Opponent's report

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Macroporous copper electrodes in electroanalysis of organic compounds

The present thesis described fabrication of macroporous copper screen-printed electrode with different pore diameter for electrochemical analysis of various analytes. In the theoretical part, author describes in detail and readably basic techniques for preparation of macroporous electrodes including templates and substrate materials and also techniques for synthesis and deposition. In addition, sensor fabrication is also focused on miniaturization of devices mass production for commercial availability. The author mentioned also mentioned the rule of copper electrode in electroanalysis of organic compounds and its application in non-enzymatic (enzymeless) sensors for detection of different biomolecules avoiding the cost and tedious steps for enzyme immobilization in enzymatic biosensors. Finally, brief presentation about the target analytes was discussed.

In the practical part, attention was paid to the copper porous and ex situ film sensors fabricated using screen-printing and colloidal crystal templating. Macroporous copper screen-printed electrodes with different pore diameter were used for non-enzymatic amperometric determination of selected carbohydrates namely; D-fructose, D-galactose, D-glucose, and D-sucrose in alkaline solution. Electrodes were characterized using SEM to display the effect of diverse porous structures on sensor performance. It was concluded that larger diameter of pores can improve the sensitivity via easily entrap a desired molecule from solution to and within a porous electrode, notably in lower concentration.

In addition, selected amino acids can be determined amperometrically at 600 mV by the fabricated electrodes. This has been carried out with a film and porous electrode to compare their current response. The obtained results revealed that surface modification does not mostly affect sensitivity of measurement, while the hydroxyl group containing amino acids improved the sensitivity through their adsorption on surface of macroporous copper electrode rather copper film electrodes.

The macroporous copper electrode improved electrochemical detection of catecholamine (dopamine) in contrast with a simple film electrode, if accumulation period was used before voltammetric scan. Generally, the enlarged active area of porous structure provides higher sensitivity and a respectable stability for electrochemical measurements of selected biomolecules.

Comments:

- In the theoretical part, references related to the mentioned figures should be added.
- Fig. 28, 42: Rescale Y-axis to start from 0-2.5 and 0-4.
- Fig. 46: Stability of porous copper electrode is interesting. Could author explain why the current noise, visible at the end of measurement, disappeared when the next saccharide was analyzed?
- Cyclic voltammograms of amino acids in sodium hydroxide show different behavior at the anodic end of working potential window for both types of copper electrodes. Is there any explanation why the anodic range is shortened by almost 200 mV in case of porous electrode comparing to film electrode?
- In Fig. 67, the peak potential for oxidation of dopamine is 300 mV when using cyclic voltammetry, but in differential pulse voltammetry (Fig. 69) the peak potential is shifted to 200 mV. Could author comment on this? Also, what does "Potential U (mV)" on X-axis mean?
- Fig. 69: Current has units mA for dopamine oxidation, but there is a current density written on Y-axis in evaluation of peak height in Fig. 70.
- Fig. 70: The word "peak" is missing in the description of Y-axis.
- Page 75: Half of the page is empty.

The thesis is written clearly and, especially in the introductory part, backed up by large amounts of cited expert sources. In conclusion, I can say that diplomate Bc. Jitka Poštulková fulfilled all tasks from the thesis and the aforementioned formal comments had little impact on the quality assessment of the thesis. I recommend the thesis to the defense and evaluate it as **Grade A (Excellent)**.

Elmorsy Khaled.

Pardubice, May 30, 2015

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