Noninvasive Glucose Detection in Saliva with Organic Transistors

Medical Device

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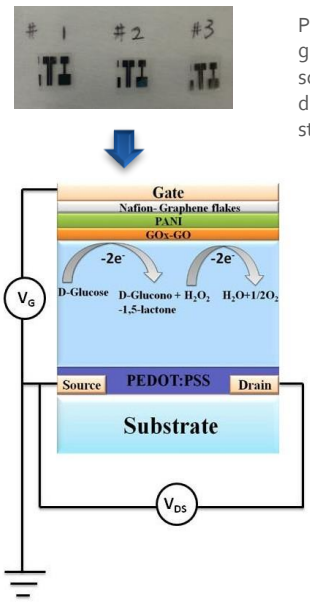
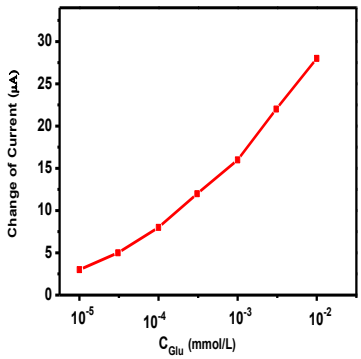
. Sensitive, Selective, Flexible and Low-cost Biosensor .

Diabetic patients need to monitor blood glucose level regularly and frequently, however conventional methods of taking blood sample for measuring glucose level are painful. To tackle this problem, we successfully developed an ultra-sensitive organic electrochemical transistor (OECT)-based biosensor which could detect glucose in saliva by no invasive approaches. The newly invented biosensor is highly sensitive to glucose and capable of measuring the range of glucose in saliva accurately in a convenient, safe and inexpensive manner.

The biosensor is fabricated with a glucose oxidase enzyme (GOx) layer, which is specifically sensitive to glucose. By detecting the electrical current, the glucose level can be calculated accordingly. To block other active biological elements in saliva (e.g,.dopamine, uric acid and ascorbic acid, etc,.), a thin layer of Polyaniline (PANI) / Nafion-graphene bilayer film was coated between the top enzyme layer and gate electrode. The highly sensitive biosensor shows a low detection limit of 10^{-5} mmol/L, which is nearly 1000 times sensitive than the conventional electrochemical approaches for measuring blood glucose. More importantly, the glucose biosensor fabricated on flexible substrates can perform in a variety of curved and moving surfaces, including human skin, smart textile and medical bandage. Thus, it has great potential for development into wearable electronic applications, such as wearable biosensor for analysis of glucose level in sweat during exercise.



Pictures of our fabricated glucose sensor (Above) and schematic picture demonstrate the modification strategy (Right).



Current change response of the glucose sensor device as a function of glucose level in human saliva sample.

Change of current signals μA	Glucose level mmol/L
3	10^{-5}
5	3×10^{-5}
8	10^{-4}
12	3×10^{-4}
16	10^{-3}
22	3×10^{-3}
28	10^{-2}

Representative Publications

1. Flexible Organic Electrochemical Transistors for Highly Selective Enzyme Biosensors and Used for Saliva Testing, Caizhi Liao, Chunhin Mak, Meng Zhang, Helen L.W. Chan and Feng Yan*, Adv. Mater. 27, 676-681 (2015).
2. Flexible Organic Electronics in Biology: Materials and Devices, Caizhi Liao, Meng Zhang, Mei Yu Yao, Tao Hua, Li Li*, Feng Yan*, Adv. Mater. 27, 7493-7527 (2015).

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