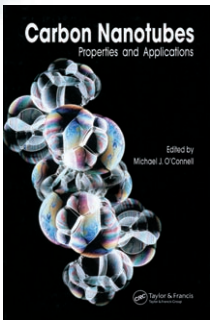
Carbon Nanotubes



Properties and Applications. Edited by *Michael J. O'Connell*. CRC Press/Taylor & Francis, Boca Raton 2006. 319 pp., hardcover £56.99.—ISBN 0-8493-2748-2

Nanometer-scale structures represent a novel and intriguing field, in which scientists and engineers manipulate materials on the atomic and molecular scales to produce innovative materials for applications in composites, electronics, sensing, and biomedicine. Carbon nanomaterials such as single- and multiwall carbon nanotubes (CNTs) are a relatively new class of materials, which exhibit exceptional mechanical and electronic properties.

Several books on CNTs have been published in the last decade. One might ask, firstly, is it necessary to have one or two new books on CNTs every year?—secondly, which of those books should one choose? The answer to the first question is: yes, for such a hot topic the number of publications grows so much each year that it is necessary to continuously update our knowledge, and a book offers the best way of covering this broad field comprehensively. For the second question, there is no firm answer—the choice depends on the reader's interests. Usually, different books address different groups of readers.

Carbon Nanotubes: Properties and Applications consists of 10 chapters written by 24 scientists, and has more than 1100 references. To produce this book Michael O'Connell has brought together many experts in nanotube science. Almost the entire field of nanotubes research is covered: physics and chemistry, theory, properties, and applications. The only missing components, if we really want to name any, are the biomedical applications and the toxicology of CNTs.

Carbon Nanotubes: Properties and Applications will be read mainly by researchers. The chapters need not be read in numerical order, but can be studied independently. The first three chapters introduce the topic, and cover the history of carbon nanotubes and the different ways of synthesizing them. In particular, Chapter 2 is well referenced and describes developments in the production of nanotubes over the last 14 years. The recent advances in growth control and alignment are also discussed. Chapter 3 gives an overview of carbon nanotube peapod materials, and describes their production and characterization. This chapter is mainly devoted to fullerene and fullerene derivatives encased in the nanotube cavities.

The following two chapters deal with the electronic and magnetic properties of CNTs. Transistors based on carbon nanotubes could be the next revolution in electronics, leading to a dramatic reduction in size of the devices. Marcus Freitag describes the principles of these devices in his chapter (CNT-based field-effect transistors, logic gates, infrared emitters, photodetectors, etc.). Junichiro Kono and Stephan Roche report theoretical and experimental results on the novel and exciting magnetic properties of carbon nanotubes: changes in their metallic character in the presence of a magnetic field, and also magneto-transport phenomena.

Chapter 6 is devoted to the characterization of CNTs. Raman spectroscopy is one of the most powerful techniques, and provides an unambiguous method to characterize nanotubes and to distinguish between metallic and semiconducting tubes. In this chapter, the different features of Raman spectra are well detailed and explained. It will be very useful for undergraduate or graduate students, but also for researchers who want to know more about characterization of CNTs.

The next two chapters (7 and 8) highlight the mechanical and electromechanical applications of CNTs. Polymer–CNT composites is a field where the mechanical properties of nanotubes are fully exploited, and is probably, in the short term, the most commercially promising development of carbon nanotubes. The chapter devoted to this aspect is full of information and contains many references.

Chapter 9 covers the chemical modification of CNTs. Functionalization of CNTs is a rapidly developing topic. Although this chapter is adapted from an earlier review by the authors, it is very well written and contains enough information to enable the reader to understand the basic principles and characterization techniques used in the functionalization chemistry of CNTs.

The last chapter deals with a very interesting theme: the use of carbon nanotubes as tips for scanning probe microscopy. Atomic force microscopy (AFM) has become an indispensable tool for imaging and manipulating matter on the nanometer scale. The radius of curvature of commercially available silicon tips is not negligible, and this increases the apparent size of the visualized objects. The large aspect ratio of nanotubes makes them ideal probe tips for AFM measurements. The recent advances in tip design based on carbon nanotubes (e.g., functionalized nanotube probes) are reported here.

In conclusion, this book is very informative and represents a useful tool for beginners, and also for those already working in the field. The information is given clearly, and the reader can go straight to the chapter of interest, without being forced to read the whole book. A very important point is that this book is strongly interdisciplinary and can be read easily by researchers working in different fields.

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