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Temperature Compensated Solidly Mounted BAW Resonators with Thin SiO_2 Layers

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Background, Motivation and Objective

Temperature compensation is becoming more and more a high demand for RF filters in order to successfully meet the tightening specifications over a wide range of temperatures. In BAW resonators SiO_2 has been the material of choice for compensation due to its unique positive temperature coefficient of elasticity which is opposite to that of AlN and the metal electrodes. This work investigates adding thin SiO_2 compensation layers at high stress regions inside the resonators, examining their effect on the resonators Temperature Coefficient of Frequency(TCF) and extracts an accurate value of the temperature coefficient of elasticity of SiO_2.

Statement of Contribution/Methods

SiO_2 thin film layers ranging from 20-60 *nm*s were placed inside the resonator, in the middle of the AlN piezoelectric layer where the stress at this location is orders of magnitude higher than that around the electrodes. In this setup the resonator TCF is very sensitive to the variation of thickness of SiO_2, and hence, it is possible to compensate resonators with a minimum amount of SiO_2 inside the resonator. With this high TCF sensitivity to the oxide thickness, it is possible to extract with high degree of accuracy the temperature coefficient of elasticity TC_{33} of the thin film SiO_2.

Results

Solidly mounted BAW resonators working around 2.47-2.65GHz have been manufactured with TCF ranging from -11ppm/°C till +12ppm/°C.

The extracted temperature coefficient of elasticity TC_{33} of SiO_2 is found to be +110ppm/°C which is significantly different from that of the bulk value of +237ppm/°C

Discussion and Conclusions

Fully compensated solidly mounted BAW resonators utilizing very thin SiO_2 layers have been manufactured. The temperature coefficient of elasticity TC_{33} of the thin film SiO_2 is different from the bulk value used in literature.