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Hydrogen (H+) Ions the from Sweat is the New Measurement Methods of Ion-selective Sensor with Non-invasive Body Apparatus: Ergonomic and Easily Calibrated Design and Prototyping

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Abstract

An unavoidable consequence of aerobic metabolism is production of reactive oxygen species (ROS) in human body. ROS includes free radicals such as superoxide anion (O_2•−), hydroxyl radical (•OH), as well as non-radical molecules like hydrogen peroxide (H_2O_2), singlet oxygen ($^1O_2$) and so on. The higher ROS level impairs oxidant and antioxidant balance in the cell and it plays an important role for ROS related diseases such as cancer. However, H+ concentration can be determined from blood and is analysed by blood gas measurement way. This measurement way generates painful, unethical and side effects for human. H^+ ion concentration plays an important role for diagnosis of the many diseases and only the measurement way from blood so far. The purpose of the study to determine H^+ ion concentration from body sweat and design to real time measurement way by the ergonomic device for human body.

In the presentation of the study we have developed the wearable electrophysical sensor. This device has contained heat sensor and H ion selective sensor. The further of the investigation is plan to have ergonomic design a model equipment to real-time applications, then aim to be able to the production of medical device in the marketing area.

Keywords: Hydrogen ions; selective sensor ergonomic device; H^+ concentration; non-invasive measurement methods

Introduction

Non-invasive cardiopulmonary exercise testing (CPET) diagnosis of cardiovascular diseases in clinical field, are widely used in determining the effect of follow-up and treatment. With this exercise testing in patients with physiological functionality, performance, capacity (eg capacity, peak oxygen consumption (peak VO_2) is evaluated by repeated testing [1]. This testing system can measure VO_2 and VCO_2 uptake. The disturbance of the VCO_2/VO_2 uptake causes metabolic acidosis in the body and increase or decrease H^+ ions level. This acidosis level is defined by determining the concentration of free hydrogen radicals obtained by arterial blood gas. Local acidosis is a common feature of allergic, vascular, autoimmune and cancer diseases. However, few studies have addressed the effect of extracellular pH on the immune response. Low values of extracellular pH are usually found in tumours and inflamed tissues. Interstitial acidification (pH 5.5–7.0) is associated with the course of inflammatory reactions against infectious agents in peripheral tissues [2]. For instance, patients with rheumatoid arthritis show low pH values in the synovial fluid of compromised joints (6.5-7.0), having the acidic pH being associated with synovial fluid leukocytosis and joint damage [3]. This pH level can detect from blood samples, this is especially true in the case, elderly and hemophobic patients, for whom blood sampling is challenging.

Most devices described in the literature focus on measurement of physical characteristics such as motion, strain, stiffness, temperature, thermal conductivity, biopotential, electrical impedance, and related parameters [4,5]. Over decades, medical devices have been developed for detecting vital analyses using, optical, piezoelectric, and electrochemical transducers. Those invasive sensors have gained a dominating role in clinical diagnostic owing to their high performance, portability, simplicity and low cost. As we knowledge, a few sensor has been developed based on tatto potoentiometric ion-selective sensors for epidermal pH monitoring [6]. This sensor measures the pH level every 25 s without a calibration from skin. Currently, Ahyeon et al. reported that the type of device is thin and soft, microfluidic system that can measure directly and reliably harvest sweat from pores on the surface of the skin. This device can measure total sweat loss, lactate, glucose concentration and pH, especially use to a long distance cycling race [7].

Therefore, we aimed to design non-invasive wearable electro physical sensor for detecting of the H^+ level and also planning to cardiac damage parameters by real-time with calibration system from body sweat.

Methods

In the process, we do our work using computer aided design techniques. It fixed the main measurement transducer with calibration system on body chest. Moreover, we put in to the reference data; such as electrocardiography, in addition H+-ISFET with evaluating the data and transmitting electronic micro-computer control system and other additional system in the device with the battery is providing energy.

Conclusion

This product will be applied for continuous monitoring of wearer's health, tracking exercise activity, and assessing soldier performance. Also we are planning to apply field of the medical science, especially detecting for cardiac damage in patients and endurance athletes.

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