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Design and Fabrication Issues on Micromachined Oxygen Sensors for Miniaturized Energy Consumption Measurement Systems

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The size and cost of indirect calorimeters hinder their application in hospitals. This study employs micro-electromechanical systems MEMS techniques to develop oxygen sensors as one part of a miniaturized energy consumption measurement system for premature babies. Typically, the system is designed to operate at high oxygen concentrations. Accordingly, the current study deals with the development of oxygen sensors capable of sensing higher concentrations of oxygen at a low operation temperature of 150℃. The proposed gas sensors consist of a polysilicon resistor and a sensing metal-oxide film placed on a thermally isolated silicon-nitride membrane or bridge. The sensing film is a tin oxide sheet, which has been doped with a low concentration of 2wt% Li. This study involves the development of three different types of oxygen sensors, which are distinguished from each other by the structure of their microheaters. The first type is a microheater on a silicon nitride membrane, the second type employs a membrane located on a thin silicon layer, and the third type uses a bridge membrane with a thin underlying layer of silicon. At an operating temperature of 150℃, the power consumptions of these three sensors are found to be 24 mW, 223 mW and 1240 mW, respectively. The resulting experimental data indicate that the proposed oxygen sensors are capable of detecting oxygen with concentrations ranging from 21% to 50%, and that they exhibit a linear output behavior. These characteristics render the oxygen sensors suitable for use in most clinical applications within a hospital environment.

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