Nanosensor for diabetes management

Diabetes is a major health concern for millions around the world. In addition to the analysis of free glucose level in blood, glucose bound to haemoglobin (HbA1c) is considered to be a very useful diagnostic marker for diabetic patients. The amount of HbA1c in the erythrocytes increases with the average concentration of glucose present in the blood. As it shows the average blood glucose level over the 2-3 months before because of 100-120 days life span of erythrocyte's. The measurement of HbA1c is important for clinical long-term blood glucose control in persons with diabetes mellitus. HbA1c has also been linked to complications of vital organs such as the kidney, heart and eyes in diabetic patients.

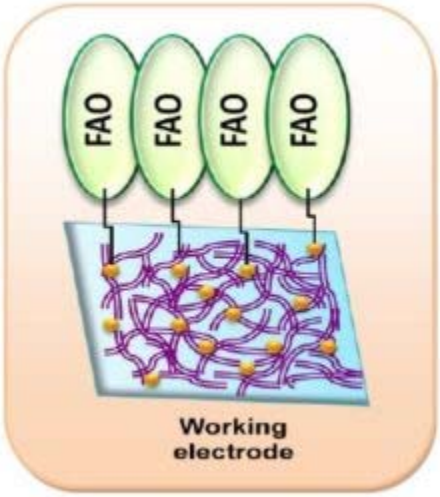

Fig. 1. Graphical model for nanoparticles and enzyme modified working electrode.

Present methods for estimation of HbA1c levels are time-intensive and require significantly trained person. To develop a simpler method, Dr. Jain and his research group modified the working electrode with Au nanoparticles (GNPs)-dotted tubular TiO_2, for the construction of an electrochemical HbA1c biosensor. A reducer (12-phosphotungstic acid) has been used after depositing well-dispersed GNPs on TiO_2 nanotubes (TiO_2 NTs), which work as an electron intermediate to improve the catalytic reaction of enzyme. It also increases the long term stability of the sensor. Finally, fructosyl amino-acid oxidase enzyme was attached to the nanoparticles-modified ITO electrode (Fig. 1).

The researchers tested the sensing efficacy of the working electrode using whole blood samples collected from diabetic patients. First, they treated the whole blood samples with enzyme protease, which broke down HbA1c and released fructosyl valine. The biosensor became active in the presence of fructosyl valine, with the measured current being directly proportional to the fructosyl valine concentration. High levels of fructosyl valine help to measure the concentration of HbA1c.

Nanoparticles incorporated biosensor exhibited low detection limit (0.5 μM) and fast response time (3 s). The biosensor lost 50% of its initial efficacy after 100 uses over a period of 4 months when stored at 4 ºC. The researchers say that the biosensor is simple to use, fast and highly sensitive, making it potentially useful for HbA1c detection. This biosensor prototype could be used effectively as the basis for HbA1c determination for diabetic patient's medical management.

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Glycated hemoglobin biosensing integration formed on Au nanoparticle-dotted tubular TiO2 nanoarray.
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