MINIATURE BIOSENSOR FOR DETECTION OF GLUCOSE AND LACTATE IN BLOOD

Description

It is proposed bionanotechnology to create a sensitive low-cost biosensor for glucose and lactate level detection in blood, based on the carbon nanotubes emission. This technology utilizes the NIR luminescence of semiconducting single-walled carbon nanotubes bound with recognizing biosystems (enzymes: glucose oxidase, lactate oxidase). For this purpose using small diameter nanotubes (0.6-1.1 nm) are preferable because its emission can be detected in the spectral range 0.9-1.2 mkm by a conventional low-cost CCD matrix or photomultiplier. In this spectral range human tissues are optically transparent and a sensor can be implanted into the body. The central issue in designing and forming such devices is a creation of the interface between the nanotube and the recognition biosystem. To avoid loss of intrinsic nanotube properties upon chemical modification, a noncovalent nanotube functionalization will be applied. In this R&D we propose two approaches to the functionalization of small diameter nanotubes. First, a chemical compound whose flat part couples with the nanotube surface by means of the p-p interaction and with the linker immobilized by the enzyme will be identified and synthesized. Another possible approach to the non-covalent nanotube functionalization is using polymer wrapping around the tube. A method of enzyme immobilization on polymer-wrapped nanotube will be developed.

Distinctive features of proposed R&D are:

- noncovalent functionalization of small-diameter nanotubes by specially synthesized chemical compound;
- efficient enzyme immobilization on small-diameter noncovalent functionalyzed nanotubes;

application of conventional CCD matrix or photomultipliers for emission detecting.

Innovative Aspect and Main Advantages

An important advantage of the glucose and lactate sensors we propose to develop is the possibility of implanting the sensors directly into the tissue and using them for continuous monitoring. Proposed glucose and lactate sensor will detect optical signal in the near infrared spectral region where human tissues are optically transparent. Such a biosensor does not require outside power to operate and the information from the sensor can be obtained by means of wireless communication.

Areas of Application

Medicine, veterinary.

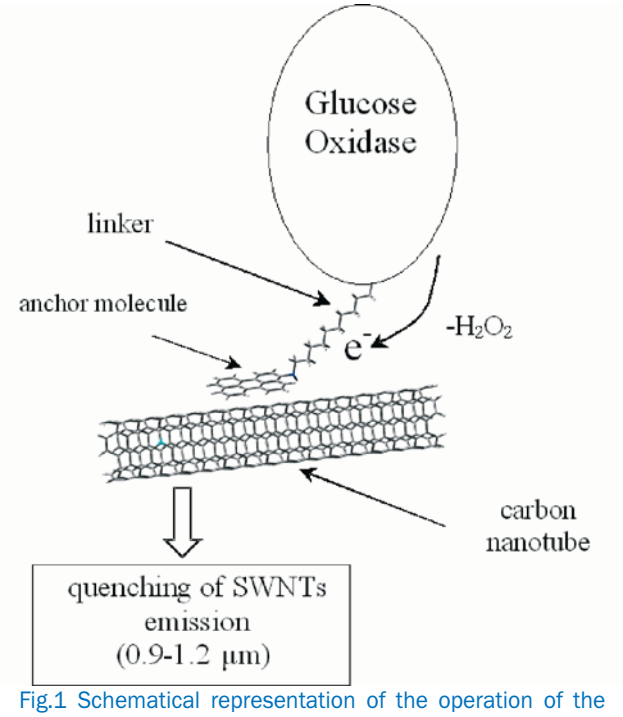

Fig.1 Schematical representation of the operation of the glucose biosensor

Stage of Development

The biosensor is under development.

Influence of glucose level in aqueous solution on the nanotubes emission intensity was tested. It was found out that enzyme immobilized on DNA-wrapped nanotubes keeps its native activity.

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