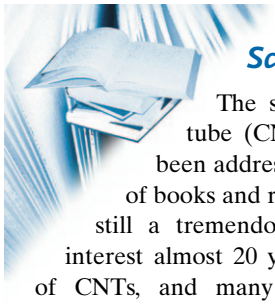


Carbon Nanotube Science

The subject of carbon nanotube (CNT) science has already been addressed recently in a variety of books and review articles, as there is still a tremendous amount of research interest almost 20 years after the discovery of CNTs, and many questions remain unanswered. The contents of this book cover research activities on both multiwalled carbon nanotubes (MWCNTs) and single-walled carbon nanotubes (SWCNTs), and are concerned with production and growth, purification and processing, and structure and physical properties. Exohedral and endohedral functionalization, the formation of composites, and applications of CNTs are also considered. The main emphasis is clearly on CNT production, growth, and structural characterization by transmission electron microscopy (TEM).

The book is well structured, and provides good summaries at the end of each chapter, as well as at the end of the book. Although the chapters contain extensive lists of references, an in-depth discussion of the different topics is avoided. Thus, at first glance it appears to be highly suitable for young researchers and newcomers to CNT research. However, for that purpose it is a little too specialized in the area of production. The book is also nicely illustrated by TEM images, but TEM is certainly not the only standard technique used for the characterization of CNTs, and therefore the emphasis on TEM throughout the book overstates its importance.

The book begins with an extensive and highly valuable description of the various production techniques for both SWCNTs and MWCNTs, including recent developments. The partly contradictory theories about growth mechanisms are described in detail and are carefully evaluated against each other. The advantages and disadvantages of the various production techniques are also well summarized, thereby providing an excellent platform for further reading.

That is followed by a description of the purification and processing of SWCNTs and MWCNTs. The author focuses on previous groundbreaking developments rather than on recent advances. The section on processing includes the alignment of CNTs, as well as the formation of controlled architectures during production and post-synthesis treatment. However, although the chapter mentions post-synthesis separation approaches, these are only outlined very briefly, even though there is currently huge interest in this subject in the CNT research community, as selective CNT growth has not been achieved up to now. The author also omits some clearly important aspects of CNT separation, such as the method of density-gradient ultracentrifugation introduced in 2006 by Hersam and co-workers[1] for the fractionation of SWCNTs according to diameter and electronic properties. As the book aims to provide a short but comprehensive summary of CNT science in general, it would have been desirable to also cover recent advances in post-synthesis separation.

The author then begins a description of CNT structures, also discussing the structure of MWCNT and SWCNT ends. Experimental structural evaluation is then discussed with the aid of numerous TEM images. Although this is certainly interesting, the experimental description is perhaps too detailed for the general readership that is envisaged.

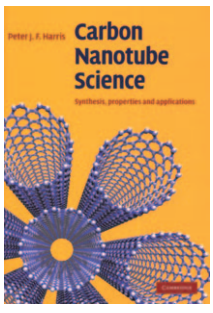
In the following sections, the physical and electronic properties of CNTs are summarized. A detailed theoretical account of the electronic properties is not given, but the interested reader is referred to suitable publications. The mechanical properties of both SWCNTs and MWCNTs in theory and experiment are then outlined. However, the optical and spectroscopic properties of CNTs, which are of extreme importance for their characterization, are barely touched on, again presenting a rather distorted view of CNT characterization.

Next, the author provides a short overview of exohedral functionalization, including the immobilization of biomolecules. No recent advances are described, either in the vast field of covalent CNT chemistry or in the developing topic of noncovalent CNT chemistry. As stated by the author, functionalization was outside the scope of the book, and therefore only the early groundbreaking studies are highlighted.

In the section concerned with the formation and characterization of CNT composites, the focus is on polymers as a matrix, but the incorporation of nanotubes into ceramics, carbon, and metals is also briefly discussed.

Endohedral CNT functionalization, including filling the nanotube cavities of SWNTs and MWCNTs with water, fullerenes, gases, or inorganic material is covered in the next chapter. The formation of heterogeneous boron and nitrogen CNTs is also summarized. In contrast to the treatment of exohedral functionalization, the descriptions in this chapter are more detailed, even though the applicability of this kind of CNT derivatization is certainly far less apparent than that of covalent and noncovalent exohedral functionalization.

In the last section, the applications of nanotubes as probes and sensors are outlined, with a focus on the production of atomic force microscopy tips with nanotubes anchored to the cantilever. Other applications are not explicitly addressed in a separate chapter as suggested by the subtitle, but



Carbon Nanotube Science
Synthesis, Properties and Applications. By Peter J. F. Harris. Cambridge University Press 2009. 314 pp., hardcover £45.00.—ISBN 978-0521828956

rather appear within the chapters concerned with nanotube properties. Thus, the subtitle *Synthesis, Properties and Applications* might be slightly misleading.

In general, the book had the opportunity to stand out above other publications in this field, as it aims to give a brief overview of the many facets of CNT research, also including areas that are usually only marginally considered in general reviews—for example, heterogeneous nanotubes, nanotube composites with ceramics or metals as matrix material, or a detailed description of MWCNTs. However, it seldom goes beyond the level of reviews that already exist in large numbers in the literature, except for the topics of nanotube production and characterization by TEM. This gives a rather subjective view of nanotube research. With some reservations, the book can be recommended for newcomers, as well as for readers especially interested in the production and growth of CNTs.

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DOI: 10.1002/anie.201000314

[1] M. S. Arnold, A. A. Green, J. F. Hulvat, S. I. Stupp, M. C. Hersam, *Nat. Nanotechnol.* **2006**, *1*, 60.

