



Review Report on PhD Thesis

Faculty: **Central European Institute of Technology
Brno University of Technology in Brno**

Academic year: **2019/2020**

Student: **Ing. Dominika Kalasova**

Doctoral study program: **Advanced Materials and Nanosciences**

Field of study: **Advanced nanotechnologies and microtechnologies**

Supervisor: **prof. Ing. Jozef Kaiser, Ph.D.**

Reviewer: **prof. Markku Kataja**

PhD thesis title: **X-ray nano computed tomography of structured polymeric biomaterials**

Topicality of doctoral thesis:

The primary field of the thesis is very topical indeed. The powerful X-ray micro- and nanotomographic techniques are still rather new in materials science, and are developing rapidly. Not all of their potential has been exploited so far, and new areas of application are constantly found. The thesis contributes to establishing and promoting the use of X-ray tomography especially in the study of light bio-based materials. In addition, the thesis discusses X-ray tomography in the context of other complementary experimental methods used in materials science, thereby putting it in perspective as another research tool.

Meeting the goals set:

The primary goal of the thesis and the planned means to achieve that goal was stated in Section 2. 'Aims of the thesis' as:

"The general aim of this thesis is to study, explore and bring new insights into the field of imaging of polymer biomaterials by X-ray computed nanotomography. This is achieved by the exploration of two areas of interest: research and development of CT imaging itself, specifically propagation-based phase contrast imaging, and application of this technique on specific applications in material science."

Clearly, the goals of the thesis are not very precisely described, and there seems to be no specific scientific goals in addition to "study, explore and bring new insights" into the selected

field. According to this statement the most important aim of the thesis work is to gain technical and methodological know-how and practical expertise on the use of X-ray tomographic techniques, in general, and in the context of the selected applications, in particular. On the other hand, such a definition of goals does not imply strong expectations to results - the stated goal can be achieved even without original new scientific results. Indeed, this seems to be the case. In the Conclusion section, the author summarizes the general results of the thesis work as follows:

"The particular contribution of this work is the extension of expertise in phase contrast imaging within the Laboratory of X-ray micro and nano computed tomography at CEITEC BUT. Implementation of this method on specific topics from material research extends the possibilities of characterisation of materials, primarily in the field of soft materials. In general, this thesis contributes to the establishment of an X-ray computed tomography technique as a common tool for 3D imaging and analysis of biomaterials."

In that sense, the primary goal of the thesis has been achieved. In addition to this general goal and corresponding results, the thesis includes several specific results that contribute to that conclusion (see below).

Problem solving and dissertation results:

As stated above, the main objective of the thesis is not related to solving any particular physical or technical problem, but to more generally explore the capabilities and techniques available within X-ray tomographic methods in materials science. In addition to the general results related e.g. to extension of expertise, extending the possibilities of characterisation of materials and establishment of an X-ray computed tomography technique, the thesis includes several specific results that contribute to those results and related conclusions. These include:

- "A theoretical description of the machines"* that can be used to estimate the capabilities and limitations of the propagation-based phase contrast imaging method (PBI).
- A graphical user interface was designed for implementing and testing phase retrieval algorithms.
- Results from two case-studies utilizing several complementary methods, namely CT, light microscopy, scanning electron microscopy and 3D energy dispersive X-ray spectroscopy were presented and critically assessed.
- A sample holder that allows study of a single sample using both CT and scanning electron microscopy was designed.

The particular applications within which these questions are studied do not seem to include very deep physical problems that should be solved in order to achieve the goals stated. Consequently, the thesis includes little original or novel scientific or technical results.

Importance for practice or development of the discipline:

The main merits of the thesis are clearly related to promoting and establishing the X-ray tomographic method as an effective research tool in materials science, light bio-based materials, in particular. I believe, the expertise developed during the thesis will have significant contribution to future research carried out by the candidate and by her home laboratory. The

results may also contribute to proliferation of X-ray tomographic methods in materials science, in general.

Formal adjustment of the thesis and language level:

The thesis is well structured and well written, in general. The language used is mostly correct, logical and easy to read. Some of the equations given in the literature review and theoretical sections seem to include minor errors or discrepancies. Furthermore, some graphs shown in Figures lack necessary details such as axes titles. In some cases, the Figure Caption should be more complete explaining all the details shown.

A somewhat confusing feature of the text is the frequent use of direct lengthy quotations of the text of the related publications (co-authored by the candidate). The amount of such text sums up to about two pages out of the roughly 40 pages of plain text. Although the text excerpts are clearly indicated by quotation marks and no confusion of the origin remains, the original text is from publications with several authors. It is not at all clear what has been the actual contribution of the candidate in creating those parts of the text. However, based on the information given to me on the general criteria for thesis work at Brno University of Technology, I can not state whether such a practise is acceptable by the rules of the home institute of the candidate. I just mention that in my home university, and more generally in the scientific community I believe, such a custom is strongly discouraged as self-plagiarism. Even more confusingly, in Section 1.2.2 the candidate seems to quote portions of text directly from an independent publication (ref. [74] in the long version of the thesis) without an obvious reason to do so. Here too, the excerpts are enclosed in quotation marks and the reference given. Nevertheless, such direct quotation alludes to a form of plagiarism (called verbatim plagiarism), irrespectively whether the source is given or not. The total amount of text thus quoted is not very large, though. I leave it to the faculty or the relevant thesis evaluation body of the University to assess, whether such parts of the text are acceptable in doctoral thesis, given the general standards and practises of the University.

Questions and comments:

Comments:

- In the case that it is still possible to edit the manuscript, I strongly suggest the candidate to replace the direct quotations to an independent publication, ref. [74] (if I understood the meaning of the text correctly), with an original text by the candidate.
- The above comment would apply to some extent also to direct quotations to the publications co-authored by the candidate. At the least, instead of merely repeating the abstracts of some of those publications in Sections 4.1.1 and 5.3.2, the candidate should give a short review of the content and the results of those papers - using original text created by the candidate.
- I have sent a version of the manuscript including minor comments and suggestions directly to the candidate. If still possible, I wish the candidate takes these comments into account in producing the final version of the thesis.



Conclusion:

In accordance with the goals set for the thesis, it certainly adds to technical and methodological know-how and to practical expertise on the use of X-ray tomographic techniques in materials science. The total amount of work required to compile the thesis and the related publications has been substantial and adequate from the point of view of common requirements of a doctoral thesis. Even though the original scientific results obtained in the thesis are rather scarce, they are sound and have already been accepted for publication in peer reviewed scientific journals. I have no doubt that the thesis constitutes a valuable contribution from the point of view of the candidate's home laboratory and for larger scientific community working in this field.

In my opinion, the reviewed thesis fulfills the requirements posed on theses aimed for obtaining PhD degree. This thesis is ready to be defended orally in front of respective committee.

I evaluate her thesis by grade C on the ECTS scale (A-F).

If any revision of the text is still possible, the candidate may take into account the comments I have made in this statement and in a separate document I have sent directly to her.

Jyväskylä, Finland, 2.12.2019

Markku Kataja,
Professor