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A micro-machined thin film electro-acoustic biosensor for detection of pesticide residuals

Key words: Biosensors, Electro-acoustic resonator, Pesticide residues, Immunoreactions

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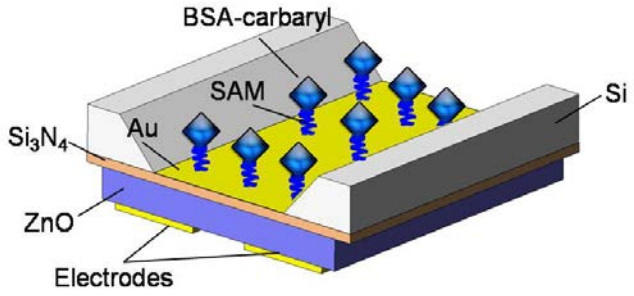
Background & Motivation

- The pesticide residues in farm products have become one of the most serious food safety problems.
- The existing methods can hardly satisfy the requirements of low cost, being easy to use, and providing high-through detection.
- Based on micro-electromechanical technology, the film bulk acoustic resonator (FBAR) was developed as a mass-sensitive transducer.

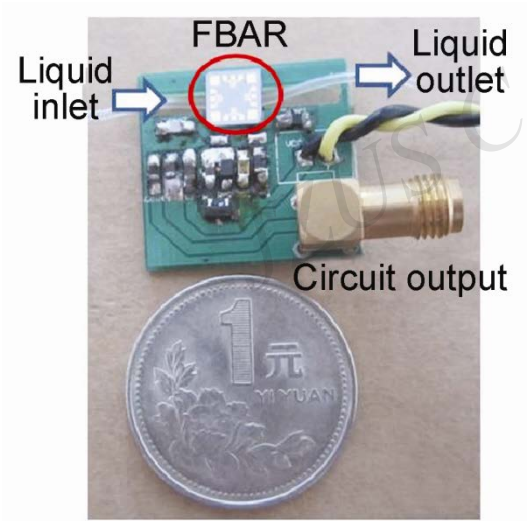
Features of the FBAR biosensor

– A portable electro-acoustic biosensor based on FBAR was realized for pesticide detection.
– The high sensitivity of FBAR and the specificity of antibody-antigen reactions were combined.
– The limit of detection for typical pesticide is 2×10^{-10} M.
– The proposed device has a significantly smaller sensor size and simpler operation in the packed system to realize this real-time detection.

Structure and fabrication of the FBAR biosensor



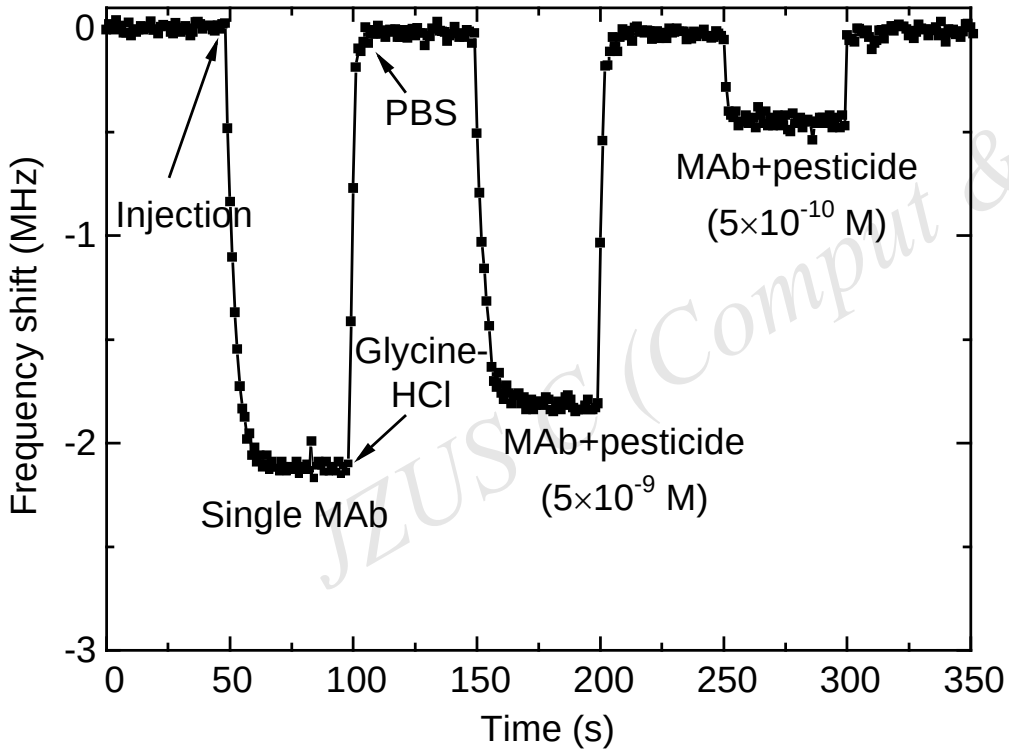
Basic configuration of the FBAR biosensor



