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LiNbO3 Bulk Acoustic Resonator characterization at liquid helium temperature.

Bulk Acoustic Wave (BAW) resonators utilize the piezoelectric effect in materials like quartz or lithium niobate to generate and detect acoustic waves within a solid medium [1,2]. These devices find applications in filtering and stabilizing radio frequency (RF) signals in communication systems [3,4]. The objective of this research project is to investigate the properties of LiNbO3-BAW resonator mate-rials at both room temperature (RT) and liquid helium temperature (4K). The initial characterization of the crystal has already been conducted at room temperature within the frequency range of 4-25MHz. This characterization is being re-verified at the temperature of 4K. The results show several high-quality modes, having Q-factors on the order of 106 for both longitudinal and shear modes. Crystal modes are studied using the finite element method (FEM) modeling tool COMSOL. It has been observed that there are two types of modes which are longitudinal(A-type) and shear modes present inside the crystal [5,6]. LiNbO3 crystal is of macroscopic dimension. 3A,5A,7A,9A,11A longitudinal modes and 3,5,7,9 shear modes are identified using COMSOL modelling. Q-factor for the iden-tified longitudinal and shear modes are measured at 4K with a high Q-factor of ˜10ˆ6. A re-entrant cavity with the split post of frequency˜5Ghz operating at TM010 mode is designed in COMSOL to further investigate BAW_MWC coupling rates for LiNbO3.[7]

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