

CMUT

Capacitive micromachined ultrasonic transducers (CMUTs) are widely recognized as key enabling devices for next-generation ultrasonic systems, particularly in medical imaging, non-destructive evaluation, and immersion-based sensing applications [3-6]. Due to their flexural membrane operation, CMUTs exhibit low mechanical impedance and efficient acoustic coupling to liquids, making them well suited for broadband ultrasonic transmission and reception.

The CMUT structure [3-7] consists of a composite membrane suspended over a vacuum gap, forming a variable capacitor between the top membrane electrode and the bottom fixed electrode. The electrostatic gap is defined by sacrificial-layer processing and sealed to form a cavity (see Fig. 4).

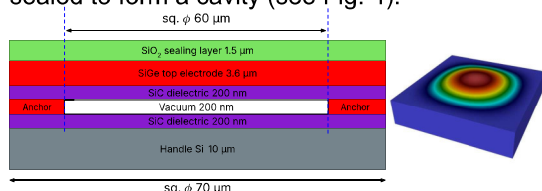


Fig. 5. a) Cross section layer stacks of CMUT [7].
b) Membrane deflection (first mode)

The same model is implemented in Quanscient Allsolve, with its response shown in Fig. 6-7; experimental mechanical and acoustic characterization enables comparison of resonance frequency, quality factor, and transient response.

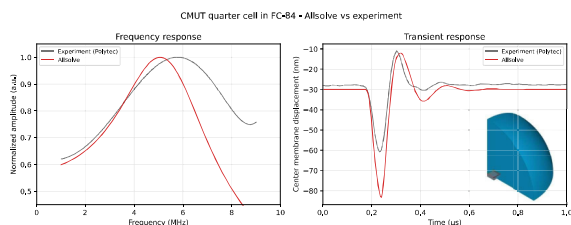


Figure 6. Frequency and transient response of the quarter cell CMUT [7]. Drive voltage: $V_{DC} = -160V$, $V_{pulse} = -60V$.

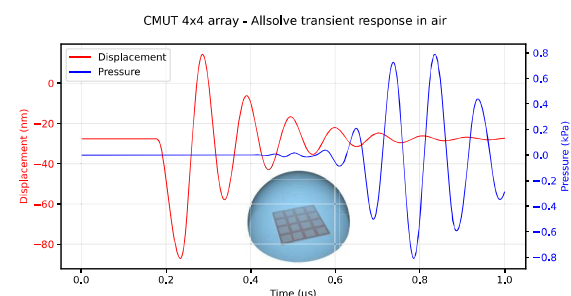


Figure 7. Transient response of a CMUT 4x4 array. Drive voltage: $V_{DC} = -160V$, $V_{pulse} = -60V$.

Conclusion

The presented work demonstrates an experimentally validated methodology for the design and simulation of PMUT and CMUT devices. The study compares results from different simulation software and with experimental data.

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