PCB of the fabricated FBAR biosensor

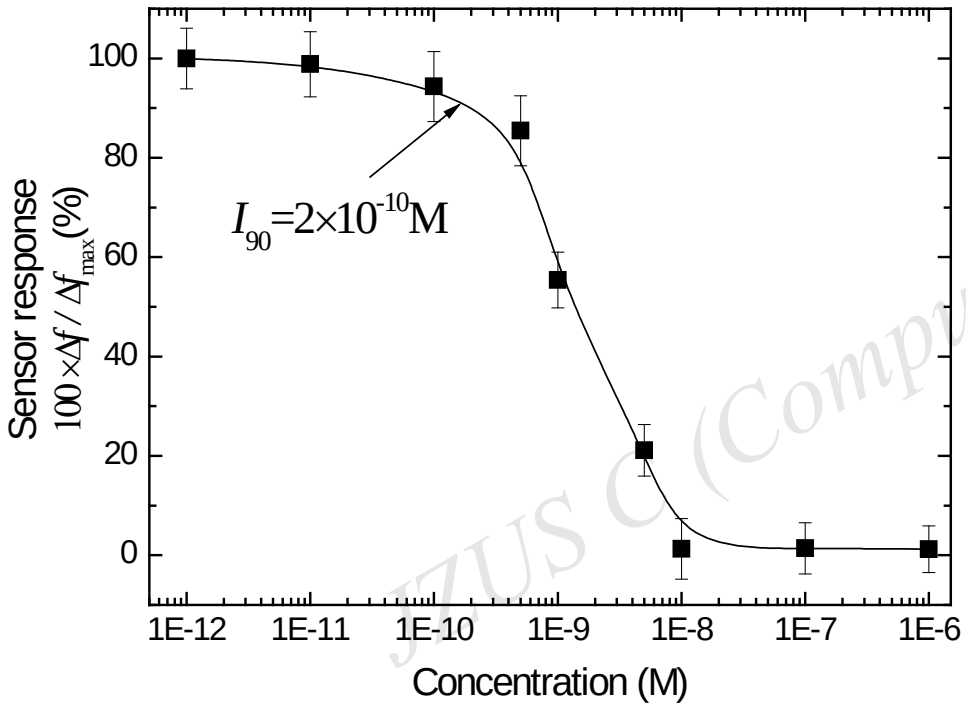
- The device was fabricated using a standard MEMS process.
- A high-*Q* shear mode ZnO resonator was designed.
- A testing channel was fabricated for liquid testing.
- The artificial antigens were immobilized on the sensing surface.
- Competitive format for the immunoassays was employed.

Sensing performance of the FBAR biosensor (I)



The figure shows the time-dependent frequency profile. The competitive immunoreactions can be clearly observed through monitoring the frequency changes of the FBAR.

Sensing performance of the FBAR biosensor (II)



The standard calibration curve of the FBAR biosensor for carbaryl (Δf_{max} is the maximum frequency shift, in single MAb solution)

- An ultralow LOD of 2×10^{-10} M was achieved for carbaryl.
- No related compounds gave a cross-reactivity higher than 0.3%.
- Glycine-HCl buffer can be used for the regeneration.