

A Three-Dimensional Millimeter-Wave Frequency-Shift Based CMOS Biosensor using Vertically Stacked Spiral Inductors in LC Oscillators

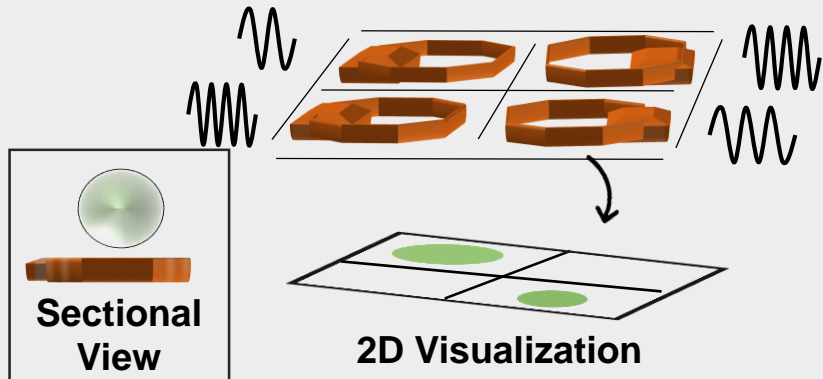
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Architecture of the Proposed Biosensor

Previous Work

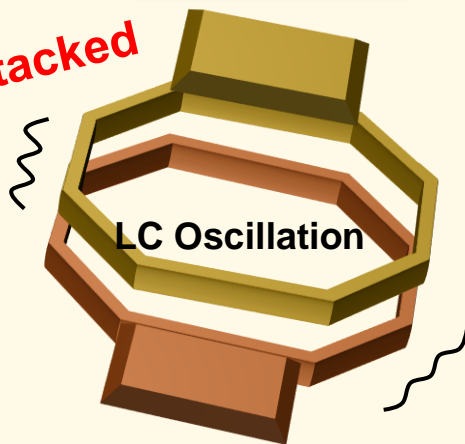


T. Mitsunaka et al., IEEE Journal of Solid-State Circuits, vol. 51(11), pp. 2534-2544, Sep. 2016.

This work presents a frequency-shift-based CMOS biosensor that is capable of providing three-dimensional (3D) resolution.

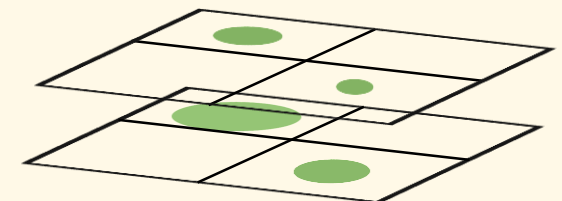
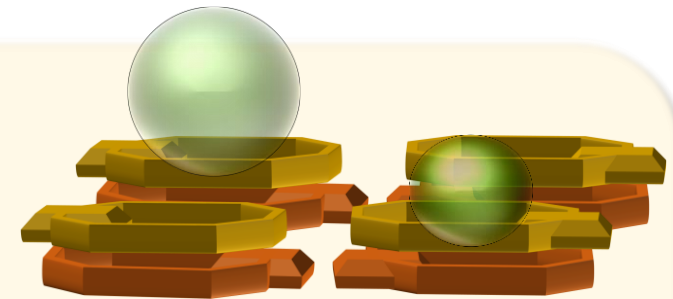
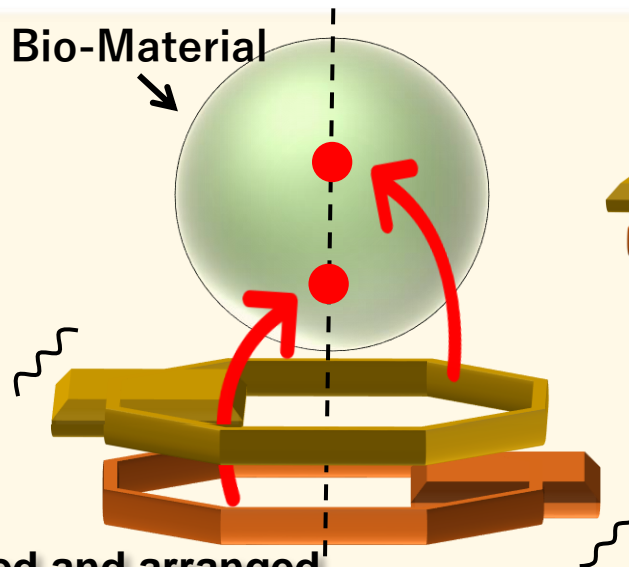
This Work

