Transparent Highly Sensitive Buckled Dome Etalon Ultrasound Transducers

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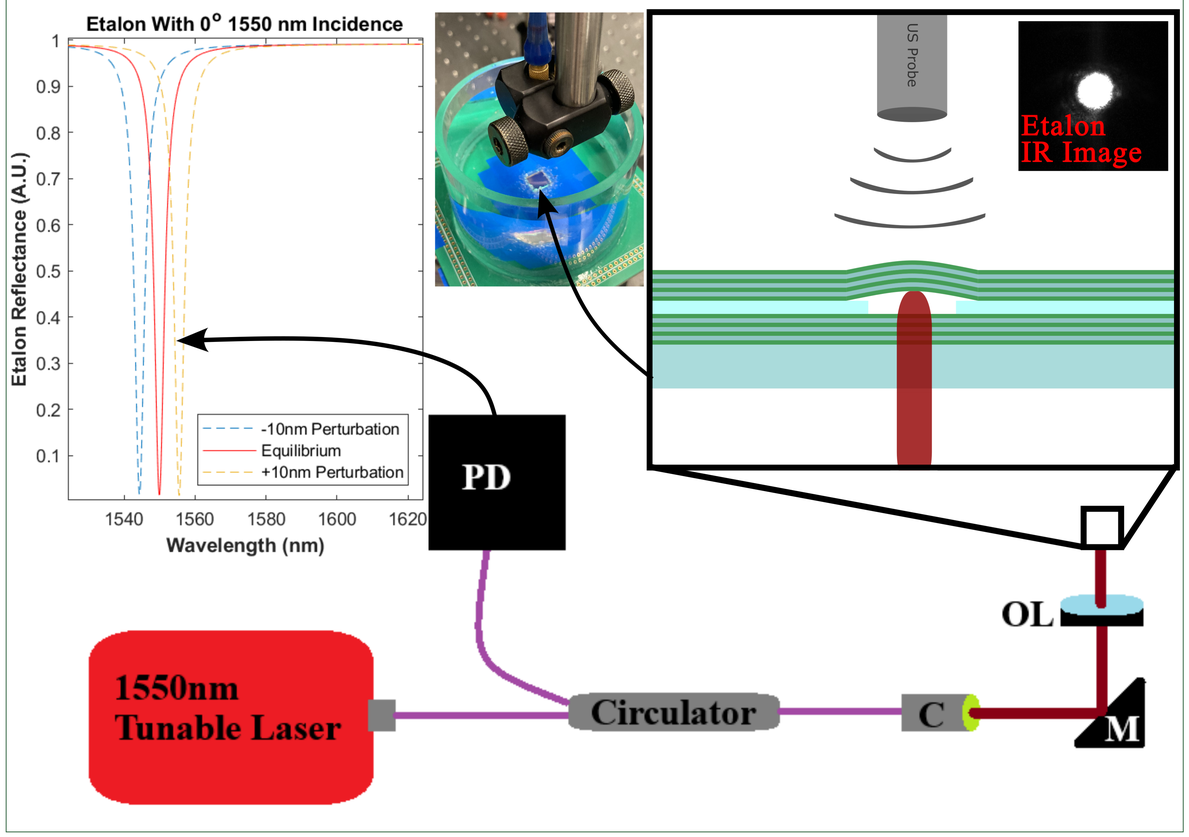
Introduction

