„If you don't think about the future, you cannot have one."

John Galsworthy (1867–1933)
an English novelist and playwright, the Nobel Prize Winner in 1932

Introduction

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In the following years the fundamental own studies on the issues of nanotechnology and developmental perspectives of new nanostructural engineering materials on ***"Conceptual study on a new generation of the high-innovative advanced porous and composite nano-structural functional materials with nanofibers"*** (2011), the issue of new solutions of constructional and material scaffolds used in tissue engineering and regenerative medicine on ***"Overview and general ideas of the development of constructions, materials, technologies and clinical applications of engineering scaffolds for regenerative medicine"*** (2014) and the possibility of use of engineering materials meeting both function of scaffolds and implants on ***"Obtaining of porous high-strength materials engineering scaffolds for assuring the synergy of classical prosthetics/implantation and tissue engineering methods"*** (2015) in therapeutic practice. Those studies are at the basis of a few proposals of different already implemented research projects or being in the evaluation stage. The general objective of those projects is to develop a new generation of materials engineering, respectively nanostructural and composite materials, and engineering and biological composites with the intention of its use in tissue engineering and regenerative engineering as well as testing methods for producing those materials, their structure and properties, including resistance to bacteria and fungi, and the ability to culture natural human cells on a substrate made of those materials, when applying them for scaffolds and implants. It opens up new perspectives of cooperation between doctors of medicine and engineers, as well as a wide area of new potential applications in medical therapeutics.

The book refers to the results of researches carried out during last few years in the framework of the scientific and research project on ***"NANOCOPOR - Determining the Importance of the effect of the one-dimensional nanostructural materials on the structure***

and properties of newly developed functional nanocomposite and nanoporous materials", which received funding under the OPUS programme, based on the decision number DEC-2012/07/B/ST8/04070 taken by National Centre for Science in Krakow. The mentioned NANOCOPOR project concerns the multi-aspect basic research in the field of nano-technology, covered by the most avant-garde research trends mentioned in the 13th National Smart Specialisation: ***"Multifunctional materials and composites for advanced properties including nanoprocesses and nano-products"***, worked out by the Working Group, chaired by me personally in the Ministry of Economy, at the same time acting as the manager of that project.

In the framework of the NANOCOPOR project numerous detailed experiments used on the one hand to the form a variety of new nanostructural materials engineering and on the other hand, to know their structure and properties, through a series of specialist researches, including microscopic (SEM, STEM, TEM, HRTM AFM), spectroscopic (Raman, EDS), X-ray (XPS, XRD), thermogravimetric and heuristic methods using technological foresight and biological research that apply to each of the newly produced materials within the performed Project. Researches done in the framework of the Project were a content-related material that was used to print numerous scientific papers and scientific concepts developed in the project allowed to undertake a number of patent applications, have become the canvas of several doctoral theses, defended or seriously advanced, and the results of the project have been repeatedly presented at scientific conferences in the country and abroad, including in the USA, Mexico, India, China, Turkey, France, Spain, Slovakia, Slovenia, the Czech Republic and at international exhibitions of inventions, receiving numerous awards.

The given book relates only to one of aspects of research and studies carried out in the framework of the NANOCOPOR Project and one group of the outoworked nanostructural materials engineering. In general, the development of such avant-garde researches in the field of nanotechnology is to serve to create the most promising areas which are priorities for science and innovation policy of the country till 2020. The approach is consistent with the thought of a Nobel Prize winner for literature yet in 1932 – John Galsworthy, which is the motto of the book. Thinking about the future, it is necessary to take effective actions giving rise to it, just today. There is no doubt, tracking statistics that progress in the field of nanotechnology is so huge and the financial commitment of many traders all over the world is so significant that it is difficult to find another area of technology that would develop so

dynamically. Only today many of the contemporary challenges of civilization is solved with the use of nanotechnology, and the trend will continue to strengthen and extend to more detailed areas. It, of course, must encourage to look into the future, and that close one and that remote for some decades. From that perspective, there is no way not to engage in research and development of the area of knowledge and learning, which has already have and become to have greater importance in the development of civilization of the Humanity. If someone is not to do that, certainly after a few years, he will find himself in a situation that the entire new knowledge gained as a result of those actions will become impossible for him to begin and cannot blame anybody that further progress in the area will be done without his participation. It applies to individuals – students or scientists, individual research units, but also to entire countries.

