1S-8

A Current-Integration-Based CMOS Amperometric Sensor with 1.2 μm × 2.05 μm Electroless-Plated Microelectrode Array for High-Sensitivity Bacteria Counting

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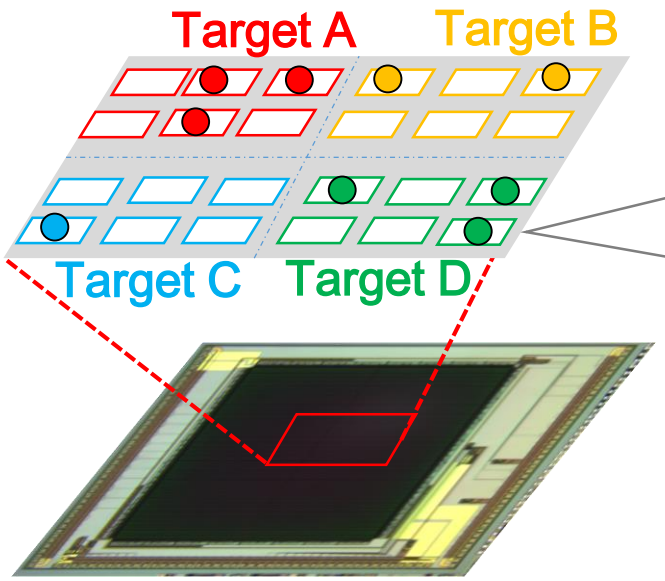
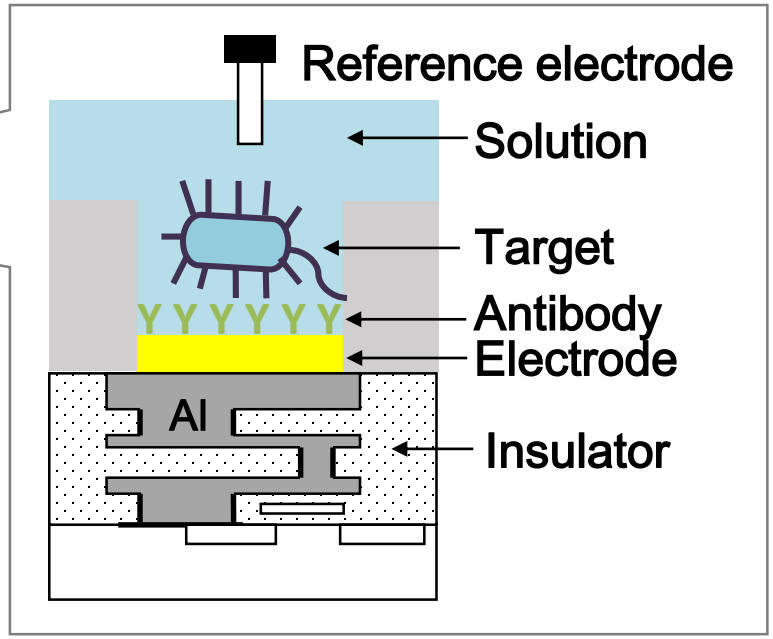
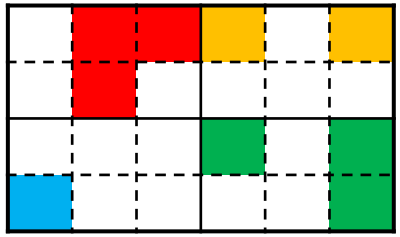
Research object

