Edited by Dirk M. Guldi and
Nazario Martín

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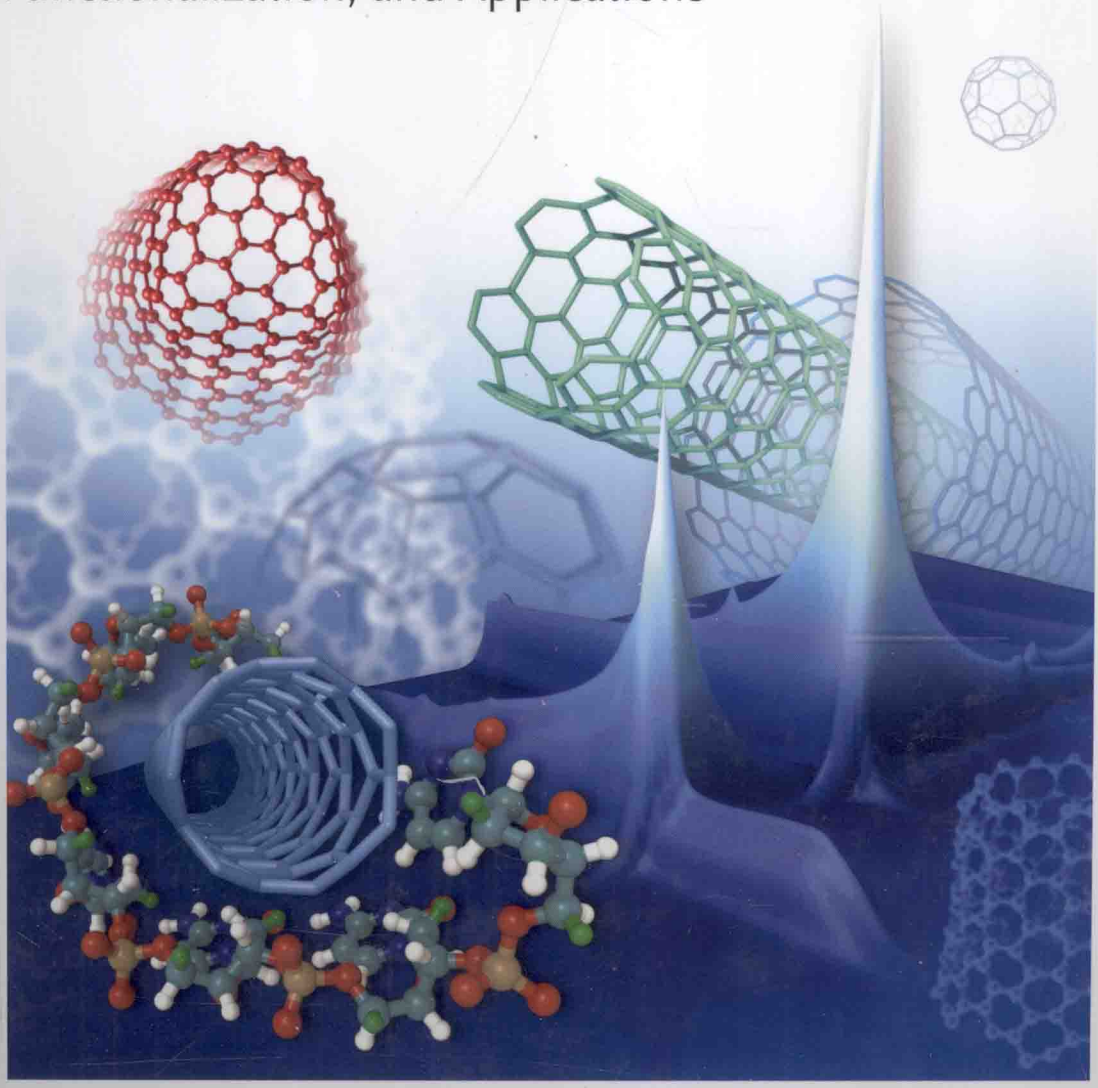
Synthesis, Characterization, Functionalization, and Applications



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Further Reading

Martín, N., Giacalone, F. (eds.)

Fullerene Polymers

Synthesis, Properties and Applications

2009

ISBN: 978-3-527-32282-4

Hierold, C. (ed.)

Carbon Nanotube Devices

Properties, Modeling, Integration and Applications

2008

ISBN: 978-3-527-31720-2

Yudin, A.K. (ed.)

Catalyzed Carbon-Heteroatom Bond Formation

2010

ISBN: 978-3-527-32428-6

Kim, D.M.

Introductory Quantum Mechanics for Semiconductor Nanotechnology

2010

ISBN: 978-3-527-40975-4

Krüger, A.

Carbon Materials and Nanotechnology

2010

ISBN: 978-3-527-31803-2

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Optimization of Polymer Nanocomposite Properties

2010

ISBN: 978-3-527-32521-4

Monthioux, M.

Meta-Nanotubes - Modification of Carbon Nanotubes

2010

ISBN: 978-0-470-51282-1

Kumar, C. S. S. R. (ed.)

Nanomaterials for the Life Sciences

10 Volume Set

ISBN: 978-3-527-32261-9

Kumar, C. S. S. R. (ed.)

