Lithium Niobate Thin-Film Resonators

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Commercial markets desire integrated multi-frequency "band"-select duplexer and diplexer filters, with fractional bandwidth (BW) ranging from 3% to 10% and steep roll-off for high stop band rejection. The achievable bandwidth of such filters is ultimately limited by the electro-mechanical coupling factor (k_t^2) of the resonators, while the roll-off is determined by resonator quality factor (Q). Therefore, resonators with both high k_t^2 and high Q are desired for large BW steep roll-off filters.

In this talk I present the fabrication technology, design and characterization of thin-film lithium niobate (LN) contour-mode resonators. By carefully positioning the inter-digital transducer (IDT), we achieved CMRs with $k_t^2 \times Q$ of 148 (IDT @ node) and very high k_t^2 resonators with spur-attenuated response (IDT @ anti-node)[1, 2]. We have demonstrated resonators with frequencies ranging from 400MHz to 1.9GHz on a single chip. Additionally, we have demonstrated high optical Q photonic resonators on the same platform paving the way for high-bandwidth and efficient chip-scale microwave photonics[3].

[1] Renyuan Wang, Sunil A. Bhave, and Kushal Bhattacharjee, "Thin-film high kt2□Q multi-frequency lithium niobate resonators," 26th IEEE International Conference on Micro Electro Mechanical Systems (MEMS 2013), Taipei, Taiwan, January 20-24, 2013, pp. 165-168.

[2] Renyuan Wang, Sunil A. Bhave, and Kushal Bhattacharjee, "Modeling of interdigitated transducer for high-order contour-mode resonators," IEEE International Ultrasonics Symposium (Ultrasonics 2013), Prague, Czech Republic, July 21-25, 2013, pp. 1926-1929.

[3] Renyuan Wang and Sunil A. Bhave, "High Optical Q, GHz FSR Lithium Niobate-on-silicon photonic resonators," 2014 Solid State Sensor, Actuator and Microsystems Workshop (Hilton Head 2014), Hilton Head Island, South Carolina, June 8-12, 2014.