17p-E14-11

Continuous potential measurement of DNA modified sensing surface using analog circuit towards point of care detection

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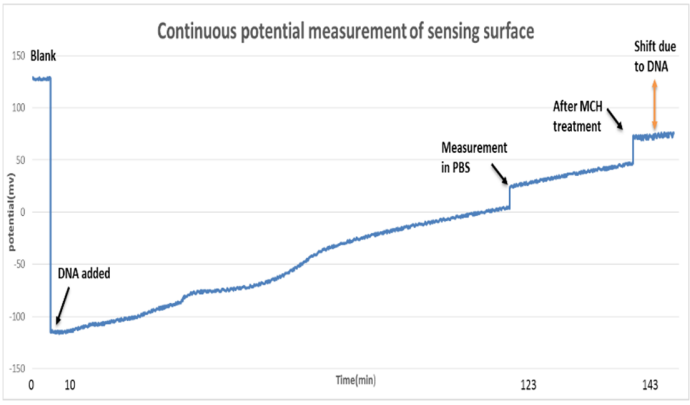
DNA sensor has great importance in genomic studies and clinical applications such as disease diagnosis, drug discovery etc. Most conventional DNA detection techniques include attachment of fluorescence label to the target molecule for readout purpose which is expensive, time consuming, lacks portability. Therefore, label free detection has been prime interest among scientists in recent times. There have been reports on the development of field effect transistor based devices [1, 2] which are often substantially affected by post passivation of sensing surface, integration of floating type electrode and costs. CMOS based devices [2] though integrate multiple sensing and readout electronics in a very small areas, often lacks reusability and disposability. Moreover these kinds of devices do not provide support for fluid transport and therefore lacks true portability. A fully electronic biosensor that is really fast, robust, portable and inexpensive is a challenge yet to achieve. Our aim is to develop an analytical tool that can meet such criteria and can be used for multiple target detection and analysis.

Toward this, recently we presented our work [3] on label free DNA sensing through surface potential measurement using simple analog circuit made of low cost discrete components and were able to detect significant potential shift for very low concentration (1 uM) of target molecule. We further fabricated [4] small patterned electrodes surrounded with PDMS wall and employed differential measurement to increase sensitivity and selectivity. The fig.(right) shows the continuous potential measurement of sensing surface during different modification steps of DNA immobilization such as blank, DNA solution, buffer, MCH treatment etc.. Such kind of continuous detection technique shows the possibility of making a fully portable microfluidic based DNA sensor for future point of care detection.



We next aim to work on microfluidic device to integrate it with our sensing electrodes and readout circuit towards making a Lab-on-chip device. There are few mentions [5] of using microfluidic device with electronic sensing. But most of them used it partially for example, using PDMS wall only to supply, incubate measurement buffer etc. However, integration of microfluidic device can add total flexibility in handling any kind of samples that is necessary throughout the measurement such as supply and mixture of probe and target molecules and measurement buffer. With such kind of device continuous measurement of sensing surface and therefore detection of target analytes will be possible on the same device with only little amount of samples.

[1] D. Gonc¸alves et al., "*Detection of DNA and proteins using amorphous silicon ion-sensitive thin-film field effect transistors*" Biosensors and Bioelectronics 24 (2008) 545–551
[2] K.-H. Lee et al., "*A CMOS label-free DNA sensor using electrostatic induction of molecular charges*", Biosensors and Bioelectronics 31 (2012) 343– 348
[3] Tanzilur Rahman, Takanori Ichiki, "*Direct potential measurement for label free DNA hybridization detection using discrete electronic circuit*", 74th JSAP Autumn Meeting, 2013, Kyoto, Japan
[4] Tanzilur Rahman, Takanori Ichiki,"*DNA hybridization detection through differential potential measurement on a patterned gold multi electrode using analog circuit*", 23rd Annual Meeting of MRS-J, Yokohama, Japan
[5] Seokheun Choi et al.,"*Microfluidic-based biosensors toward point-of-care detection of nucleic acids and proteins*", Microfluid Nanofluid (2011) 10:231–247

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