SAW Symposium 2014
Surface Acoustic Wave Sensor Symposium
October 30th - 31st | Vienna, Austria

Author/Company/University	Lamia EL Fissi[1], Rachid Haouari[1], and Laurent A. Francis[1] [1] ICTEAM Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium.
Title:	**Fabrication of Love Mode Surface Acoustic Wave Devices with Substrate Buried Interdigital Transducers**

SAW Symposium 2014
Surface Acoustic Wave Sensor Symposium
October 30th - 31st | Vienna, Austria

Abstract:

1. Background, Motivation and Objective :

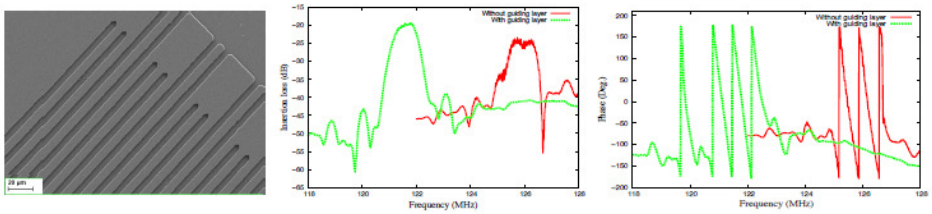
A major part of the research on Love mode surface acoustic wave (SAW) device operated in liquids, *e.g.* biosensors, is focused on using different conventional piezoelectric substrates, and different guiding and sensing layers in order to obtain low insertion loss, high power durability, high sensitivities, etc. [1]. In a classical fabrication scheme, the device is configured as a delay line and the metal electrodes of the
interdigital transducers (IDTs) are buried between the piezoelectric substrate and the guiding layer. Although damascene processes have been developed for a shallow embedding of the electrodes in the substrate and to keep a flat surface, notably for microfluidic applications and for improved reliability when handling high input powers [2], there is relatively little investigation related to substrate embedded transducers. The main reason is linked to the difficulty for micromachining piezoelectric substrates such as quartz, lithium niobate and lithium tantalate. However, burying the electrodes in the substrate can lead to enhanced transduction efficiency and higher acoustic impedance contrast needed for efficient Bragg reflectors designs. In this work, the metal pattern of the IDTs have been buried in the piezoelectric substrate and the response was compared to the conventional approach where electrodes are standing directly on the substrate.

2. Statement of the Contribution/Methods :

Love mode devices with delay lines configuration were built on 500 µm-thick single side polished ST-cut quartz and a 1.2 µm-thick photoresist (AZ 6612) guiding layer atop the quartz. The Love mode is excited and detected using IDTs composed of 50 pairs of 4-fingers-per-wavelength (λ = 40 µm) electrodes made of 1 µmthick evaporated Aluminum in 1 µm-deep grooves. The grooves were etched in the quartz wafer using reactive ion etching and a mixture of SF6 (16/10 sccm) and CHF3 (500/10 sccm) (Electrotech RD600) (Fig.1- a). From a theoretical standpoint, finite elements simulation with Comsol Multiphysics have been performed to better understand the generation of the acoustic wave using substrate buried IDTs and the acoustic
mismatch, according to the depth of the electrodes in the piezoelectric substrate.

3. Results/Discussion :

To evaluate the quality of the embedded IDTs, a comparative study between conventional SAW sensors and the new ones will be presented. The preliminary results shown here indicate that the insertion loss and the phase of the fabricated devices, observed and recorded using an Agilent N5242A Network Analyzer (Fig.1-b and c), are suited for sensing purposes with a low insertion loss and a linear phase.



(a) (b) (c)

Figure 1: SEM top view of the ST-cut quartz dry etched grooves. Measured transfer function (f_c = 121 MHz): (b) insertion loss & (c) phase for the substrates w/o the guiding layer.

References:

[1] K. Länge *et al.*, Surface acoustic wave biosensors: A review. Anal. Bioanal. Chem. 2008, 391, 1509-1519.
[2] S. Menzel *et al.*, Fabrication of Surface Acoustic Wave Structures with buried Copper Damascene Process,
International Conference on Planarization/CMP Technology, Oct. 25-27, 2007, Dresden.