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REVIEW OF PHD THESIS

PhD student: Ing. Jakub Zajíc
Title: DEVELOPMENT OF ACTIVE PART OF OPTICAL FIBER BIOSENSOR USING GENETICALLY MODIFIED ORGANISMS

1. Thesis topicality

The subject of the submitted PhD thesis is very topical. Effective monitoring of pollutants in wastewater or soil is a challenging task. The thesis deals with the development of an optical fiber sensor of organic pollutants and endocrine disruptors. Microorganisms producing bioluminescence were used as the active part of the sensors.

2. Achieved goals

The goals of the PhD project as declared in the thesis were accomplished. The future research goals should be discussed in more detail.

3. Methods and procedures

The author used modern methods for the characterization of the optical fiber elements as well as the microbial colonies. Standard laboratory techniques were used to study the performance of the developed sensors.

4. Reported results and candidate contribution

The results of the PhD project were published in two peer-reviewed journals: Sensors and Chemical Papers. The PhD candidate is the first author of both papers, which is a good indicator of his significant contribution. The project results were presented at one international and one national conference.

5. Impact for practice and development of study program

The PhD thesis reports on the efforts to develop an efficient bioluminescence sensor for long-term monitoring of pollutants in environment. It is possible to conclude that the project findings are highly relevant for the study program Biomedicinal and clinical technique. The obtained findings can contribute to the development of modern biosensors.

6. Formal quality

The formal quality represents the main weakness of the PhD thesis. The language quality is low. It is sometimes difficult to understand the meaning of sentences. For example: "The design of whole cell biosensor was chosen for its low cost in comparison to lengthy chemical analysis, simplicity, and relatively fast analysis." or "For the use in biosensors it is necessary to quantify the analyte concentration by the gene expression." or "Small second peaks confirmed experimental calculations, ...".

The outcomes and future course of research are declared two times in pages 81 and 82. Probably to emphasize their significance.

The list of references is shown in very sloppy form. Why a standard software such as Endnote was not used to keep the same format of references? The format of citations is also non-uniform within the thesis. Sometimes it is numbered, sometimes it is based on the author names.

It is a bit strange to describe the used devices on 11 pages with full photo documentation.

In scientific literature, equations are usually numbered. Instead of numbers, the author used letters.

7. Questions and concluding remarks

Page 20. Please explain, how the sensitivity of a cell to a substance is determined by its receptor-ligand binding constant in the case of toluene. Is there a special receptor for toluene?

Please explain, why the shape of OFEs is approximated by a bi-exponential function in Tab. 4 and by a cubic function in Fig. 35. What is the R2 value of these approximations?

Please explain in more detail, how did you calculate the free energy of interactions between cells and their carrier?

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Fig. 40, right. "Increasing T of OFE shapes from the most curved to nearly linear confirmed the assumption that the best shape of an OFE is a frustum cone." I do not see anything linear in this figure. Please, explain.

Normally, an efficiency of anything is a quantity independent of amount or size of the system. OFE efficiency is directly proportional to the interfacial area.

Page. 64. "An unfavorable (positive) total adhesion energy balance (Table 6-7)...". I do not see any balance or the Gibbs free energy in these tables.

Page 66. How are the surface charge and zeta/potential related to the surface hydrophobicity?

Figs. 43-46. Why the plotted dependencies are not discussed. What is the reason for the bioluminescence fluctuations during the 18 hours periods? Do they correspond to the nutrient consumption or the fluctuations in the toluene concentrations?

Why the position of the bioluminescence probe in the vessel was different in different measurements?

I guess that Fig.2(A) and (B), respectively, refer to the opposite arrangements.

After my reading of the PhD thesis, I can conclude that Ing. Jakub Zajíc showed ability of independent scientific work. He attained valuable results. Hence, **I recommend his PhD thesis for the defense.**

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