Fabrication of glucose micro sensor

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The importance of glucose determinations for the diagnosis and effective treatment of diabetes has been well recognized. Therefore, much effort has been devoted to developing an effective sensor for the continuous estimation of glucose concentration in subcutaneous tissue [1-6]. Nevertheless, improvement of the lifetime and compatibility of the glucose sensors in the biological environment is still essential for practical application. Miniaturization of the sensor device is also an important subject, since smaller devices are less invasive, both physically and psychologically. A finer device will excite fewer pain receptors in the skin and will cause less tissue damage and less pain. However, since the miniaturization lead to easy distortion and fraction of the sensor, it was difficult to fabricate finer sensor device than 200 μm diameter with enough strength to maintain its function implanted in the body. In this study, super-elastic Ni-Ti alloy wire was applied as core material and platinum thin film was sputtered on its surface. Glucose oxidase (GOx) was immobilized on the platinum surface using electropolymerization technique [7-10]. Glucose sensor properties of the obtained electrode were investigated.

Enzyme immobilized electrodes were fabricated using super-elastic Ni-Ti alloy wire with the diameter of 50 to 200 μm. After the Pt sputtering on the surface of Ni-Ti alloy wire, dielectric polymer film was coated leaving the both ends uncovered, one for sensing region and the other for electric connection. Then the electrode was soaked in the solution of GOx, 1-(6-D-gluconamidohexyl) pyrrole (**GHP**) and $LiClO_4$, and applied a constant potential of 1.2 V (vs. Ag/AgCl), in order to electropolymerized **GHP** on the platinum surface. Amperometric responses of the prepared electrodes to glucose were examined by measuring the electrooxidation current at a potential of 0.55 V (for hydrogen peroxide detection). The calibration of the sensor was carried out by adding increasing amounts of glucose to the stirred phosphate buffer solution (pH 7.4).

GOx immobilized electrode prepared from 200 μm diameter Ni-Ti wire performed good response up to 22 mM glucose. However, the linear relationship between response current and glucose concentration was up to 5mM. The electrode prepared from 50 μm diameter Ni-Ti wire also performed as glucose sensor while the sensitivity was lower than that prepared from 200 μm diameter.

References

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