光硬化樹脂を用いた酵素パターニング技術の開発

Development of a pattering technique for enzyme-immobilized membranes using cross-linkable polymer ^oイ ユナ¹、堀尾 智子¹、奥村 弘一^{1,2}、岩田 達哉^{1,2}、高橋 一浩^{1,2}、石田 誠^{1,2}、澤田 和明^{1,2} (1. 豊橋技術科学大学、2. EIIRIS)

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Background

The neuronal communication in the brain is based on the complex interactions among the separately or multiply released neurotransmitters in nerve cells. Currently multi-detection methods using fluorescence microscopy is widely used to analyze the mechanism. But it has difficulties the fluorescent labeling of biomolecules. Therefore, to provide a more efficient method, we have been developing a multi-modal bio image sensor which can simultaneously detect the spatiotemporal information of the co-released neurotransmitters. In this study, as a progress of the development, we suggest a patterning technique for an apyrase-immobilized membrane on a bio image sensor. Cross-linkable polymer was considered as the most suitable material [1] and was experimentally demonstrated to fabricate the membrane.

Results and discussion

A cross-linkable polymer containing apyrase was deposited and patterned by lithography method on bio image sensor. The dimension of a pattern was $250 \times 250 \ \mu m^2$. The fabricated sensor with the apyrase-immobilized membrane was evaluated experimentally. The highest responsivity of the sensor was 0.035 V at 1 mM ATP concentration. And the limit of detection was 1 μ M. In figure 1, the optical image of the surface of the proposed sensor with the apyrase-immobilized membrane is shown. And the next five sequential 2-dimensional images are the measurement results of the ATP movement by the sensor. Just at the area where is the patterned membrane containing apyrase, ATP was reacted and determined by the increased output voltage. Those results successfully provide us the specific spatial information and temporal alternation of ATP movement.

[1] A. Sassolas, et al, "Immobilization strategies to develop enzymatic biosensors" Biotech. Advan. 30, 489-511, 2012.



Figure 1 Optical image and sequential reaction images of the patterned apyrase-immobilized membrane with ATP solution of 1 mm concentration.