



Prague, 29 July 2014

Report on the PhD Thesis entitled

**“IN VITRO TESTING OF POLYANILINE BIOLOGICAL PROPERTIES”**

presented by

Zdenka Kuceková

to the Faculty of Technology, Tomas Bata University in Zlín

Submitted doctoral Thesis is of interdisciplinary character, combining elements of polymer chemistry and material science with cell biology, immunology and clinical science. The Thesis deals with preparation, modification and biological properties of polyaniline, one of the best known electrically conducting polymer. The main goal of the presented Thesis was to investigate the biological properties, such as cytotoxicity, hemocompatibility, antibacterial activity, of different forms of polyaniline (powders, colloids and thin films), as well as its interactions with cells. In the past few decades, the use of conducting polymers in biological and medical applications, including cardiac and neural tissue engineering, drug delivery and biosensors is growing. However, polyaniline is not favourable conducting polymer due to limited biocompatibility studies. From this point of view, the topic of PhD Thesis is actual and it is a useful contribution to the ongoing work in this research area.

The Thesis consist of five papers (four of them have already been published) and 62 pages of comments. In four of them Zdenka Kuceková is the first author, in one – the fourth author. In addition, Zdenka co-authored four additional papers, not included in the Thesis, which deal with determination of cell viability.

Theoretical introduction of the Thesis is composed of several parts. The first part provides information about polyaniline, including historical background starting at 1862, its

synthesis, morphology and properties. The second part deals with biological properties of materials in general. The third describes determination of antibacterial activity. The following two parts give an overview on research which has already been carried out during past years on polyaniline biocompatibility and antimicrobial activity.

The part "Aims of the doctoral study" is clearly written with good description of the thesis aims.

The summary of results presents a brief overview of the most important results. The role of precursors used in chemical polymerization as well as oligomer on impurity profile and cytotoxicity of polyaniline powders has been discussed. Also purification of polyaniline with methanol and hydrochloric acid leading to decrease in cytotoxicity level can be consider as very useful results in further applications. However, the processibility of polyaniline powders is not easy and limits it use in practical application. For that reason, various application forms have been search. Among them, the conducting polymer colloids are the most promising. The studying and understanding of their biological properties can have a remarkable impact for their application in biomedical devices and biosensors. At the same time polyaniline thin films as well as their composites with silver nanoparticles or polymeric acid can have broad spectrum of applications in biomedical and biological fields which is clearly demonstrate by Zdenka in this thesis. The summary was followed by a detailed literature list.

The text is written in English language, in addition to one paper written in Czech language. I have nothing to comment on the already published papers that underwent a standard peer review. However, there are a couple of misprints or small mistakes in introduction parts, but at the same time they never interfere with understanding the text.

Finally, I have also some questions for the candidate and comments concerning the PhD Thesis:

1. You conclude that polyaniline colloid shows low antibacterial activity. Have you been thinking about adding some additives which can improve antibacterial properties?
2. The modification of standard polyaniline (PANI) with poly(2-acrylamido-2-methyl-1-propanesulfonic acid) (PAMPSA) has a significant impact on blood coagulation and improves the pH stability due to formation of interpolymer complex. First, I would like to ask if you have tried to use other modification, e.g., with another polymeric acid, for example poly(4-styrenesulfonic acid)? The second question is connected to

pH dependence. You mention that PANI-PAMPSA is stable at pH of 6. How long did you study behaviour of PANI-PAMPSA at pH 6? Do you think that it will be worth to check the long term stability of PANI-PAMPSA in this pH?

3. I could not find in the enclosed paper “Antibacterial properties of polyaniline–silver films” any information about silver particles. More precisely, about their size, morphology, as well as the content in final product. As you mention in your Thesis, silver nanoparticles are well known as antibacterial agents. Do you have information about your silver particles and do you think that this information could have any impact on antibacterial properties of your composites?

## Conclusion

The aims of submitted PhD Thesis have been fulfilled. The set of five papers presented as doctoral research together with valuable comments on the performed studies represents a high scientific level and contains many interesting results.

To conclude, the Thesis of Ms. Zdenka Kuceková entitled “IN VITRO TESTING OF POLYANILINE BIOLOGICAL PROPERTIES” satisfies all requirements for a doctoral degree. I have no hesitation in recommending the award of the PhD degree based on the Thesis.



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