비효소적 포도당 모니터링 마이크로 니들 시스템

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A Non-Enzymatic Glucose Monitoring Microneedle System

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Abstract

For an effective treatment of diabetes, continuous glucose monitoring (CGM) is necessary, because of unpredictable fluctuation of blood glucose of the patients. However, the high cost for the use of the available systems is the main obstacle for the adaptation by the patients. As the result, only 2 % of the patient could control their glucose using the system. The use of tiny small electric or optical sensors and the short replacing cycle less than 2 weeks might charge the high cost of the system. Therefore, we present a new strategy to replace a sensor in a cheap and to use a separated detecting unit. The sensor is composed of a microneedle and a glucose responding pad, which emits enhanced fluorescence upon combining with glucose. Since the microneedle and pad can be fabricated by simply pouring polymer to a mold and immobilizing the glucose responding dyes on a substrate, the replacing cost of the sensor could be affordable. In addition, the detecting unit consisting a LED and photodiode is reusable as long as their life-time allow. The performance of the proposed CGM system will be discussed during the presentation

Scheme and Methods

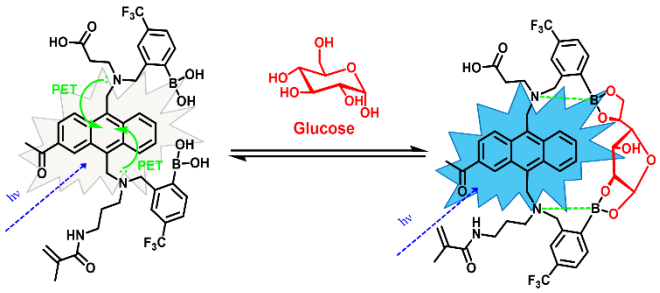

Fig.1 Glucose sensing molecules and its glucose sensing mechanism: As a result of the interaction between two boronic acids and glucose, Photoninduced Energy Transfer (PET) is inhibited and the fluorescence of the anthracene is restored

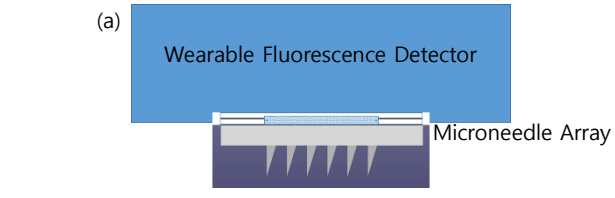

Fig. 2. Microneedle system: (a) Illustration of the system, (b) Microneedle Array and (c) Wearable Fluorescence Detecting Sensor

Results

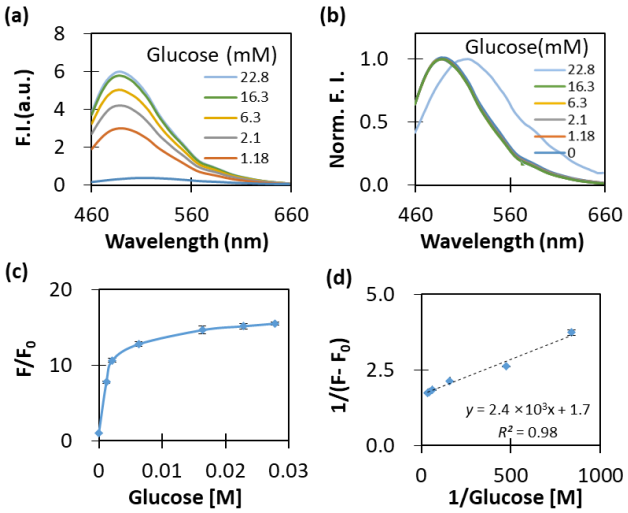

Fig 3. Glucose Sensing Performance. (a) Emission spectra and (b) normalized emission spectra for glucose at concentrations of 0–500 mg/dL. Fluorescence intensity at the maximum wave-length was used for the normalization. (c) Relative fluorescence intensity. (d) Benesi–Hildebrand plot.

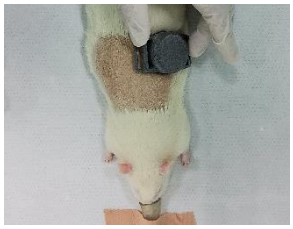

Fig 4. Animal test of the system

Conclusions

We successfully developed a non-enzymatic glucose monitoring system using a microneedle array and diboronic acid anthracene derivate. The glucose detecting performance fulfill the FDA requirement. Animal test using rat also showed promising result.

Acknowledgements

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References

[1] Choi, H.; Song, J.; Park, C.S.; Yim, HS.; Kim, J.H. "Acetylated trifluoromethyl diboronic acid anthracene with a large stokes shift and long excitation wavelength as a glu-cose-selective Probe." *Appl. Sci. 2022,* **12**, 2782

[2] Funtanilla, V.D.; Candidate, P.; Caliendo, T.; Hilas, O. Continuous glucose monitoring: A review of available systems. *Pharm. Ther. 2019*, **44**, 550

[3] Joseph, J.I. Review of the long-term implantable senseonics continuous glucose monitoring system and other continuous glucose monitoring systems. *J. Diabetes Sci. Technol*. 2021, **15**, 167