Stacked



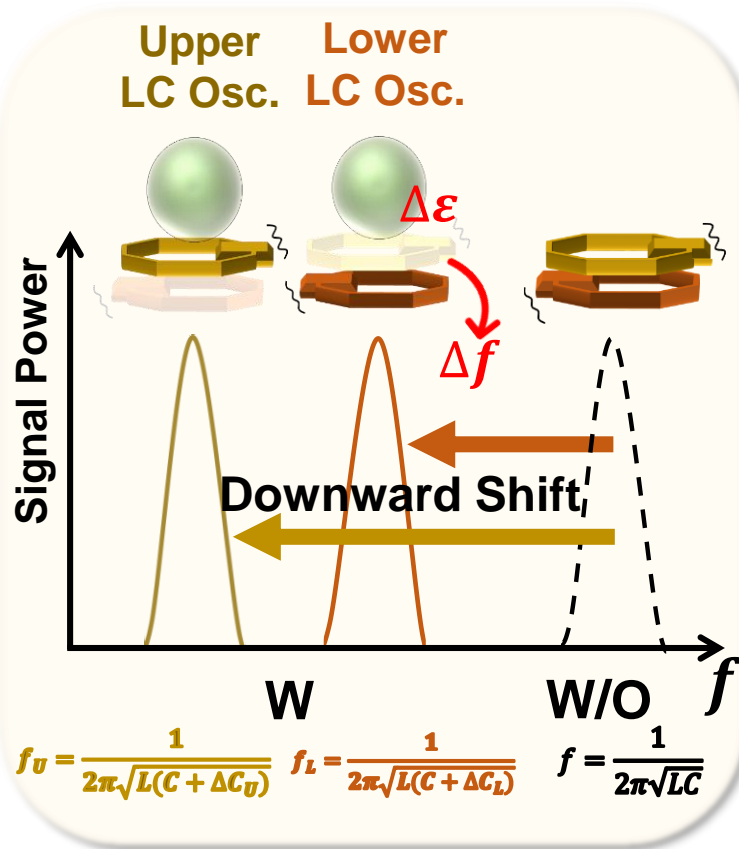
LC oscillators are stacked and arranged alternately in the upper and lower layers.

