

Properties of LiTaO₃ Single Crystals for SAW Device Applications

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LiTaO₃ single crystals have been grown by the Czochralski method. The characteristics of the crystals are evaluated to determine the optimal orientation for a SAW device. Theoretical calculations suggest the Y-cut, Z-axis orientation to be the optimal SAW propagation path, which has been confirmed by experiments.

1. Introduction

There are a number of piezoelectric materials available to the SAW component designer; the choice depends on the type of device to be prepared, the frequency of operation, the bandwidth, the time delay, and application of the system. In this study, LiTaO₃ piezoelectric single crystals have been grown and their characteristics evaluated for various cuts and propagation directions to determine the optimum orientation for the substrate of a SAW device. Of the many criteria for evaluation, eight main items are selected: velocity, coupling factor, surface permittivity, frequency-temperature coefficient, air-loading attenuation, pure mode propagation, beam steering, and misalignment sensitivity. The LiTaO₃ piezoelectric single crystals are specifically applied to the fabrication of SAW chemical sensors. Analysis of the results reveals the optimum orientation which meets our requirements. The validity of the selection is confirmed through actual fabrication and performance measurement of the devices. The quality of the crystal is also checked by comparison with that of commercially available samples.