On the other hand, it is necessary to look at the application of research results, which are included in the book. Size woes that afflict millions of people globally, is all overwhelming and difficult to describe. It often involves the loss of many parts of the body and organs, mutilations and the related loss of ability to function normally, and actually even in general to live in normal conditions, the necessity to leave the job and with many physical suffering and numerous constraints and strong mental discomfort. Its reasons may be different. They are most often the effects of cancer, but also postoperative ones related to the removal of the effects of inflammation in various areas of the body. Injuries after a traffic accident because of the popularisation of travel and a dramatic increase in the number of cars and travels by railway, planes, ships and other means of transport, various illnesses associated with radical extension of human life and aging, as well as which must shock after accidents as a result of active sport by many people, including very often young people, who even though is to guarantee health, but too often leads to very cumbersome injuries and health complications are very often the causes of such a situation. Statistics indicate that the described problems affect millions people worldwide. Fighting with the effects of those events is a very serious challenge both for medical services and science. The point is that in very complex therapeutic measures, often combined with prostheses, implantation, using very modern methods of contemporary surgery, such as methods of regenerative medicine and tissue engineering, to restore people's efficiency comparable to that before the described events that led to the destruction of their organisms and restore them the opportunity of normal functioning in the society. Engineering materials which are described in the book may be used for technical support to troubleshoot of

some of those health problems previously mentioned and therefore also fall within the broad thought, is quoted as the motto of the book. Biomaterials market, in which, among others polymer nanofibers are inscribed, already represents a very significant segment of the economy, and because of the reasons given above, its significant and rapid growth is expected. It is also important condition to undertake research in the field and develop new original engineering materials that can contribute to solve larger problems. Polymer nanofibers described in the book undoubtedly meet the described criteria and can provide an important engineering material used in tissue engineering and regenerative medicine.

The book is a collection of three appropriately selected, but separately outworked monothematic papers, which presents selected representative results of studies and research carried out within the NANOCOPOR research project. The first paper on ***"Materials Challenges in Regenerative Medicine"*** refers to general, retrospective look at issues of materials engineering in the context of progress, requirements and challenges of modern regenerative medicine and the study worked out as a state-of-the-art basing on the review of the available world literature. The study indicates on the one hand the directions of current scientific research in the area of expertise, on the other hand reveals thematic and research reserves, so far inadequately worked out by science, while having significant reserves of development. On the basis of the study it was revealed that among of nanostructural engineering materials worth of scientific interest because of the expectations of tissue engineering and regenerative medicine there are polymer nanofibers. In turn in the second paper on ***"Polymer Nanofibers Materials, Fabrication Technologies and Research Methods"***, being a combination of literature studies and generalisation of the own research experience includes a description of the selected polymer materials applied in regenerative medicine, the standard and co-axial polymer nanofibers and their fabrication methods and the general presentation of key polymer nanofibers investigation methods. The paper with general remarks regarding the application and research perspectives of polymer nanofibers, indicating at the same time in a very concrete way with the content-related justification for the range of possible and legitimate own research in the area. The third paper on ***"Polymer Nanofibers Applied in Regenerative Medicine"*** is the original report from a personal own research and explains the concept and scope of own research of polymer nanofibers for application in regenerative medicine, the presentation of technological conditions and methodology of own research into polymer nanofibers, and above all very detailed description of the results of own

investigations of polymer nanofibers, including numerous materialographic pictures made among others in electron, scanning and a high-resolution transmission microscopes, and above all the results of biological research, proving the usefulness of the newly developed nano-engineering materials and their applicability in regenerative medicine, as also in tissue engineering. The results of those studies are fully original and represent a significant author's contribution to achievements of Materials Science and Engineering in the field of Nanotechnology. Moreover, in the book there is this general introduction and the end of each paper – final remarks.

By handing over the book into the hands of PT Readers, I remain deeply convinced that it will contribute to raise the level of knowledge on the structure and morphology of polymer nanofibers, as a special group of nanostructural engineering materials potential for use in regenerative medicine and tissue engineering. I also hope that the outworked material will be useful as a source of scientific knowledge to researchers, involved in nanostructural engineering materials, and become a scientific aid sought by students related to nano-technology and advanced materials engineering.

Giving a book to print special thanks go to its co-authors, for the fruitful cooperation, and I thank also the PT Reviewers with whom I have the honour and pleasure to work for many years and undoubtedly many discussions with them, even years ago, constituted a valuable contribution to the inspiration to undertake researches which results are summarized in three very extensive papers contained in the book, as well as support and valuable content-related comments and all others who contributed to the print edition of the publication, and provided assistance in the implementation of performed researches.

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