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ORIGINAL ARTICLES

Toward an Injectable Continuous Osmotic Glucose Sensor

Erik Johannessen, Ph.D.,[1] Olga Krushinitskaya, M.Sc.,[1] Andrey Sokolov, M.D.,[2] Philipp Häfliger, Ph.D.,[3] Arno Hoogerwerf, Ph.D.,[4] Christian Hinderling, Ph.D.,[5] Kari Kautio, M.Sc.,[6] Jaakko Lenkkeri, Ph.D.,[6] Esko Strömmer, M.Sc.,[6] Vasily Kondratyev, Ph.D.,[6] Tor Inge Tønnessen, M.D., Ph.D.,[7] Tom Eirik Mollnes, M.D., Ph.D.,[2] Henrik Jakobsen, M.Sc.,[1] Even Zimmer, M.Sc.,[8] and Bengt Akselsen, M.Sc.[8]

Abstract

Background:

The growing pandemic of diabetes mellitus places a stringent social and economic burden on the society. A tight glycemic control circumvents the detrimental effects, but the prerogative is the development of new more effective tools capable of longterm tracking of blood glucose (BG) *in vivo*. Such discontinuous sensor technologies will benefit from an unprecedented marked potential as well as reducing the current life expectancy gap of eight years as part of a therapeutic regime.

Method:

A sensor technology based on osmotic pressure incorporates a reversible competitive affinity assay performing glucose-specific recognition. An absolute change in particles generates a pressure that is proportional to the glucose concentration. An integrated pressure transducer and components developed from the silicon micro- and nanofabrication industry translate this pressure into BG data.

Results:

An *in vitro* model based on a 3.6 × 8.7 mm large pill-shaped implant is equipped with a nanoporous membrane holding 4–6 nm large pores. The affinity assay offers a dynamic range of 36–720 mg/dl with a resolution of ±16 mg/dl. An integrated 1 × 1 mm^2 large control chip samples the sensor signals for data processing and transmission back to the reader at a total power consumption of 76 μW.

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Author Affiliations: [1]Vestfold University College, Tønsberg, Norway; [2]Institute of Immunology, Oslo University Hospital, Oslo, Norway; [3]Institute of Informatics, University of Oslo, Oslo, Norway; [4]Swiss Center for Electronics and Microtechnology, Neuchâtel, Switzerland; [5]Zurich University of Applied Sciences, Wädenswil, Switzerland; [6]VTT Electronics, Oulu, Finland; [7]Department of Anesthesia and Intensive Care, Oslo University Hospital, Oslo, Norway; and [8]Lifecare AS, Bergen, Norway

Abbreviations: (aSi) amorphous silicon, (AAO) anodic aluminum oxide, (ASIC) application-specific integrated circuit, (BG) blood glucose, (BGM) blood glucose meter, ($CaCl_2$) calcium chloride, (CGM) continuous glucose monitoring, (Con A) concanavalin A, (ISO) International Organization for Standardization, (LTCC) low temperature cofired ceramic, ($MnCl_2$) manganese chloride, (MWCO) molecular weight cut-off, (NaCl) sodium chloride, (NC) negative control, (Q) quality, (Si) silicon, (SiO_2) silicon dioxide, (TCC) terminal complement complex, (σ) standard deviation

Keywords: CGM, injectable, microtechnology, nanotechnology, osmotic, pressure

Corresponding Author: Erik Johannessen, Vestfold University College, P.O. Box 2231, N-3103 Tønsberg, Norway; email address eaj@hive.no

Abstract cont.

Conclusions:

Current studies have demonstrated the design, layout, and performance of a prototype osmotic sensor *in vitro* using an affinity assay solution for up to four weeks. The small physical size conforms to an injectable device, forming the basis of a conceptual monitor that offers a tight glycemic control of BG.

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