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Abstract of the Master Thesis

„Characterization of opto-chemical sensors for determination of pH, oxygen and dissolved carbon dioxide in a mobile blood gas analyzer "

Proper functioning of the human body requires, among others, a good balance of many substances present in different fluids. Blood is one of the most common fluids used to diagnose diseases or medical conditions. The acid-base state of the body can be determined through an arterial blood gas (ABG) test, since it allows the measurement of the amounts of oxygen and carbon dioxide in the blood, as well as its pH. An imbalance of such a state results in either acidosis when the pH is lower than normal or in alkalosis in the opposite case. This imbalance can be respiratory or metabolic and, depending on this, different symptoms are manifested.
An ABG test can be easily and accurately performed under laboratory conditions. However, some applications require portable equipment to perform such tests in-situ as fast and reliable as possible. As part of the development of a mobile blood gas analyzer device, this work focuses on the creation of a laboratory setup capable of characterizing opto-chemical sensors designed to measure pH, pO_2 and pCO_2 in blood. The setup comprises pieces of hardware and software composed by different elements. The most relevant components are a gas-mixer, a six-channel motorized valve, a peristaltic pump, measuring chamber and electronics, which allow the generation of the excitation signals and the measurement of the optical response signals.
The optimal configuration of the setup allows to perform stable and reproducible measurements under the principles of ratiometric and phase fluorimetry. The results obtained show that it is necessary to improve the manufacturing process of the sensors, in such a way that they are more uniform and present better characteristics of dynamic range, response time and resolution. On the other hand, it is important to carry out future measurements that enable a more complete characterization of the sensors. Some of these measurements are: Effect of different values of buffer solution as medium for the pCO_2 sensor, photobleaching and leaching study, and temperature and storage effect for all three sensors.
The implementation of some improvements in the setup is recommended, particularly in the measuring chamber to prevent light leakage from the light sources towards the detector. In addition, the gas-washing bottle must be redesigned so that it has a smaller capacity and diameter, thus reducing the previous time to dissolve the gas in the liquid medium to be used. Finally, the gas mixer must be automated and integrated into the measurement software, avoiding the use of an additional software and manual switches to activate the electro-valves. Despite these factors to improve, the developed setup constitutes an important basis for future characterization of the pH, pCO_2 and pO_2 sensors, to be used later in a mobile blood gas analyzer.

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