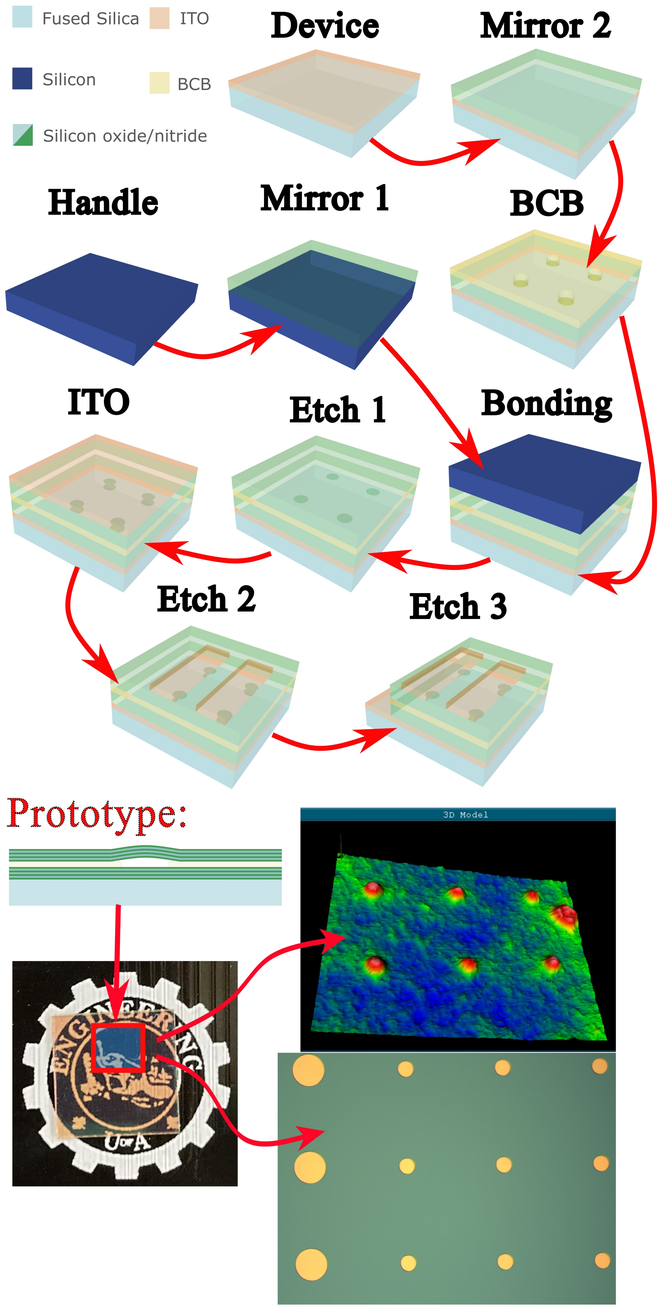
- Optical based ultrasound transducers are devices that exhibit large changes in optical properties upon the presence of external pressure perturbations.
- This type of transducer can easily outperform Capacitive Micromachined Ultrasound Transducers (CMUTs) and traditional piezoelectric devices in receive sensitivity with similar active area size.
- Theoretically better sensitivity performance should enable higher resolution ultrasound Imaging at greater (tissue) depths.
- Existing buckled dome etalon (BuDE) transducers like ours have achieved noise equivalent pressure (NEP) sensitivity performance of ~30 μPa/$\sqrt{Hz}$ (down to the thermomechanical noise limit) [1].
- However, they're are difficult to scale up to arrays and cannot transmit ultrasound intrinsically.
- With implementing ITO electrodes, we hope to perform optical resonance tuning to correct for non-uniformities in arrays and do ultrasound transmits like other transparent CMUTs.

Methods

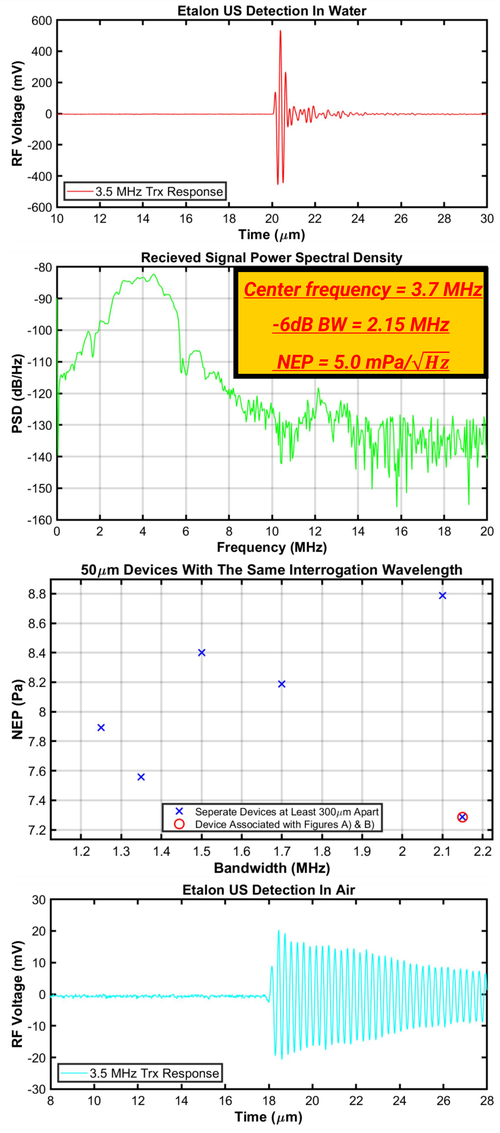


Fabrication

$$Sensitivity \propto F \cong \frac{\pi\sqrt{R}}{1-R}$$



Prototype Results



Conclusion

- High sensitivity and transparency observed.
- Transparent CMUT type ITO electrodes will be needed for full array functionality (optical resonance tunability) and ultrasound transmits.

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[1] G. J. Hornig, K. G. Scheuer, E. B. Dew, R. Zemp, and R. G. DeCorby, "Ultrasound sensing at thermomechanical limits with optomechanical buckled-dome microcavities," *Optics Express*, vol. 30, no. 18, p. 33083, Aug. 2022. doi:10.1364/oe.463588

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