Ridge-shaped periodically poled transducer for wide band R-F filter

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Most resonators and filters for telecommunication applications are based on Surface Acoustic Wave (SAW) technology using inter-digitated transducer (IDT). This mature technology is particularly addressing radio-frequency filter demand, but it is limited by various factors. Recently, the interest of periodically poled transducer (PPT) built on single crystal $LiNbO_3$ Z-cut plates was investigated as an interesting alternative to classical IDTs[1]. Performances of such a device were theoretically demonstrated, showing many advantages such as electromechanical coupling and equivalent phase velocity overcoming those of SAW. This paper shows the manufacturing and test of an acoustic filter around 250MHz based on a PPT ridge-shaped transducer.

This new device has been modeled with our finite and boundary elements simulation tool for $LiNbO_3$ to optimize the device design. High aspect ratio ridge-shaped transducers were made of $LiNbO_3$ to show the resonator capabilities. These resonators have been mounted in filter configuration, showing a band pass of about 5 MHz at 250MHz. The manufacturing process is achieved by dicing a ridge into a poled plate with a diamond-tipped saw and plating the ridge walls to define the electrodes.

The dispersion properties analysis have shown one longitudinal mode (k^2_{max}=12%) and one shear mode (k^2_{max}=22%) for a ridge width/poling period ratio of 0.4 and 0.2 respectively. The shear mode was used to fabricate the filter, using a 150µm-deep and about 20µm-wide ridge made of periodically poled $LiNbO_3$ exhibiting a poling period of 14.9µm. Although more back-end efforts are needed to reach the agreement between effective and reconstructed filter response, the experimental setup is conforming the basic theoretical predictions.

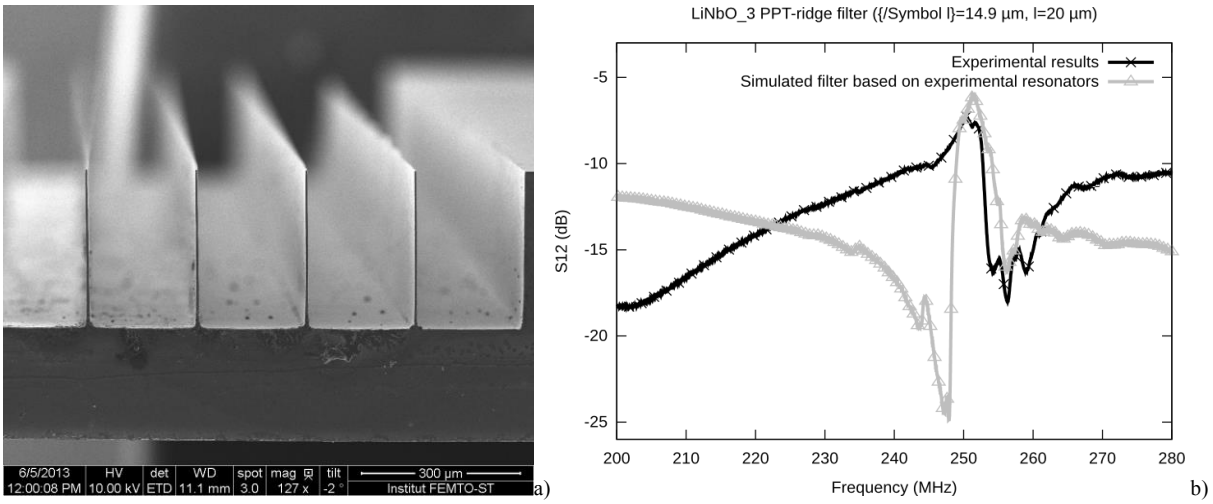

Fig. 1: SEM view of ridge shaped transducer (a) and a comparison of theoretical and experimental filter (b)

[1] E. Courjon et al., "Lamb wave transducers built on periodically poled Z-cut LiNbO3 wafers", vol. 102, 114107, 2007.