Bio-Material

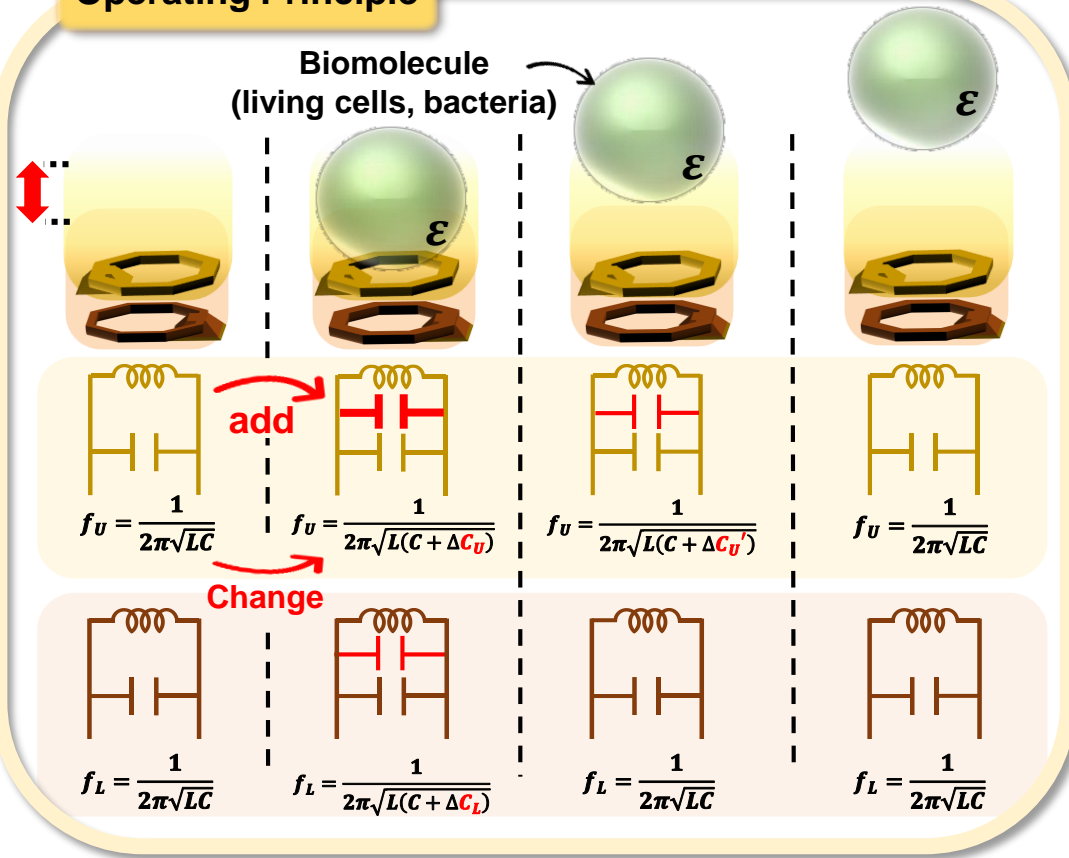


3D Visualization

Architecture of the Proposed Biosensor



Operating Principle

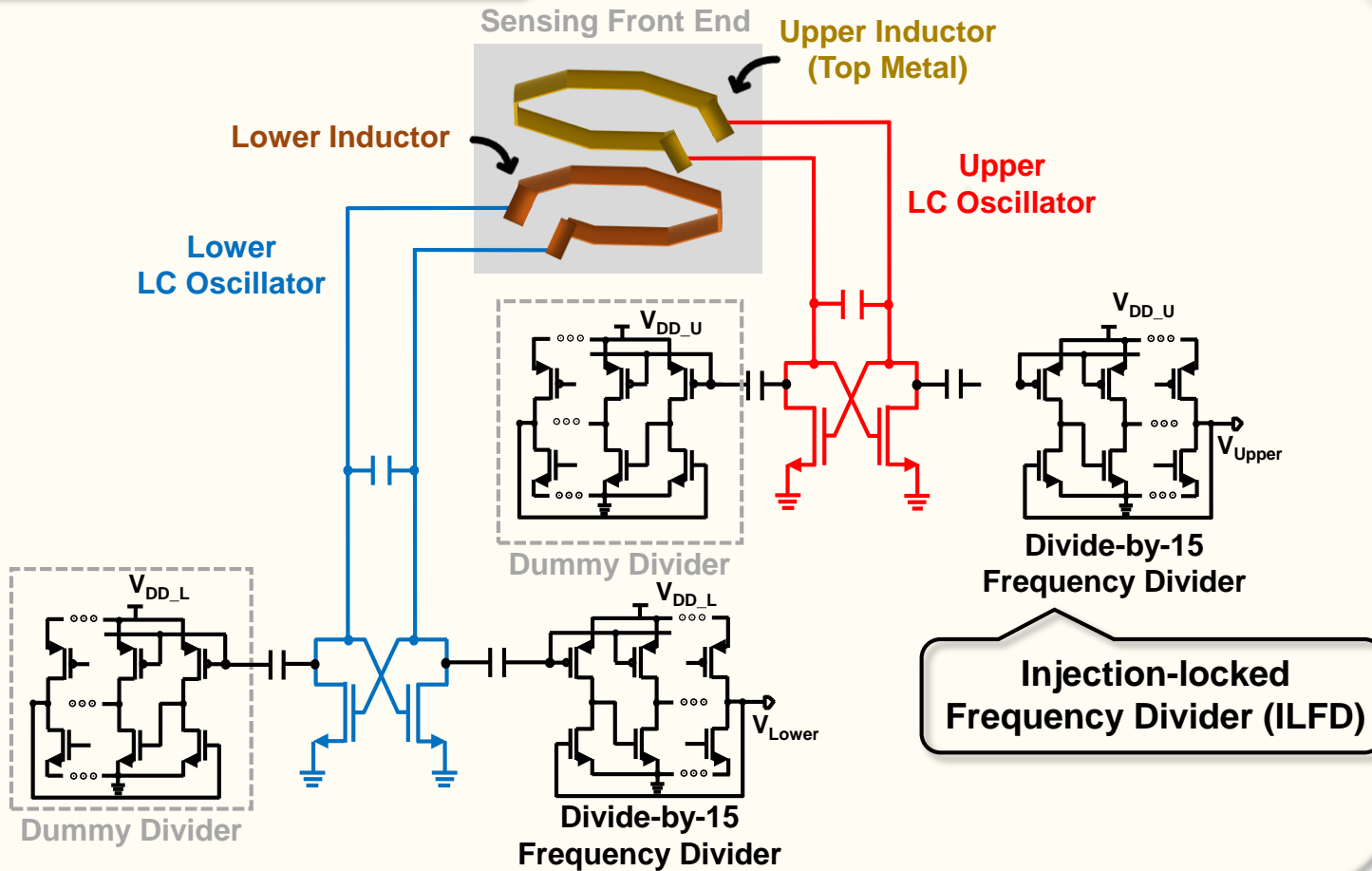


The change in the ϵ is affected by electric field of **Upper** LC osc. \gg electric field of **Lower** LC osc.

The frequency from the **Upper LC osc.** is more greatly decreased than the **Lower LC osc.**

1A-2 Circuit Configuration of the Proposed Biosensor