Realization of high-sensitivity bacteria counting chip



CMOS sensor chip



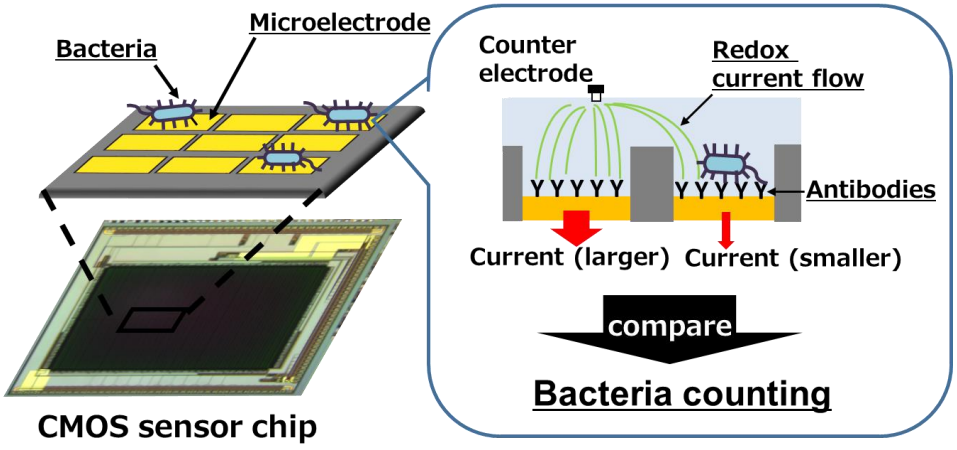


Detection

A = 3	B = 2
C = 1	D = 3

Bacteria Counting

A CMOS amperometric sensor



- 0.6-μm standard CMOS
- Electrode size: 1.2 μm × 2.05 μm
- Array size: 1024 × 1024
- Detection resolution: 1 cell

■ The way to detect bacteria

In amperometry, redox current is reduced when bacteria is on the microelectrode.

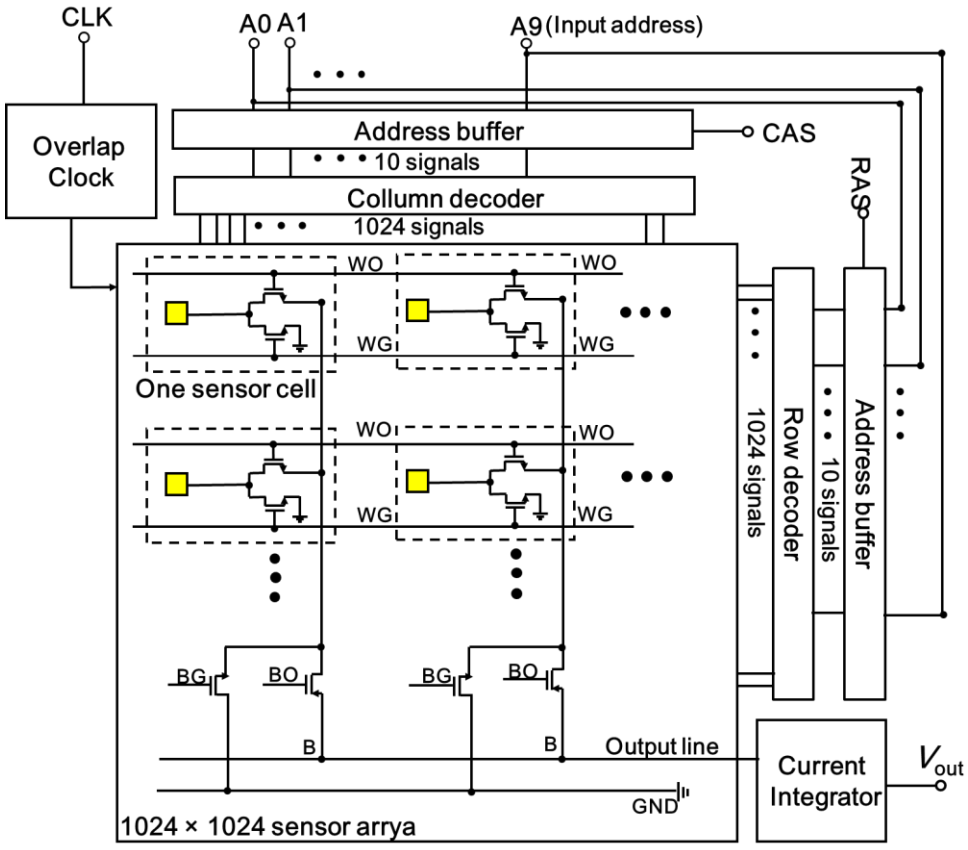
The circuitry in sensor chip measures redox current on each electrode and judge whether bacteria is on each electrode.

