

The review of doctoral thesis

"Composite materials based on polysaccharides"

Author: Ing. Simona Káčerová

Supervisor: Prof. Ing. Petr Humpolíček, Ph.D.

Consultants: Assoc. Prof. Ing. Zdenka Víchová, Ph.D. et Mgr. Jan Vícha, Ph.D.

This thesis is focused on the development of hydrogels based on polysaccharides and colloidal dispersions of polypyrrole as bioactive composites for wound healing. The relevance of the dissertation can be seen from the objectives that were set at the beginning of the doctoral studies:

- 1) The preparation and characterisation of hydrogels based on hyaluronic acid,
- 2) The fabrication and characterisation of polypyrrole colloids,
- 3) The preparation and characterisation of smart functional wound dressing composites based on chitosan and polypyrrole colloidal dispersion,
- 4) Determination of biocompatibility of prepared materials.

The thesis is written as brief review of the current state of knowledge, experimental solution of defined goals and summary of results. Three papers have already published in a journals respected by the scientific community (*Carbohydrate polymers*, *ACS Biomacromolecules* and *Materials&Design*), one paper has published in MDPI (*International Journal of Molecular Sciences*). In none of these articles is the student listed as first author. However, some of the methods of the newly developed materials are described in the submitted patents and therefore these main results of the PhD student had to be sent to the editors of the journals later (two papers have submitted by student as the first author). For the above reasons, it is perfectly fine to submit the thesis as a collection of articles with comments and not as a monograph.

Although many of the results have already been reviewed in internationally respected journals, I would like to take the liberty of having a few comments, recommendations and, above all, questions that the PhD student should answer (especially to the unpublished parts of the dissertation:

- 1) In the article published in *International Journal of molecular sciences*, page 6, is table 1. There are contact angle given to the nearest hundredth of degree. Is it correct? Is it really

possible to measure the contact angle so precisely? Further in the article the results are given as for example $(63.27 \pm 3.08)^\circ$. Is this standard deviation of any significance? MDPI journals often get away with these obvious mistakes, but certainly a UTB student should not make such mistakes.

2) Please explain how the published articles relate to the topic of the dissertation and its objectives?

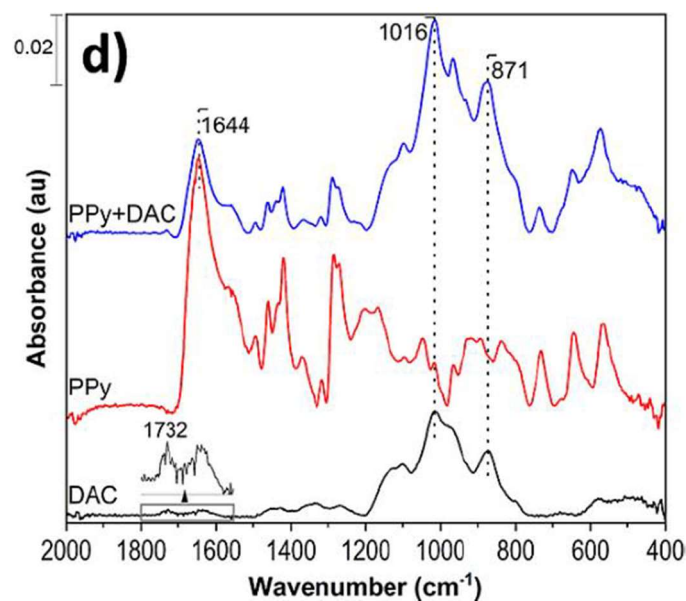
3) It is a great pity that you did not include in your dissertation the prepared and submitted articles, where you are the main author. I assume that the experimental part of the dissertation is part of them, but certainly this text will not be sufficient for publication and the articles will have to describe in detail all the characterization techniques, which is missing in the text. In addition, after each part of the summary of results it has written: "For more details see the ready-to-submit manuscript APPENDIX I." But the appendix is not part of the dissertation text I received for review in paper form. Unfortunately, these ready-to-submit manuscripts are also not included in electronic version, which can be seen in STAG-portal. If it can be fixed, by all means do it. However, fortunately your supervisor has sent me these appendixes and therefore we can address the questions on these prepared manuscripts.

(a) Comment to the manuscript entitled *"Biocompatibility of polypyrrole based colloidal dispersions"*:

- in Experimental section will be better to divide UV-VIS, TEM and DLS separately
- in UV-VIS will be better use not "optical spectra" but "absorption spectra"
- Formation of polypyrrole was confirmed by absorption peak around 450 nm. Why doesn't this peak occur in pyrrole? Why does a polaron form in polypyrrole (what is the physical nature of this quasi-particle)?
- Particle size was determined by two methods – DLS and TEM. Can you show relation between intensity and particle size for the same samples in table 1? How did you determine the particle size and standard deviation from the TEM images? It would be fine to describe this in the list of experimental techniques as well. How does the hydrodynamic diameter differ from the particle size determined by TEM?

(b) Comment to the manuscript entitled *"Antibacterial, anti-oxidant, conductive, and anti-inflammatory polypyrrole/chitosan/dialdehyde cellulose hydrogel wound dressings"*:

- In the first picture you present the FT-IR spectrum:



Is it necessary to focus on peak 1732 cm⁻¹ for confirmation of PPy-DAC reaction? This peak is completely inconclusive in the image. But maybe I'm not understanding it correctly.

- Can you explain difference between methods Raman spectroscopy and FT-IR spectroscopy (differences in type of interaction between molecules and photons)?

Dissertation written by Ing. Simona Káčerová fully meets the requirements for this type of thesis within the meaning of Act No. 137/2016 Coll. on Higher Education. However, I would recommend adding an appendix to the official text of the dissertation when the key results will be published. The student has demonstrated the ability of creative work and independent scientific activity. Therefore, I recommend to accept this thesis for further proceedings and after successful defence to award the Ph.D. (philosophiæ doctor) degree.

Prof. Aleš Mráček, MSc., Ph.D.,

Department of Physics and Materials Engineering,

Faculty of Technology and Centre of Polymer Systems

Tomas Bata University in Zlín