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微纳技术与精密机械

GGBP蛋白修饰的表面等离子共振微创血糖检测仪

栗大超*，李国卿，张晶鑫，于海霞，徐可欣

天津大学 精密测试技术及仪器国家重点实验室，天津 300072

摘要： 根据基于微流控芯片的组织液透皮抽取系统设计了一种小型化微创人体血糖检测仪器。该仪器基于微创的方法，利用真空负压抽取人体组织液，并采用表面等离子共振（SPR）技术，通过检测皮肤真皮层组织液中的葡萄糖浓度来预测血液中的葡萄糖浓度。通过绑定对葡萄糖具有特异性吸附的D-半乳糖/D-葡萄糖结合蛋白(D-GGBP)，对SPR传感器表面进行预处理，实现对葡萄糖分子的特异性吸附。实验配制了不同浓度的葡萄糖溶液，检测并得出葡萄糖溶液浓度与折射率的关系曲线。应用课题组设计的微创血糖检测仪，实验测量了葡萄糖溶液浓度与组织液浓度，并与血糖仪测量得到的葡萄糖溶液浓度进行了比较。结果表明，使用GGBP修饰过的表面等离子共振传感器测量葡萄糖水溶液浓度的下限为0.625 mg/dL，当葡萄糖水溶液浓度在0.625~5 mg/dL时有较好的线性。通过测试实验验证了该仪器的可行性，显示了结合GGBP蛋白的SPR测量技术在微创血糖检测领域有良好应用前景。

关键词： 血糖检测仪 表面等离子共振 D-半乳糖/D-葡萄糖结合蛋白（GGBP） 组织液 微创

Minimally-invasive blood glucose detection instrument based on surface plasmon resonance sensor decorated with GGBP

LI Da-chao *, LI Guo-qing, ZHANG Jing-xin, YU Hai-xia, XU Ke-xin

State Key Laboratory of Precision Measuring Technology and Instrument, Tianjin University, Tianjin 300072, China

Abstract: A portable minimally-invasive human blood glucose detection instrument was designed by a microfluidic chip based interstitial fluid transdermal extraction system. On the basis of the minimally-invasive method, the instrument utilizes a vacuum pressure to extract the interstitial fluid from human body, adopts the Surface Plasmon Resonance (SPR) technology to measure the glucose concentration of the interstitial fluid, and then predicts the blood glucose concentration with the glucose concentration of the interstitial fluid. Moreover, by immobilizing D-galactose/D-glucose Binding Protein (D-GGBP) which has a specific adsorption function to the glucose, it preprocesses the surface of the SPR sensor and realizes the specific adsorption of glucose molecules. In the experiment, the glucose solution with different concentrations was prepared and detected. According to the experimental results, the curve illustrating the relationship between glucose concentration and refractive index was obtained. In addition, the glucose solution and interstitial fluid were measured by using minimally-invasive blood glucose detection instrument designed by our research group. The test result was compared with that measured by a glucose meter. The experimental result indicates that the glucose detection resolution could reach 0.625 mg/dL using the SPR sensor decorated with the GGBP. It shows a good linearity when the glucose concentration ranges from 0.625 mg/dL to 5 mg/dL. The experiment verifies the feasibility of the instrument, and demonstrates that the SPR technology with immobilized GGBP will obtain a wide application in the field of minimally-invasive glucose measurement.

Keywords: Glucose detection instrument Surface plasmon resonance D-galactose/D-gluocose Binding Protein (GGBP) Interstitial fluid Minimally-invasive

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通讯作者: 李国卿

作者简介: 栗大超(1976-)，男，河南南阳人，博士，副教授，硕士生导师，2001年、2004年于天津大学分别获得硕士和博士学位，2004~2006年在北京大学微电子学研究院“微米/纳米加工技术国家重点实验室”从事博士后研究工作，2006~2008年于美国CWRU大学电子工程系从事博士后研究工作，主要从事微系统技术与微型仪器、生物医学检测技术、精密测试技术及仪器等领域的研究。
作者Email: liguoqing@tju.edu.cn

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