NANYANG TECHNOLOGICAL UNIVERSITY

CBC SEMINAR ANNOUNCEMENT

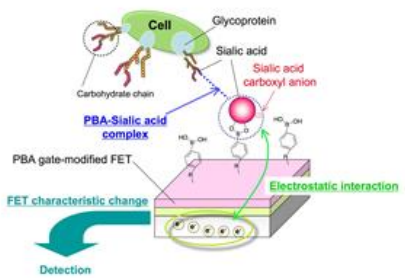
Professor Yuji Miyahara
Institute of Biomaterials and Bioengineering
Tokyo Medical and Dental University

Detection of Biomolecular Recognition Using Bio-Transistors

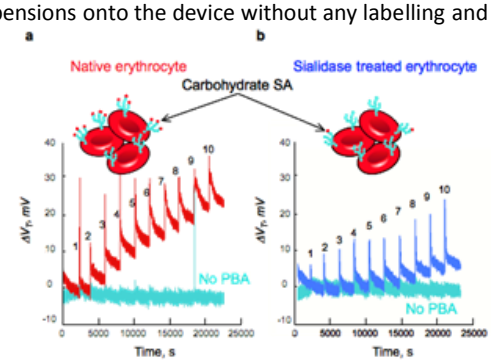
We have been investigating direct interaction between biomolecules and electrons in silicon. We have proposed the novel concept of a bio-transistor (Bio-FET) which is based on the direct transduction of charge density change of biomolecules into electrical signal by the field effect. Potentiometric measurements of allele specific oligonucleotide hybridization, intercalation and primer extension at the surface of the gate insulator have been demonstrated using a genetic field effect transistor. Since DNA molecules are negatively charged in an aqueous solution, hybridization event at the gate surface leads to charge density change in the channel of the FET and can be transduced into electrical signal directly without any labeling for target DNA molecules. One of the unique features of our method is to utilize a single-base extension reaction on the gate for DNA sequencing. Single-base mismatch of the target DNA as well as DNA sequencing could be successfully demonstrated with the use of the genetic FETs [1]. The genetic FET platform is suitable for a simple, accurate and inexpensive system for SNP typing and high throughput DNA sequencing in clinical diagnostics and molecular biology.

We also propose an oocyte-based field effect transistor (oocyte-based FET) for drug transport analysis, in which target transporters are expressed at the cell membrane of the oocyte. Non-invasive monitoring of the uptake kinetics of substrates mediated by membrane-bound transporters can be realized with oocyte-based FET. Discrimination of transporting ability among genotypes of the transporters could be realized using the oocyte-based FET [2].

A label free, potentiometric method to detect cell surface sialic acid (SA) using phenylboronic acid (PBA) compound integrated into the form of self-assembled monolayer (SAM) has been developed using a field effect transistor (FET) extended gold gate electrode [3-4]. Due to predominant binding between undisassociated PBA and SA at pH 7.4, we found that carboxyl anions of SA were exclusively detectable among other glycan chain constituent monosaccharides, as the change in threshold voltage (V_T) of the PBA-modified FET. The technique was applied to analyses of altered SA expressions on rabbit erythrocyte as a model for diabetes, as shown in Fig. 1. The comparative analyses revealed that the disease could be feasibly diagnosed simply by placing the cell suspensions onto the device without any labelling and enzymatic procedures.



a) Conceptual structure of FET for sialic acid detection



(b) Analyses of SA expressions on rabbit erythrocyte

Fig. 1 PBA-modified FET for detection of cell surface sialic acid

References

[1] T. Sakata and Y. Miyahara, *Angew. Chem. Int. Ed.*, 45, 2225-2228 (2006) [2] T. Sakata and Y. Miyahara, *Anal. Chem.* 80, 1493-1496 (2008) [3] A. Matsumoto, N. Sato, H. Cabral, K. Kataoka, and Y. Miyahara, *J. Am. Chem. Soc.*, 131, 12022–12023 (2009). [4] A. Matsumoto, H. Cabral, N. Sato, K. Kataoka, and Y. Miyahara, *Angew. Chem. Int. Ed.*, 49, 5494-5497 (2010)

Date:	**25th September 2012 (Tuesday)**
Time:	**4:00pm – 5:30pm**
Venue:	**NTU SPMS CBC Building Level 2, Conference Room**
Host:	**Asst Professor Martin Pumera**