Composite substrate material for SAW Sensor

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Abstract

Surface acoustic wave (SAW) sensor is an important role of the acoustic wave (AW) sensors. Two-port SAW delay line is the primary device of SAW sensor and two-port delay line-based oscillator is a measurement technology for SAW sensor. Y-128° $LiNbO_3$ is a well-known high-electromechanical-coupling substrates for SAW sensor, but its usefulness is limited because of its poor temperature-stablility property. AlN films have some excellent characteristics, such as high SAW velocity, stable chemical properties, and high-temperature stability. In this research, the c-axis-oriented AlN films were sputtered on Y-128° $LiNbO_3$ to be a new composite substrate, the films quantity was measured by X-ray and Atomic Force Microscope (AFM) methods. We make a two-port SAW delay line device (wavelength is 100 μm) and two-port delay line-based oscillator for sensor measurement circuits. Compared with the original Y-128° $LiNbO_3$ substrate, the properties of the sensor oscillator using the composite substrate were study in the research.

After measuring, X-ray and AFM figures exhibited the deposited films is well c-axis-oriented AlN films. The AlN film-thickness is 4.51 μm. For the composite substrate (AlN/)Y-128° $LiNBO_3$), the sensor oscillator frequency at 15℃ also increased from 40.1209 MHz up to 42.0103 MHz and the temperature coefficient of frequency (TCF) value of sensor oscillator was from –76.32 (ppm /℃) to –28.21 ppm/℃. It exhibited the composite substrate (AlN/Y-128° $LiNBO_3$) will enhance the sensor oscillator frequency and effectively improve the poor temperature stability. That composite substrate is good for the applications on SAW sensor.