Schematic of the Sensor Circuit



Measurement Frequency Shift @ 40 μm

High

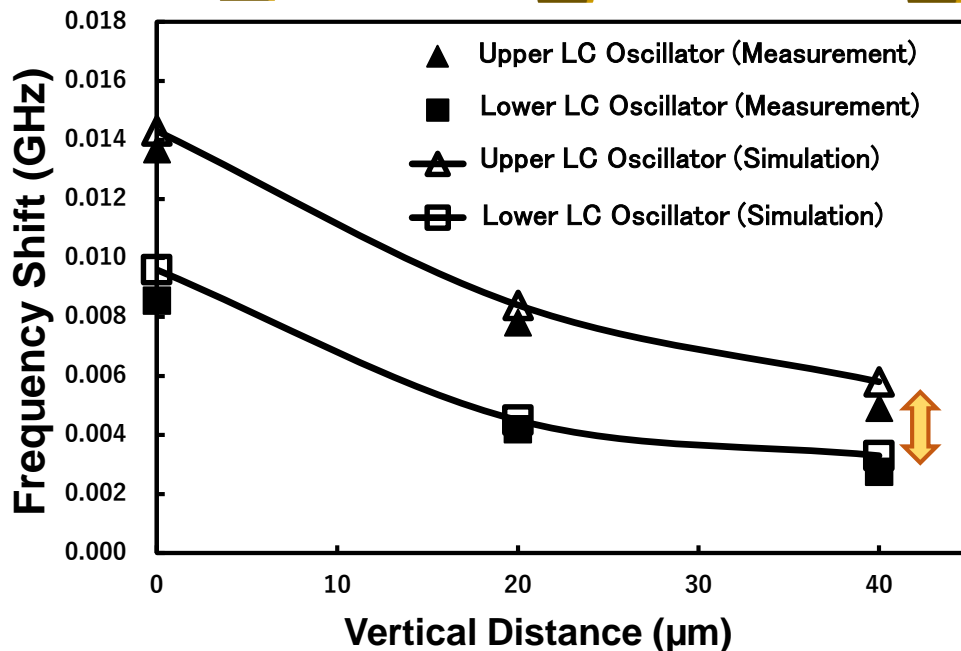
Upper LC oscillator



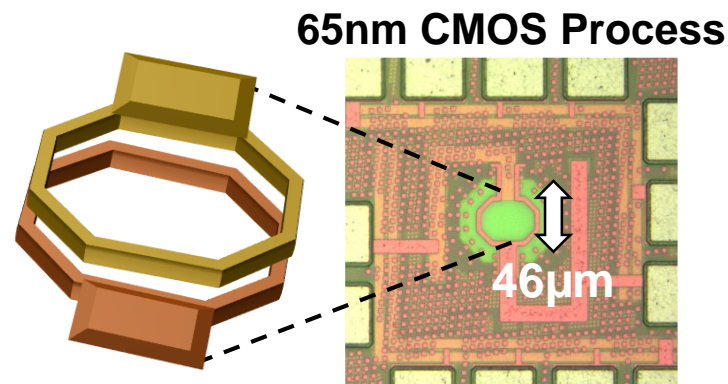
1.56 MHz

Low

Lower LC oscillator



Chip Microphotograph



There was a difference in the frequency shift of the upper and lower LC oscillators.



It was demonstrated the capability of the proposed biosensor to provide 3D resolution.