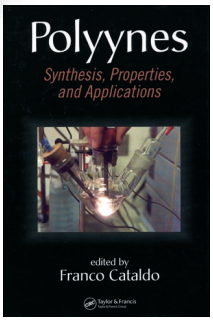
## Polyynes




Synthesis, Properties and Applications. Edited by *Franco Cataldo*. CRC Press/Taylor & Francis, Boca Raton 2005. 528 pp., hardcover $ 139.95.—ISBN 1-5744-4451-2X

As the title would suggest, polyynes dominate much of the work described in this monograph. Nonetheless, there is also a significant amount of discussion concerning the existence and characterization of the "Holy Grail" of polyynes, the elusive carbon allotrope carbyne. Whether as a mineral or material, carbyne has been a controversial subject historically. It is interesting that this controversy continues in the present monograph, where several different definitions of carbyne are suggested. What is carbyne? Is it "an ideal form of solid elemental carbon made by sp-hybridized carbon atoms" or "an ill-defined crystal containing sp-bonded all-carbon chains"? Or, perhaps carbyne is simply an extremely long polyyne: R-$(C{\equiv}C)_{\infty}$-R. The answer one receives to such a question will likely depend on whether one asks a chemist, a physicist, a mineralogist, an astrophysicist, a biologist, or an engineer. In October 2003, a diverse group of scientists from many of these disciplines met in Naples, Italy, to discuss the formation and physical characteristics of polyynes, at the Interdisciplinary Meeting on Polyynes and Carbyne. The work of these researchers and that of other experts in the field has been assembled in this book, thereby giving an overview of recent achievements in the area.

The 52 authors have combined to write 20 chapters that cover the remarkable breadth of this subject, drawing from no less than a half-dozen different disciplines. The result is a book that, from a scientific viewpoint, offers something for everyone. There is, nonetheless, a fair amount of disparity in both the quality of the content and the level at which the chapters are written. Some chapters offer excellent readable reviews on a particular topic, with comprehensive referencing, while others are written to the level of an expert in the field and focus on a very specific aspect in great detail. The number of authors and their diverse backgrounds result in an abundant use of acronyms throughout the text. Although many are explained in a list at the end of the book, it is not as complete as one would like.

The formation of polyynes and/or carbyne is a consistent theme throughout the book, and all but a couple of chapters expand on this topic. Experimental methods for the synthesis of these materials are described (some in great detail). These include the vaporization of carbon, ion irradiation, and electrochemical routes, as well as more traditional solution-state chemical methods such as homocoupling of acetylenes and dehydrohalogenation. These procedures can yield polyynes in the gas phase, in frozen matrices, in solution, on several types of surfaces/substrates, or in bulk quantities. The natural formation of polyynes on earth, such as the enediyne natural products and chaoite from the Ries crater, is also described in some detail. The origin of polyynes and cyanopolyynes in the inter- and circumstellar media of space is also discussed, and plausible mechanisms for their formation are presented. These chapters on synthesis are rounded off by an excellent discussion of cyclic polyynes and their potential role in the formation of fullerenes. However, two aspects of polyyne formation are conspicuously missing from this book. First, it is well known that polyynes are found widely distributed as natural products from a variety of sources, and a chapter on this topic would have nicely complemented the chapter describing the enediyne natural products. Secondly, there is scant discussion of the recent success of researchers in extending the range of monodisperse polyynes that can now be prepared synthetically in the laboratory. These new polyynes provide remarkable insights into the potential properties of carbyne, and their inclusion would have made for a more complete story on the topic.

A major strength of this book arises from the considerable attention given to the characterization of polyynes and carbyne by modern state-of-the-art techniques. For samples ranging from a few atoms to carbyne, numerous spectroscopic, mass spectral, crystallographic, and surface analysis methods are nicely described. Infrared, Raman, and UV/Vis spectroscopies (for the gaseous, solution, and solid states) figure heavily in these studies, and each provides a characteristic signature that has been ascribed to the various structural forms of carbyne (e.g., acetylenic or cumulenic) and polyynes of different lengths. Likewise, imaging techniques such as TEM, AFM, and SEM have recently been used to give a better understanding of the structural characteristics of thin films and crystalline samples.

Overall, the current state of polyyne research is reasonably well covered by this book, and the discussion is split approximately equally between methods for making polyynes and their characterization. The interdisciplinary cast of authors is well suited for addressing the many aspects of polyyne research that are currently being pursued, and the result is an excellent overview of the topic. Although the casual reader will likely find some of the chapters too technical, the book will be a useful resource for those working in the area of polyynes and carbon-rich materials.

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