A CHEMFET MICROCELL SYSTEM FOR MEDICAL AND BIOTECHNOLOGICAL ONLINE ELECTROLYTE MONITORING

W. Gumbrecht, W. Schelter, B. Montag

Siemens AG, ZFE AMF 32, Paul-Gossen-Straße 100, D-8520 Erlangen

SUMMARY

A ChemFET microcell system for online electrolyte monitoring is described. The sampling sensor element only consists of a two lumen catheter and a sandwich flow through cell with spatially separated ISFETs, temperature sensor and heater. The required sample volume is about 10 µl.

1. INTRODUCTION

Since the first ChemFET paper of Bergveld (1970), many efforts have been made for the development of these devices [1]. The advantages over conventional sensors (e.g. ion selective electrodes) are well known, but there still remain problems like packaging, reference electrode and drift. With respect to in vivo application the problems of thrombogenic behaviour, calibration and toxic membrane components have to be emphasized.

Recent work about bloodelectrolyte monitoring evades the problems of catheter tip sensors by using ex vivo systems, connected directly to the patient [2,3]. But these advantageous methods suffer from rather complex assemblies.

In this paper a simple micro cell system is presented, which only consists of a two-lumen catheter combined with a sandwich flow through cell.

2. SAMPLING SENSOR ELEMENT

A silicon chip with two equal ISFETs is mounted on a chip carrier. A PMMA slide with engraved flow through channel serves as a cover and separates the two ISFETs by said channel. The latter is connected to the inner tube of a two lumen catheter, the outer lumen exceeding the length of the inner lumen.

3. SENSOR WORKING CYCLE

To calibrate the ISFETs, a calibration solution is pumped through the outer lumen of the catheter and is ejected into the flowing analyte. With a second pump a fraction of this solution is withdrawn from the catheter tip via the shorter inner lumen to the flow through cell (calibration mode). If the flowing direction in the outer lumen is reversed for some seconds, analyte is withdrawn into the inner lumen of the catheter. After reaching the first ISFET the difference output gives the measurement signal, because the second ISFET works as a reference (Fig. 1).

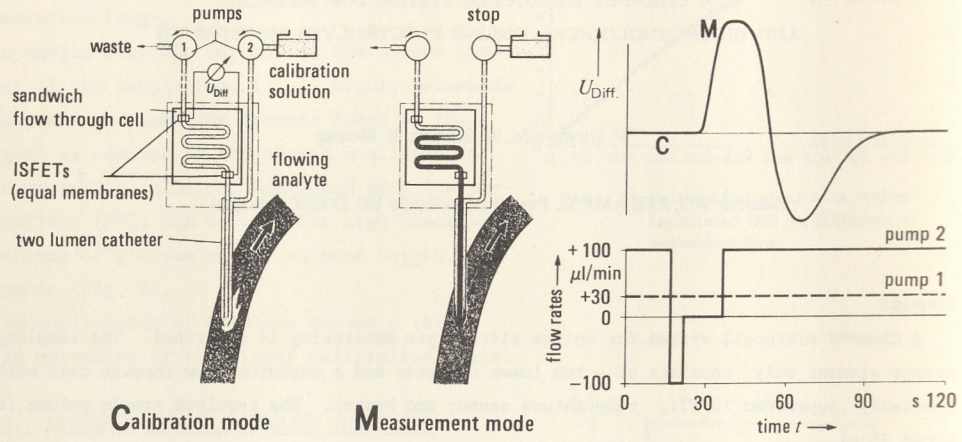

Fig. 1: Sensor Working Cycle

4. RESULTS AND DISCUSSION

Experimental data of Ringer solutions at room temperature were received with K+-selective membranes [4].

The time period of analyte membrane contact (20 s -> 10 µl sample volume) is only a fraction of the cycle time (2 min) so that contamination with analyte components (e. g. proteins) is minimized.

The time delay between calibration- and measurement registration is only 15 s, eliminating drift problems. In addition the differential measurement of two ISFETs with equal membranes, which are in contact with the same fluids (time averaged), leads to a remarkable baseline stability (0.05 mV/h for 150 h).

There is no need for any valves or conventional reference electrode. For medical application toxic risk and blood stagnation are avoided.

References

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