

SPCE Based Glucose Sensor Employing Novel Thermostable Glucose Dehydrogenase, FADGDH: Blood Glucose Measurement with 150nL Sample in One Second

Hideaki Yamaoka, M.S.¹ and Koji Sode, Dr. Eng.^{1,2}

Abstract

Background:

Self-monitoring of blood glucose (SMBG) is an important component of the modern therapy for diabetes mellitus. Thanks to the current progress in electronics and sensor fabrication technology, both the time and the blood sample volume required for the measurement have decreased drastically. However, devices that work with an even smaller sample volume and a shorter measurement time are in demand.

Methods:

A disposable glucose sensor that works with an ultra-small sample volume was developed employing the novel thermostable glucose-dehydrogenase (FADGDH) complex composed of a catalytic subunit, an electron transfer subunit (cytochrome c), and a small subunit. The electrode is a screen-printed carbon electrode (SPCE), and hexaammineruthenium (III) chloride (Ru complex) is utilized as the electron mediator. A disposable enzyme sensor was constructed by depositing the FADGDH complex and Ru complex onto the SPCE, and the sensor performance was evaluated.

Results:

Whole-blood glucose can be measured within 1 sec using this enzyme sensor and a 150-nL whole-blood sample, with high precision (>0.99) and high reproducibility ($CV < 0.45\%$) within the glucose concentration range of 0-533 mg/dL. The sensor reading was stable for more than 60 days even at 70°C.

Conclusions:

The simplicity of the construction and the high precision of this FADGDH-based glucose biosensor makes it an alternative to previously reported commercially available glucose sensors. Especially the sample volume of 150 nL and the 1-sec measurement time are the highest specifications in the world for currently available glucose sensors designed for the SMBG.

J Diabetes Sci Technol 2007;1(1):28-35

Author Affiliations: ¹Department of Biotechnology, Graduate School of Engineering, Tokyo University of Agriculture and Technology, Koganei, Tokyo; and ²Department of Technology Risk Management, Graduate School of Technology Management, Tokyo University of Agriculture and Technology, Tokyo

Abbreviations: (CV) coefficient of variation, (PQQGDH) pyrroloquinoline quinone glucose dehydrogenase, (R) correlation coefficient, (SPCE) screen-printed carbon electrode, (SMBG) self-monitoring of blood glucose, (TB) time base

Keywords: catalytic, glucose, glucose-dehydrogenase (FADGDH), recombinant, sensor

Corresponding Author: Koji Sode, Dr. Eng., Department of Biotechnology, Graduate School of Engineering, Tokyo University of Agriculture and Technology, 2-24-16 Naka-cho, Koganei, Tokyo, 184-8588, Japan; email address sode@cc.tuat.ac.jp