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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Realization of high-sensitivity bacteria counting chip

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

Detection  Bacteria Counting
**A CMOS amperometric sensor**

**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.

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

① Reset (S1:ON) $V_{out} = 0$

② Integration (S1:OFF)

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

Current integration reduces noise.
→ Improving the detection sensitivity.
Chip microphotograph and measurement results

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

- **Partial 2D imaging of silicone**

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