

Enhanced discrimination using additional polymer layers for a multiplexing ACh and pH image sensor

You-Na Lee¹, Koichi Okumura¹, Tatsuya Iwata¹, Kazuhiro Takahashi¹, Kazuaki Sawada¹

¹ Department of Electronics & Electrical Information Engineering, Toyohashi University of Technology, 1-1 Hibarigaoka, Tempaku, Toyohashi 441-8580, Japan

E-mail: 2.una.biblio@gmail.com

To elucidate neuronal signaling interplay, multi-target detection of neurotransmitters is crucial [1]. Therefore, we proposed in previous report a multiplexing bio-image sensor which was able to measure neurotransmitters such as adenosine triphosphate (ATP), acetylcholine (ACh) and pH distribution, simultaneously [2]. The developed sensor determines ATP and ACh concentrations by measuring the formed H^+ ions from an enzymatic reaction at the enzyme-immobilized pixels, because each pixels of 128×128 pixels bio-image sensor are working as pH sensors. However, the produced H^+ ions were easy to diffuse through buffer solution (RM) and detected at other nearby pixels as shown in figure 1 (a). It makes difficult to distinguish between the produced and H^+ ions and the diffused H^+ ions from nearby enzyme-immobilized pixels. In this study, to improve the discrimination, additional polymer layers were proposed and deposited on an ACh and pH image sensor with various thicknesses: 0, 1.8 and 3.6 μm . In figure 2, the bio-image sensor with 3.6 μm -thick layer enabled to measure the 42%-decreased output voltage at a pixel of 18.1 μm apart from an enzymatic reaction origin than without the polymer layer. We are considering the decreased diffusion of H^+ ions was caused by the porous structure and dangling bonds of polymer layers, as shown in figure 1 (b). The proposed polymer layer is expected to apply a multiplexing bio-image sensor in the future study.

REFERENCES:

- [1] R.S. Redman et al., J. Physiology, pp. 117-127, 1994.
- [2] Y.-N. Lee, et al., APCOT, Japan, pp.137-138, June 2016.

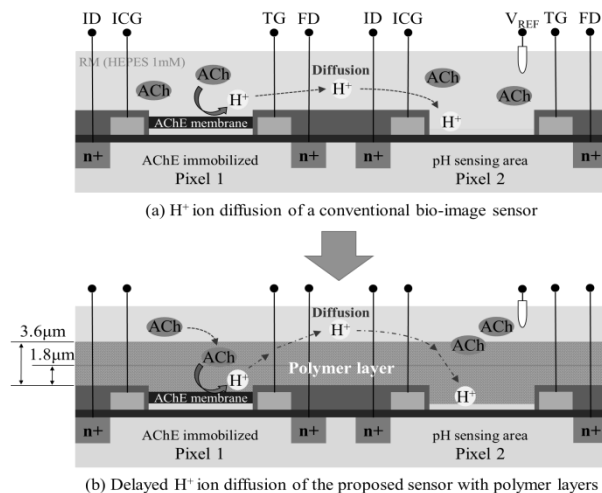


Figure 1: Comprised H^+ ion immigrations of a conventional and the proposed sensors.

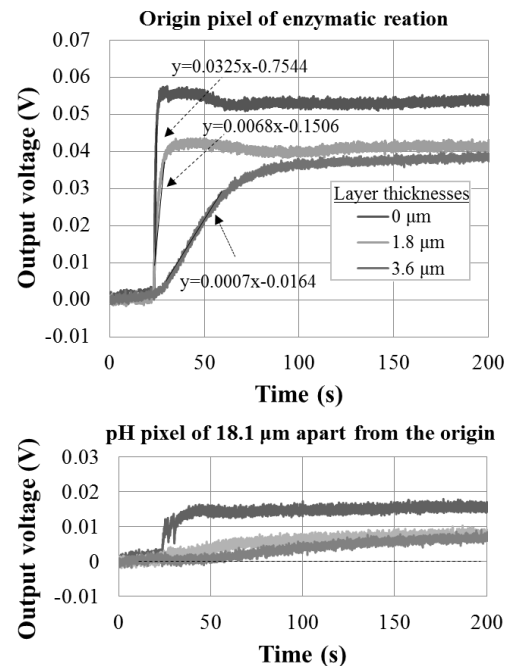


Figure 2: Measured output voltage vs. time results after and before dropping 10 mM ACh.