■ For high-sensitivity counting

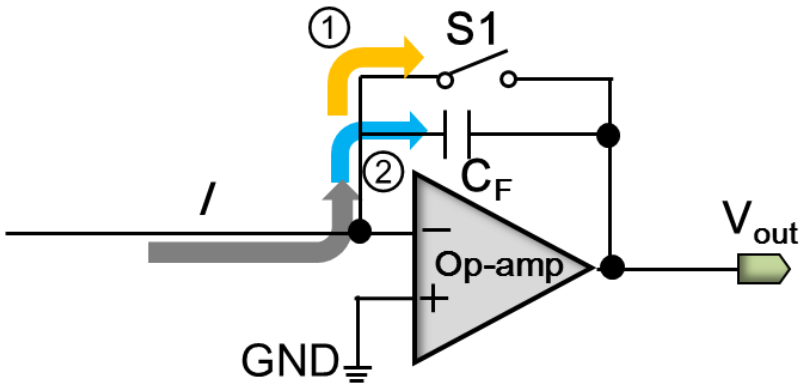
- We developed a microelectrode with size almost same to that of bacteria.(about 1 μm)
→ We can detect the number of bacteria.

- To reduce noise,
we integrated a current integrator.

System architecture



■ **Current integrator**



①Reset (S1:ON) $V_{out} = 0$

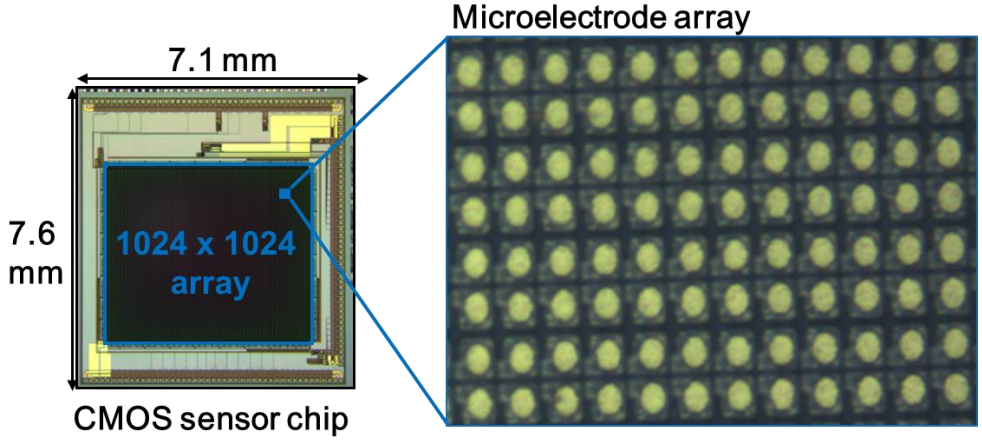
②Integration (S1:OFF)

$$V_{out} = -\frac{1}{C_F}\int_0^{T_{int}} Idt$$

Current integration reduce noise.
→Improving the detection sensitivity.

Chip microphotograph and measurement results

■ Chip microphotograph



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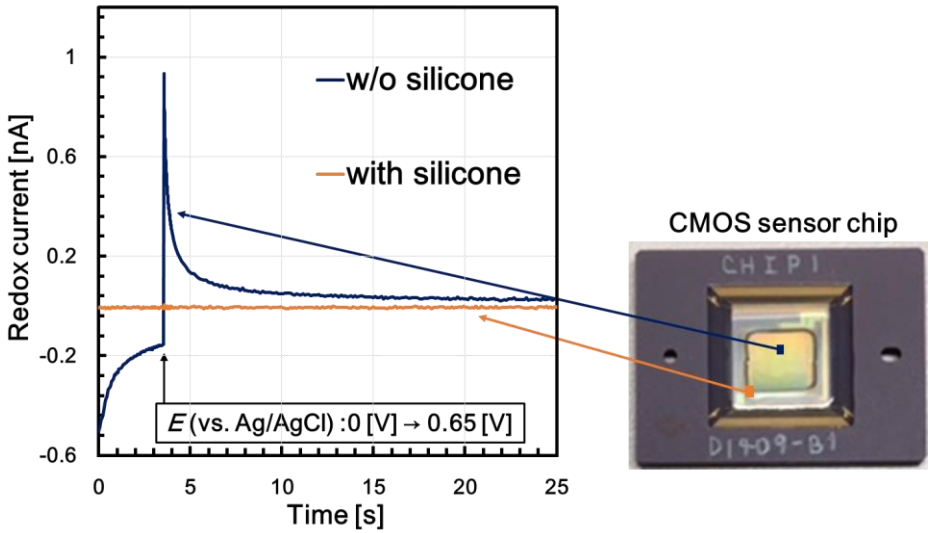
■ Partial 2D imaging of silicone



By comparing both waveforms, we can determine whether the silicone is on the electrode.