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Doctoral thesis review
Dissertation title "Composite Materials for Medical Application"
Submitted by: Michal Machovský

Dissertation deals with the promising polymer materials for medical applications. The work is written in English in the form of an annotated set of four original articles focused on the preparation of polymer composites with antibacterial properties. The main interest was oriented on the processes of synthesis of active fillers for antibacterial polymer system, the characterization of fillers, mixing, the prepared composite, testing and evaluation of surface antibacterial activity.

First of the objectives was focused on prepare of product containing zinc oxide as an antibacterial component. The originality of the work lies in the exploring of microwave energy field for the synthesis of soluble zinc salts. A reaction mechanism was explained by the formation and growth of crystals of zinc acetate and zinc oxide. It is also significant that the material was in contrast to the known procedures prepared in the form of particles with sizes on the micrometer level, but a deciding effect is achieved by nanostructured surface or internal structure. Such material solves the problem of dosing and mixing with the polymer matrix.

The theoretical part is based on a good level. Author summarizes here knowledge about the properties of materials that can be used in medicine and that both materials used for production of tools or materials may be placed permanently in the body, given the demands on their chemical and physical properties, an overview of the polymers used in medicine, the questions biofilms, principles of antibacterial function of polymer systems resp.

Based on the knowledge acquired in the theoretical analysis of the problem and evaluation of instrumentation facilities were designed objectives of the dissertation.

In the experimental part of the thesis preparation processes of composites are described, including non-traditional manufacturing in microwave field. For analysis of the results achieved with the use of X-ray powder diffraction, scanning electron microscopy, thermogravimetry, exploration methods of mechanical and electrical properties. Furthermore, the samples are tested for antibacterial activity.

Discussion is based on the results presented in the accompanying publication output. In particular, the conditions are discussed hydrothermal synthesis in a microwave field, which gives

rise to various morphology that are competitive both in terms of large active surface on one side and on the other hand, their size is preferred for mixing and uniform distribution in the matrix. Remarkably enlarge the particle surface. They evaluated antibacterial materials based on ZnO, and further discussed the possibility of using metallic silver. This is basically a link discussion of publication output.

In conclusion, a comparison of the results and their significance for the application and indicate future research and exploitation.

The work has 155 pages, 62 pages represents the coupling text. A large number of 219 links to professional work devoted to study the issue. The graphic images and micrographs are at a high level. It is to be appreciated contribution doctoral student in publishing 15 articles and 18 conference papers.

Comments and Questions

1. Nontraditional methods of synthesis in the microwave field are likely difficulties arising from construction equipment. On the one hand, the energy within the mass effect of the sample on the other hand, our experience shows microwave field is homogeneous. The commercially available devices compensate for this disadvantage by turning the plate. You have tested the optimal location of the sample?
2. Optimize the temperature of the mixing PVC additive?
3. It is possible to evaluate the thermal conditions in a microwave field as a relatively stable and do not show the effects of the unstable thermal field such as the kinetics and mechanisms of reactions discussed on page 34

Conclusion

The topic is extremely promising because it combines the potential of basic research and also provides insights applicable in a wide range of science and on the other hand, contributes to the expansion of the application. The author showed technical ingenuity, the ability to theoretically predict and correctly assess the progress going on and is hoping for a scientific career.

Work achieves the criteria required for dissertation and I recommend the adoption of the defense, and on that basis then grant **Ing. Michal Machovský** by scientific and academic rank "Philosophiae Doctor" (PhD).

In Brno, the august 2th, 2013

Jaromír Havlica

