华东师范大学学报(自然科学版) 2009 2009 (5): 37-44 ISSN 1000-5641 CN 31-1298/N

应用物理 电子学

改善酶固定以增强葡萄糖传感器的生物电化学活性

杜伟杰[1]， 娄 蕾[1]， 朱自强[1]， 王依婷[2]， 朱建中[1]

1. 华东师范大学 信息科学技术学院， 上海 200062；
2. 华东师范大学 科学与技术跨学科高等研究院, 上海 200062

收稿日期 2009-1-6 修回日期 2009-2-20 网络版发布日期 2009-9-18 接受日期 2009-9-15

摘要 研制了一种基于多壁碳纳米管(MWCNTs)和氧化锌(ZnO)纳米颗粒协同作用的高灵敏稳定的葡萄糖传感器. 将ZnO颗粒淀积在带有负电荷的MWCNTs层上，由于等电点（IEP）的差异，葡萄糖氧化酶（GOx）能够牢固地固定在ZnO颗粒表面，最后将一层带正电的的聚二烯丙基二甲基氯化铵(PDDA)覆盖在GOx上. 这种特殊的自组装三明治结构(PDDA/GOx/ZnO/MWCNTs)能够很好地保持GOx的活性并防止酶泄露. 在0.05 mol/L的磷酸盐缓冲溶液（pH=6.8）中进行检测，电压为100 mV(参比为Ag/AgCl电极)；用0.5单位GOx测得线性反应区域为0.1~16 mmol/L；用2.0单位GOx测得灵敏度为50.2 (mA•cm^{-2}•mol^{-1})，检测下限为 250 nmol/L (3σ) . 通过葡萄糖传感器直接检测100例人血清,与临床光学检测的结果比较发现，相关系数达到0.997.

关键词 葡萄糖传感器 葡萄糖氧化酶 MWCNTs ZnO纳米颗粒 协同作用

分类号 00657.1

Improved enzyme immobilization for enhanced bioelectrocatalyticactivity of glucose sensor (Chinese)

DU Wei-jie[1], LOU Lei[1], ZHU Zi-qiang[1], WANG Yi-ting[2], ZHU Jian-zhong[1]

1. Shcool of Information Science and Technology, East China Normal University,Shanghai 200062, China; 2. Institute for Advanced Interdisciplinary Research,East China Normal University, Shanghai 200062, China

Abstract

A highly sensitive and stable glucose sensor based on the synergic action of multi wall carbon nanotube (MWCNTs) and ZnO nanoparticles was developed. Glucose oxidase (GOx) was firmly immobilized on the ZnO nanoparticles surface due to their large difference in the isoelectric point (IEP), while the ZnO nanoparticles were deposited on the negatively charged MWCNTs layer. A cationic polydiallyldimethylammonium chloride (PDDA) layer was coated on the GOx layer. The unique sandwich-like layer structure (PDDA/GOx/ZnO/MWCNTs) formed by self-assembling provides a favorable microenvironment to keep the bioactivity of GOx and to prevent enzyme molecule leakage. Amperometric detection of glucose was carried out at 100 mV (vs. Ag/AgCl) in 0.05 mol/L phosphate buffer solution (pH 6.8); a wide linear response range of 0.1 to 16 mmol/L was measured by a sensor with 0.5 units GOx; a sensitivity of 50.2 mA•cm^{-2}•mol^{-1} and a detection limit of 250 nmol/L (3σ) were measured by a sensor with 2.0 units GOx. Results obtained from the glucose sensor directly in human blood serum were compared with ones obtained by spectrometry by a local hospital. On testing 100 samples of serum, the correlation coefficient reaches 0.997.

Key words glucose sensor glucose oxidase MWCNTs ZnO particles synergic action

DOI:

通讯作者 朱建中 jzzhu714@163.com