Polymeric Optode-Based Platforms with an Integrated Color Acale: Exploring Perspectives for Calibration-Free Analysis

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The need for *in situ* monitoring, high throughput and autonomy lead to the fact that the periodic calibration of existing sensor systems becomes burdensome. In the case of polymeric optodes, however, photodegradation, and/or leaching of active components from the sensing phase and corresponding gradual shift and/or decrease of the measured signal, renders calibration necessary [1, 2]. There is a lack of a general approach to developing calibration-free sensing devices. To date, a number of scientific groups have attempted to create calibration-free optical sensors, but the proposed solutions are complex in design and have limited potential for use in rapid sample analysis and continuous monitoring.

In this work, we report on a new approach to obtaining calibration-free arrays consisting of chromoionophore-based ion-selective optodes. Theoretical modeling of the response of optode sensors of various composition showed the feasibility of creating a color scale of an analytical signal built into the array, by using optodes containing only chromoionophore (C_T) and various amount of an ionic additive (R_T) in the sensor. The response of such optode sensors remains constant over a wide range of solution compositions (Fig. 1). This makes it possible to determine the concentration of an analyte in a solution by comparing the analytical signal of the indicator optode with the readings of the internal reference elements. This approach was tested experimentally and the influence of the composition of the sensor phase (the nature of the indicator and ionic additive), as well as the processes of coextraction, indicator leaching and chemical degradation on the possibility of creating a calibration-free array, were considered. The concept has been verified in model samples with the conventional ionophore-based optode and the developed built-in signal scale (Fig. 1C).

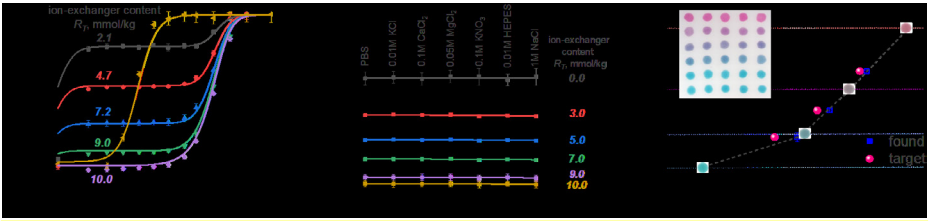

Fig. 1. A: pH response curves for the optodes with reduced amount of ion-exchanger (symbols – experimental data, lines – model data); B – the constancy of the color scale signal in solutions of different composition; C – determination of Na^+ in model samples with the developed integrated color scale.

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References

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