Fabrication and analysis of Thin Film Lithium niobate solidly mounted on SiC

Nan Xu[1], Seniz Esra Küçük[1], Naiqing Zhang[2], Victor Plessky[2 3], Luis G. Villanueva[1]

[1]ANEMS group, EPFL, Lausanne, Switzerland
[2]Huawei Technologies Co., Ltd., Shanghai, PR China

[3]NanoRF Sàrl, Lausanne, Switzerland

Email: nan.xu@epfl.ch

The rapid expansion of fifth-generation mobile networks (5G) and the widespread adoption of the Internet of Things (IoT) are leading to a significant rise in the number of radiofrequency (RF) bands that mobile devices must support. As a result, RF font and communication chain required boarder bandwidths at higher frequency. Researchers have come up with different solutions to fulfill the requirement. Among various candidates, employing high velocity substrate such as SiC is promising, as it helps to reduce energy leakage. Numerous studies have been conducted to utilize SiC as substrate in the resonator structure, such as $LiNbO_3$/SiC[1], $LiTaO_3$/SiC[2].

In this work, a novel structure of resonator made of lithium niobate film ($LiNbO_3$) and interdigital electrodes on its top surface while a bottom metal plate is mounted on the silicon carbide, is presented. The solidly mounted SH1 mode resonator[3] has a 600 nm thick X-cut $LiNbO_3$ and aluminum electrode. The initial devices exhibit high losses, resulting in both low coupling and low-quality factors at anti-resonance due to the overlap of the top and bottom electrodes. The modified fabrication process successfully solved the problem. The results show that the resonant frequency of the new structure resonator is 3.03 GHz, and the electromechanical coupling coefficient is 19.6%, which has a potential application value in n77 band.

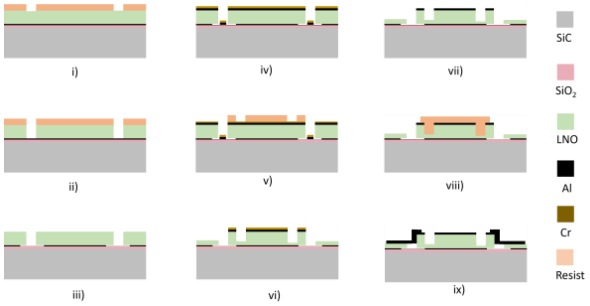

Fig. 1: Fabrication process flow for the solid mounted SH1 mode resonator

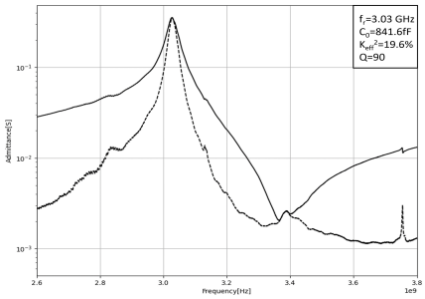

Fig. 2: Admittance curves of measured resonators in 1 port GS configuration with pitch 0.9µm, metal coverage 35% and aperture 36µm.

[1] Liu, Peisen, et al. "A near spurious-free 6 GHz LLSAW resonator with large electromechanical coupling on X-cut LiNbO3/SiC bilayer substrate." *Applied Physics Letters* 122.10 (2023).

[2] Zhang, Liping, et al. "Spurious-Free and Low-Loss Surface Acoustic Wave Filter Beyond 5 GHz." *2023 IEEE International Ultrasonics Symposium (IUS)*. IEEE, 2023.

[3] V. P. Plessky, J. Koskela, and S. Yandrapalli. "Crystalline Y-cut Lithium Niobate Layers for the Bulk Acoustic Wave Resonator (YBAR)." In 2020 IEEE International Ultrasonics Symposium (IUS), pp. 1-4. IEEE, 2020.