Single-walled carbon nanotube-based optical sensors for continuous glucose monitoring

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Abstract

One of the major threats to public health in the 21st century is diabetes mellitus, which is on the rise worldwide causing more than 3.7 million deaths per year [1]. In the absence of a cure it is essential for patients with diabetes to continuously monitor their blood glucose levels to minimize the risk of complications. This leads to an increasing demand for accurate, cost-effective and convenient glucose monitoring devices.

Semiconducting single-walled carbon nanotube (SWCNT)-based sensors are promising candidates among the "new generation" of biosensors for glucose monitoring [2]. SWCNTs fluoresce in the range between 900 and 1300 nm and this near infrared emission is highly sensitive to the surrounding environment. Due to the low absorbance of near infrared light by tissue the signal that is emitted from the SWCNT can be continuously recorded through the skin, Moreover, when the surface of the SWCNT is decorated with proteins that have high affinity for glucose we can design a saccharide-specific, implantable near infrared sensor.

In the scope of this work we will design and study optical properties of SWCNT-based glucose sensors (Figure 1, a). The protein candidate that we have chosen for this study is glucose oxidase (GOx) because it not only selectively binds to glucose, but also changes its redox potential in its catalytic cycle (Figure 1, b). [3]. We believe that modulation of the redox state alters fluorescence response of the SWCNT, enabling us to design a continuous monitoring sensor (Figure 1, c).

References

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[2] Veiseh, O., Tang, B. C., Whitehead, K. A., Anderson, D. G., Langer, R., Nature Reviews Drug Discovery, **14** (2015) p. 45
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Figures

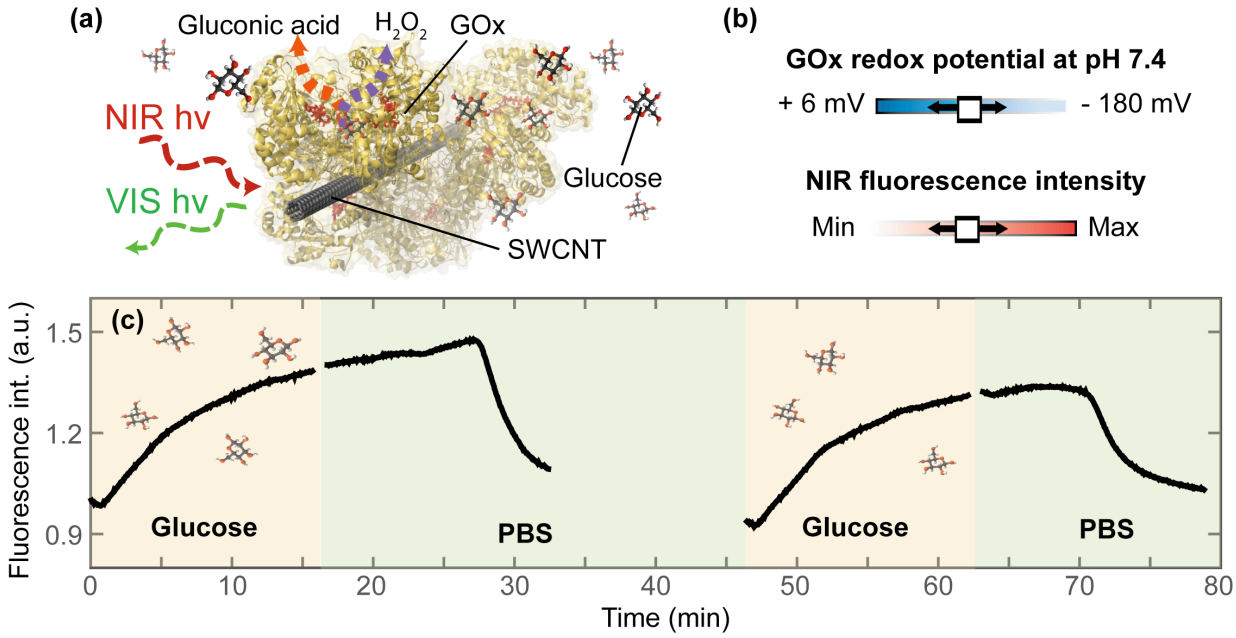

Figure 1: (a) Cartoon representing the working principle of the SWCNT-GOx sensor. **(b)** Change of GOx redox potential during glucose oxidation correlates with changes in SWCNT-GOx fluorescence intensity. **(c)** Fluorescence intensity of the SWCNT-GOx sensor after 30 mM glucose solution in phosphate-buffered saline (PBS) and PBS were sequentially administrated to the sensor.