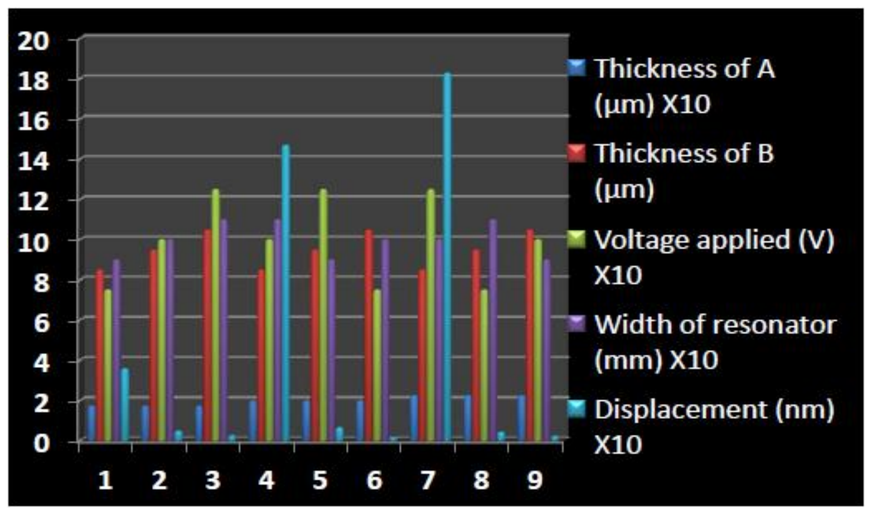

Figure 5. Comparison of varied parameters

Conclusions: Above comparison provides optimized parameters indicative for best resonator design. Thus simulation study emerges as the effective tool to provide confidence to designers to design time and cost effective design.

References:

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