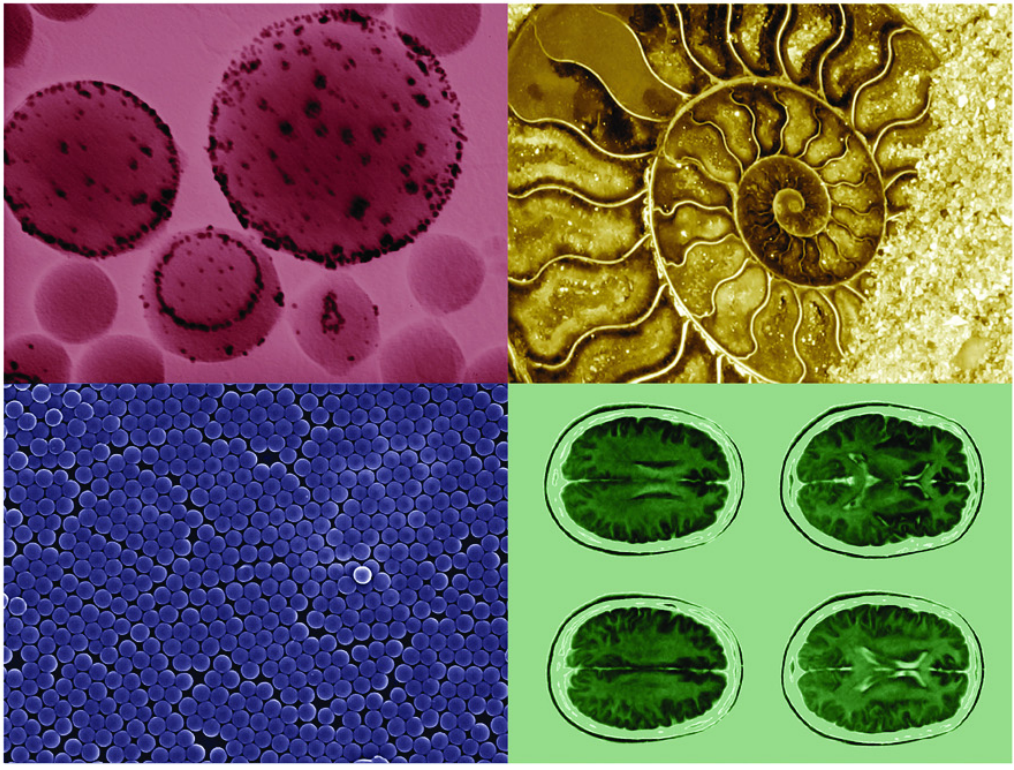
edited by Tito Trindade | Ana L Daniel da Silva

Nanocomposite Particles for Bio-Applications

Materials and Bio-Interfaces



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Preface

Over the past decades there has been a notable progress in the Science and Technology of Nanomaterials. The distinct and novel properties of nanostructured materials along with their size scale comparable to biological structures raised the interest of the pharmaceutical and biomedical industries in the field of Nanotechnology. As a result, a number of approaches has been developed aiming to produce high quality nanoparticles for several bio-applications. These efforts raise many issues related to the design of materials with specific functionalities and question how these materials interact with biological systems.

Although research on nanoparticles is evolving rapidly, nanocomposite particles have been less investigated particularly when biointerfaces are also considered in these studies. Analogous to single-phase nanoparticles, and besides chemical composition, size effects and surface structure are of great relevance in determining the properties of nanocomposite particles. However, because at least two distinct chemical components are present in such hybrid particles, there is the possibility of achieving new functionalities when compared to the individual components. Moreover, new effects can emerge due to specific physico-chemical interactions between the materials that compose the nanocomposites. This is a key feature with great consequences in many applications that to be fully developed need bridges between scientific domains that are frequently apart.

The main scope of this book is to introduce the reader to important aspects on the materials chemistry of nanocomposite particles and underpinning properties of relevance for various bio-applications. It is our aim to provide an overall picture of this field to readers, eventually having quite distinct scientific backgrounds, by covering the recent developments in nanocomposites particles. In this context, we have deliberately favored the presentation of topics of general interest to understand the properties of the materials in detriment of very specialized topics eventually circumscribed by a purist terminology.

While planning this book a number of relevant topics in nanocomposite science came to our discussions. We decided to maintain open slots covering the main aspects on nanocomposite particles for bio-applications and then to invite specialists to contribute for each envisaged topic. Chapter 1 is an introductory chapter to

general aspects on nanoparticles and their use as nano-fillers in nanocomposites. On the other hand, Chapters 2 and 3 are mainly concerned with the science of polymers normally used in nanocomposites, namely their chemical functionalization and their use in a biological context, such as in pharmaceutical and medical applications. In Chapters 4 and 5 there is a special focus on bionanocomposites and biointerfaces, bridging aspects presented previously in Chapters 1–3 to those that are dealt with in the subsequent chapters. Chapters 6–9 details synthetic routes towards diverse nanocomposite particles and also relevant properties aiming bio-applications. Finally, Chapters 10 to 12 offer examples of bio-applications that make use of nanocomposites and address a number of scientific challenges for their use in a biological context, including their health and environmental impact.

Nanotoxicological concerns are especially acute when considering bio-applications and in particular those with interest to Nanomedicine, because in this case all efforts are primarily directed to the well-being of the patient. These aspects are briefly mentioned in some of the chapters of this book. Nevertheless, nanotoxicology and nanosafety regulations are issues evolving rapidly to a specialized body of knowledge for scientists and regulatory agencies. Scientific literature concerning specifically nanotoxicology issues has been published and will be valuable for readers of this book.

The concept of this book was in a large extent inspired by a multi-disciplinary team involved in a project aiming to develop nanocomposite particles with potential for *in vitro* clinical diagnostic techniques (Project PTDC/QUI/67712/2006 funded by Fundação para a Ciência e Tecnologia/FEDER). To our colleagues and post-graduate students involved in this project we thank their long date collaboration.

We are pleased to have edited this book and we are very grateful to the authors of the chapters, for their essential contributions. This book would not be possible without their expertise and enthusiasm.

It is our hope that this book contributes not only for the state of the art on nanocomposite particles but also to convey a stronger impetus to research in this fascinating field. Nevertheless, we prefer to let the reader be the final judge of this contribution. Nanocomposite particles are small-scale materials promising a number of benefits but also a number of big challenges requiring a multi-disciplinary approach to tackle scientific issues and the engagement of diverse audiences. Somehow, this reminds us the inspired words of the poet Fernando Pessoa: *"All is worthwhile if the soul is not small".*

Aveiro, 2010

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