

Review Report on PhD Thesis

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

Academic year: **2020/2021**

Student: **Ing. Klara Zarybnicka**

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

Field of study: **Advanced Materials**

Supervisor: **prof. RNDr. Josef Jancar, CSc.**

Reviewer: **prof. Alfred Crosby**

PhD thesis title: **Cellular polymer nanocomposites**

Topicality of doctoral thesis: This doctoral thesis focuses on the development and characterization of novel polymer nanoparticle composites that can be used in creating foams with potential application in additive manufacturing. This topic is extremely relevant to current challenges in the field of materials science. 3D printing is one of the fastest growing markets, and new materials are required to meet the needs of the broad range of applications where 3D printing is hoping to have an impact. In particular, new materials that offer straightforward tunability of multiscale structures are sought. The materials developer and characterized in this thesis provide critical fundamental knowledge associated with creating such materials. Beyond 3D printing, this thesis provides comprehensive characterization of the developer nanocomposites, and these measurements lead to new fundamental understanding of how nanoparticles can seed the formation of foam pores and potentially affect mechanical properties. This information will certainly impact the development of new multiscale materials and new processing methods.

Meeting the goals set: The goals of this thesis are clearly defined and cover a range of topics that define a comprehensive and significant materials science contribution. From synthesis and processing to characterization and analysis, all stated goals of the dissertation are met or exceeded.

Problem solving and dissertation results: The dissertation results are extremely interesting and informative. The microscopy that supports the characterization of the polymer nanocomposites, as well as the nanoparticle-seeded foam pores, provides clear evidence of how the material fabrication and processing history developed. The mechanical property measurements also demonstrate that the nanoparticle seeds do not have a significant effect on the extension properties, but they do play a role in improving the compression performance. These are only two highlights of a large set of impressive results that support the findings of the dissertation.

Importance for practice or development of the discipline: The results are very important for practical development of new materials, especially for 3D printing. Not only does the experimental evidence provide clear guidelines for how to design nanoparticle-polymer composites for foaming applications, but more importantly, the dissertation provides a detailed description of why adopted processes were developed. Furthermore, a detailed analysis of the measured results is provided to teach materials engineers how to understand the results and how to adjust future processes to potentially tune materials to meet the needs of a given application.

Formal adjustment of the thesis and language level: The thesis was clearly written and organized in an easy-to-understand manner.

(4) The study is duly completed by a state doctoral examination and the defense of a dissertation, which proves the ability and readiness for independent activity in research or development or for independent theoretical and creative artistic activity. The dissertation must include original and published results or results accepted for publication.)

Questions and comments: I have no questions. I commend Ing. Klara Zarybnicka on completing an excellent thesis project and writing a foundational dissertation.

Conclusion: I fully enjoyed reviewing this dissertation. I am very impressed by the level of control in synthesizing the nanoparticle-polymer composites, as well as the foam structures that these materials were able to produce. I also fully appreciate that Ing. Klara Zarybnicka did not just make the materials and characterize their structure, but continued to measure and analyze their mechanical properties. This complete approach differentiates this dissertation from others and will help establish its lasting impact.

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

In, September 13, 2021.....

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prof. Alfred Crosby