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New polyphthalocyanines in medical diagnostics: development of H_2O_2 detection

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Abstract – Electrode reactions of the first time synthesized oligo- and polyphthalocyanines, containing Co and Fe had been investigated in this work. The purpose of this investigation is to find out the possibility their application as sensor material for analysis in solutions. The polyphthalocyanine films peculiarity is high electric conductivity and demonstration of electrode reactions at potentials most convenient for analysis. The polyphthalocyanine films were tested by the method of flow-injection analysis to determine their sensitivity in solutions for H_2O_2 microconcentrations.

The problem of oxidative stress is very important for modern medicine. The concentration of hydrogen peroxide corresponds most closely to level of oxidative stress and shows inflammation availability. The application of peroxidase into biosensors, which catalyze hydrogen peroxide reduction don't permit to get a stable electrodes, besides saturation of active centres limits capacity of using [1]. In the recent years special interest attracts to phthalocyanine films in regards with their application in sensors [2 - 3].

The substances (fig. 1) were synthesized by polycyclotetramerization of tetranitrile of pyromellitic acid in bulk and in polar solvents at 180-300°C for 5 - 30 hours in the presence of 0 - 5 mol% carbamide.

The films of PPc were sputtered on glass-carbon electrodes in vacuum or precipitated from the solutions. The films thermal sputtering were obtained at evaporation temperature of 300 – 1100 °C and pressure in chamber $1{,}33 \times 10^{-8}$ bar.

The preliminary investigations were taken in neutral water solutions (phosphate buffer of pH 7.0) at potentio-dynamic mode where potential rate was equal to 50 mV/sec. It is convenient to use neutral water solutions are attractive for analysis purposes as they do not require preliminary treatment of a test object.

The cyclic voltammograms of the Fe-containing polyphthalocyanine are more stable at the deposition from the solution. It displays the corresponding electrode reactions in the region of Ag/AgCl electrode. This seems rather attractive from the point of analytical applications.

The investigations were held on a specially developed semi-automatic flow-injection analyzer "BIO" (fig.2). The device comprises the "wall-jet" flow-through cell with working sensor electrode (PPc film on the glass-carbon electrode), a counter electrode and a reference electrode, two peristaltic pumps and injector for automatic injection of tested sample. The device is controlled by a computer that allows the measurements to be taken completely automatically.

The results proved that electrodes have sensitivity to H_2O_2 micro concentrations at levels 10^{-5} – 10^{-6} M for different substances. The signals of the PPc films are stable.

Thus, the investigations of the electrodes modified with the PPc films bring a conclusion that the synthesized Co- and Fe-containing polyphthalocyanines can be applied as the sensors to determine the micro concentrations of hydrogen peroxide suitable for medical diagnostics.

Polyphthalocyanine films' feature is high conductivity and its electrode reactions coming out in the potential region most attractive for analysis purposes.

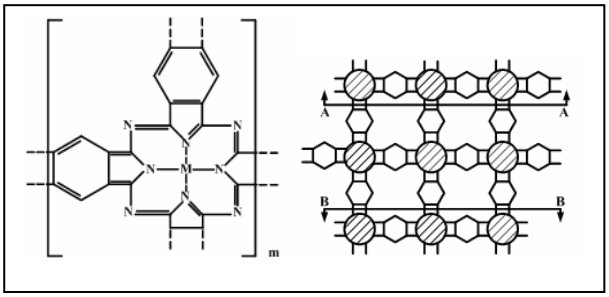

Figure 1: Typical structure of polyphthalocyanine (oligophthalocyanine - inside profile AA - BB), M = H_2, Zn, Fe, Cu, Co, Ni, Mn.

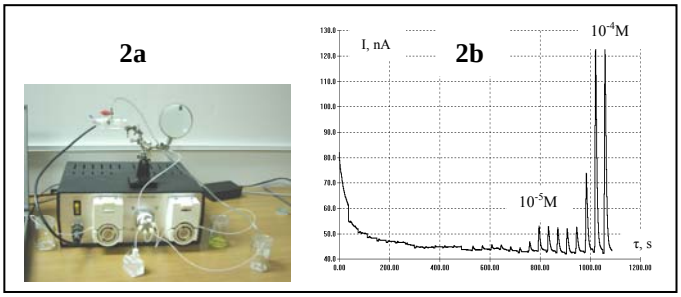

Figure 2: a) The flow-injection analyzer "BIO". **b)** Diagram for the Co-containing oligophthalocyanine in H_2O_2 solution.

References

[1] T. Ruzgas, E. Csöregi, J. Emnéus, L. Gorton, G. Marko-Varga, *Anal. Chim. Acta* 330 (1996), pp 123-138.
[2] A.A. Ciucu, C. Negulescu, R.P. Baldwin, *Biosens. Bioelectron.* B 18 (2003), pp 303-310.
[3] Zhao Jie, Huo Li-Hua, Gao Shan, Zhao Hui, Zhao Jing-Gui, Li Ning, Sens. Actuators B 126 (2007), pp. 588-594.