

LEAD DETERMINATION BY DIFFERENTIAL PULSE VOLTAMMETRY FOR FULL ROBOTIC ANALYSIS



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ABSTRACT

Miniaturization of analytical and bioanalytical instruments is the basic aim of instrument development in these days. Determination of specific group of compounds, species, cells even organisms and other targets is the point of view of this development. Developing and suggesting of simple analytical instruments, methods and procedures with low detection limits and providing on-line and in situ monitoring of environment are needed. Obviously environment and biological monitoring is connected with determination of large number of samples. In this study, we show testing and optimizing of new sensor array connected with pipetting robot (samples dosing and manipulation) for electrochemical determination of a large number of samples. Finally, there was also confirmed, that these three-electrode screen-printed planar electrodes system could be used for fully automated electrochemical detection of selected species.

METHODS

1) Fully automated pipetting system

Fully automated pipetting was carried out on automated pipetting system epMotion 5075 (Eppendorf, Germany)

Optimization of detection method consisted from testing of various time and potential of accumulation and pH of electrolyte. Influence of accumulation potential shows **Fig. 2A**. With decreasing potential of accumulation decreases

2) Three electrode system

All electrodes were galvanically covered by standard gold film during the PCB fabrication process. Unmodified gold film was used as an active layer for AE. The RE and WE active layers were screen-printed over the gold film electrodes using Aurel MOD. 880 screen printer (Aurel Automation, Italy).

3) Electrochemical determination of lead(II) ions

Differential pulse voltammetric measurements were performed using PalmSens (PalmSens, The Netherlands) potentiostat connected with sensor field (BUT, Czech Republic) through control box (BUT, Czech Republic). For smoothing and baseline correction the PalmSens software supplied by PalmSens was employed. As the supporting electrolyte acetate buffer (0.2 M CH3COOH + 0.2 M CH3COONa) was used.

RESULTS AND DISCUSSION

The main idea in sensor array design was to connect advantages of electrochemical determinations with automatic procedure at higher number of samples. Our sensor array consisted from 96 three-electrode sensor areas where each of them is created from working (WE), auxiliary (AE) and reference electrode (RE) connected to the external circuits of the sensor multiplexer by wires integrated in the PCB (Fig. 1A and 1B).

measured signal too. Measured range of potential was from -1.2 to -0.7 V. The highest signal was detected for potential -1.2 V. This accumulation potential was applied for testing accumulation time in range from 0 to 420 s (Fig. 2B). From 0 to 180 s signal linearly growth and then is approximately constant up to 420 s. As the best value of accumulation time, according to the shortest time with maximum intensity of signal, 180 s was chosen. Influence of electrolyte pH was tested in the range from pH 4 to pH 8 (Fig. 2C). The highest peak height was detected by using electrolyte pH 5. Applied these optimal parameters we obtained calibration curve presented in Fig 2D. Calibration dependence had parameters as follows: y = 4.584x; n = 3; R2 = 0.985, with limit of detection 0.88 µg/ml (for other analytical parameters see Table 1).





Fig. 1. Three electrode system

Fig 2. Optimization of Three electrode

Designed sensor field was incorporate to suggested fully automated measuring system as the most important part which is in direct contact with the sample and create physicochemical transducer of measuring signal. The whole system consisted from five parts: two parts are developed relate to the defined condition on the start of the experiment – there were sensor field, which is described above and control box. The other three parts of system are commercial available instruments: automated pipetting station EpMotion 5075, PalmSens potentiostat and PC. The schematic view of system is presented on **Fig. 1C**.

CONCLUSION

The aim of this work was design and construction of a new automated system for electrochemical determination of various species. For this purpose, we connected three commercially available instruments with sensor field and control box.

system

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