Nanotechnologies for the Life Sciences

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Preface

Following Sumio Iijima's groundbreaking discovery of multiwall carbon nanotubes (MWCNTs) in 1991, carbon nanostructures – and in particular carbon nanotubes (CNTs) – have been at the forefront of scientific research in physics, chemistry, materials science, and so on. The discovery of single-wall carbon nanotubes (SWCNTs) in 1993 set yet another milestone in an exponentially growing field. Conceptually, these new nanoforms of carbon allotropes with cylindrical geometry belong to the versatile family of fullerenes. In contrast to fullerenes with their esthetically pleasing spherical shape, CNTs have a length to diameter ratio of up to 28,000 : 1. Some CNTs reach lengths of up to several millimeters. From the very beginning, scientists realized that CNTs are inhomogeneous materials giving rise to different lengths, different diameters, and, most importantly, different structures. The structural features depend, to a large extent, on the means by which individual graphene sheets are wrapped around a chiral vector to form seamless cylinders. According to the specific indices of the chiral vector, *armchair*, *zigzag*, and *chiral* nanotubes are formed. However, they all exist together in a single sample without being controllable (!). To this end, separation and selective formation of homogeneous CNT samples constitute important challenges in contemporary CNT research. Unless significant breakthroughs are achieved in the foreseeable future, potential applications of these carbon materials will continue to be hampered by the lack of pure, homogeneous, and reproducible samples.

The initial excitement – associated with the pioneering discovery of CNTs – was based on their remarkable properties bearing enormous potential for applications in nanotechnology, materials science, and biomedicine: the outstanding tensile strength of CNTs or the fact that they reveal semiconducting and/or conducting electrical properties – to name a few of the exceptional properties of CNTs. Furthermore, CNTs have been found to efficiently interact with living cells. As a matter of fact, they function as transporters of molecules through cellular membranes and, in turn, have opened new avenues for biomedicine.

Considering the sheer endless interest in these unique compounds, a large number of authoritative reviews and comprehensive books have dealt with these carbon allotropes. It is an understatement to say that research on carbon

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nanostructures is a very active field with an enormous number of original studies published every year by groups from all over the world. This, in fact, constitutes the major thrust of this book, that is, gathering an elite number of world leading scientists from very different disciplines to highlight the recent advances in the area of CNTs and other related carbon nanostructures. Needless to emphasize the interdisciplinary nature of the different contributions – ranging from theory and production to practical applications in the field of solar energy conversion and biomedicine.

This book contains 16 contemporary chapters sharing one goal in common – carbon nanostructures. To this end, aspects associated with the production and formation of CNTs (M.H. Rümmeli, P. Ayala, and T. Pichler) are discussed in the opening chapter of the first part of this book followed by a chapter dedicated to the theory of electronic and optical properties (S.V. Rotkin and S.E. Snyder). Equally important are the perspectives that arose around the electrochemistry (M. Iurlo, M. Marcaccio, and F. Paolucci) and the photophysics (T. Hertel) of CNTs as compelling complements to the former topics. Breakthroughs in the chemistry of CNTs are covered in two matching contributions – one focusing exclusively on the covalent chemistry of CNTs (F. Hauke and A. Hirsch) and the other surveying exhaustively the field of noncovalent chemistry of CNTs (M.A. Herranz and N. Martín).

The objectives of the second part of this book are quite different. Here, properties and potential applications in different areas stand at the forefront. Biological applications and potential toxicity (P. Singh, T. Da Ros, K. Kostarelos, M. Prato, and A. Bianco) are certainly some of them, which have been brought together in one specific chapter. This is rounded out by several critical reviews with regard to the use of CNTs in emerging fields in materials science. Emphasis is placed, for example, on ground- and excited-state charge transfer (V. Sgobba and D.M. Guldi), photovoltaics in general (E. Kymakis), and layer-by-layer assembly (B.S. Shim and N. Kotov). Noteworthy are the additional two sections that describe fundamental issues related to the use of CNTs for catalytic applications (E. Castillejos and P. Serp) and the fascinating function of CNTs as containers (T.W. Chamberlain, M.d.C. Gimenez-Lopez, and A.N. Khlobystov).

As reflected in the multidisciplinary title of this book, other carbon nanostructures –besides just CNTs – that have received similar attention throughout the scientific communities, namely, nanohorns (M. Yudasaka and S. Iijima), nanographenes (W. Pisula, X. Feng, and K. Müllen), and endohedral fullerenes (L. Feng, T. Akasaka, and S. Nagase), are at the focus of the third part of this book. The closing statement belongs, however, to a chapter that deals with the calculations on energetics, thermodynamics, and general stability (Z. Slanina, F. Uhlik, S.-L. Lee, and T. Akasaka).

We – as editors of this book – share the view that all chapters should prove very useful to both students and researchers in different disciplines of carbon research. Simply, the fact that all chapters are solid and offer comprehensive discussions on the properties of carbon nanoforms assists in serving as a constructive tool for specialists in various fields and an updated reference for the broad readership of nonspecialists. In this regard, it is essential that each chapter begins with an

excellent introduction to the topic at hand and then turns to more details for the expert in the area.

Finally, we would like to express our sincere gratitude to a unique set of internationally leading authors who accepted our invitation to join this venture and committed their valuable time and efforts to guarantee the success of this book in terms of allowing a better understanding of these carbon-based systems. Moreover, we would be very pleased if this book would turn into a source of inspiration for further adventures on so far nonimagined/nonexplored carbon nanoforms. Likewise, we would like to say thanks to the dedicated Wiley-VCH staff for their continuous support and enthusiasm, especially when informed at an early stage about our keen interest in editing this book.

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