Complete Bandgap SAW Phononic Resonators

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Micro-acoustic wave technology is being developed in two main streams, employing SAW or thin film bulk acoustic wave modes, respectively. Today's state-of-the-art SAW resonators make use of 1D periodic structures. The performance of such a topology is quite often confronted with losses determined by the SAW diffraction away from the resonant cavity. On the other hand, periodic structures of higher dimensions, referred to as surface phononic crystals (SPC's), allow the definition of omnidirectional (complete) SAW bandgaps. Experiments have shown promising results regarding the omnidirectional acoustic isolation demonstrated by SPC's formed of 2D periodic arrays of scattering inclusions or air holes. However, these structures do not permit integration between the transducing and the reflecting building blocks of the SAW device, which is a prerequisite for eliminating acoustic losses from scattering in to the bulk substrate. On the other hand, classical 1D SAW resonators alleviate this problem by using transducers and reflectors of the same topology. It has been shown[1]. that the above approach is applicable to a specific type of surface phononic crystal, consisting of 1D aluminum strips on which a 2D array of low profile heavy masses is superimposed. Here, such a structure will be referred to as surface phononic grating (SPG). A specific design of SPG, employing a 2D array of hexagonal symmetry, has recently been proven to demonstrate complete bandgap characteristics while keeping the thickness of the heavy masses below 5% of the acoustic wavelength[2].

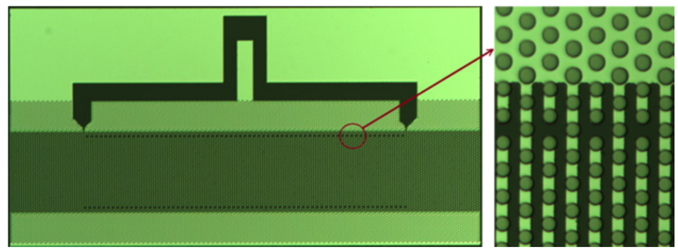

Fig. 1: Close view of a SAW Phononic Resonator

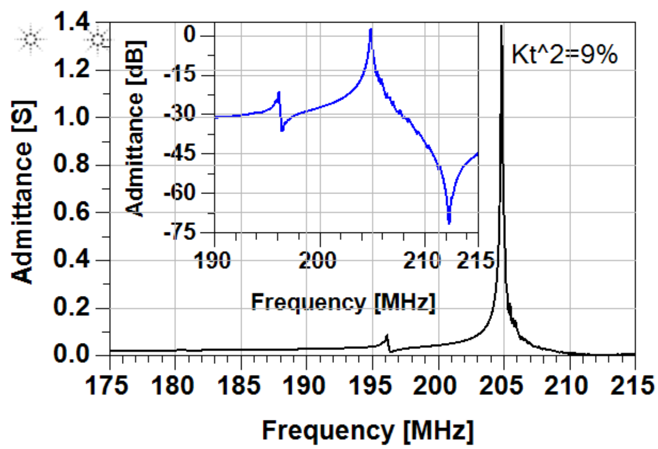

Fig. 2: Measured Response of a Phononic Resonator

In this work we demonstrate and analyze measurements on complete bandgap phononic SAW resonators (see Fig. 1 and Fig. 2) fabricated on 128° YX LiNbO3 substrate. The influences of the phononic grating over the spurious responses and the busbar quality are experimentally tested. Future optimization steps are discussed. The proposed work initiates a discussion on the applicability of the SPG in commercial SAW components.

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[1] M. Solal, J. Gratier, T. Kook, IEEE Trans. on UFFC, vol. 57, p. 30-37, 2010.

[2] V. Yantchev and V. Plessky, J. Appl. Phys., vol. 114, art.no. 074902, 2013.