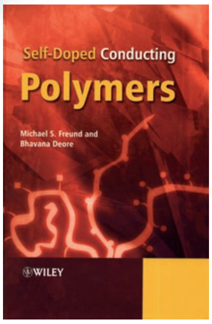
Self-Doped Conducting Polymers



By *Michael S. Freund* and *Bhavana Deore*. John Wiley & Sons, Chichester 2007. 333 pp., hardcover $ 135.00.—ISBN 978-0-470-2969-5

Since the discovery and characterization of conducting polymers, an achievement that is closely associated with the work of the Nobel Prize laureates Heeger, MacDiarmid, and Shirakawa, these systems have become an important theme of materials research. That is mainly because their unconventional properties have led to many practical applications, in areas that range from optoelectronics to artificial muscle. Thus, it is not surprising that, in addition to an enormous number of original publications, more than 60 books devoted to the subject have appeared.

The book reviewed here is concerned with a special aspect of the subject: the properties and synthesis of self-doped conducting polymers. This rather narrowly defined field is receiving intensive research efforts, as is shown by the fact that over 900 publications are cited.

The term “self-doped conducting polymers” is, in principle, misleading, as it implies that these materials are already doped because of their intrinsic structure. That is not the case. Conducting polymers of this type must, like all such systems, be transformed from the neutral state into a charged state (i.e., doped) by oxidation or reduction. The special structural feature of self-doped conducting polymers is that a considerable fraction of the monomer units in a conjugated polymer chain contain covalently bonded ionizable functional groups. In the case of p-doping (oxidation), for example, these groups become stable immobile anions that screen the positively charged polymer backbone, thus maintaining the electrical neutrality of the polymer film, while, simultaneously with the charging process, cations (e.g., protons) move out of the film into the electrolyte solution. Thus, from the viewpoint of an electrochemist, the term “self-ionized conjugated polymers” would be a better, and unambiguous, description of the structural properties of these materials. However, now a look at the contents of the book.

With five chapters and 326 pages, including the index and literature references, this is a book of readable and digestible size. As usual in works of this kind, it begins with a description of the essential properties of conducting polymers, followed by the special characteristics of self-doped polymers. Next come two chapters on self-doped polyanilines, including a section devoted specifically to derivatives with boronic acid as a substituent group, which is a special research topic of these two authors. The next chapter deals with the analogous polythiophenes, and lastly the authors discuss self-doped pyrrole, carbazole, phenylene, phenylenevinylene, and indole derivatives.

All these chapters follow a closely similar structure, beginning with synthesis, which is followed by descriptions of the electrochemical, spectroscopic, and other properties. Applications that have been described in the literature are discussed and explained in detail. An important aspect of the applications is that many self-doped polymers, in contrast to conventional conducting polymers, are soluble, which makes them much easier to process. Furthermore, it is often claimed in the literature that, because the cations are small, the charging and discharging processes occur much faster than in conventional conducting polymers, which makes these systems more suitable for applications.

To summarize, the book offers the reader a very detailed introduction to this highly topical area. An especially pleasing feature of the references is that the titles of the papers are given, which helps one to choose items of interest for further reading. However, it is a little disappointing that the authors have limited themselves very narrowly to simply reporting on the cited literature, without expanding on points that are not covered clearly in the publications, or developing their own views. The overall impression is that the authors have devoted much care and thoroughness to the compilation of a very comprehensive review article, but have only been marginally concerned with presenting a critical and analytical view (see the introduction). Nevertheless, the book can be recommended for materials scientists and chemists as a guide into the literature for further detailed study.

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Enzymatic Reaction Mechanisms

By *Perry A. Frey* and *Adrian D. Hegeman*. Oxford University Press, Oxford 2007. 848 pp., hardcover £ 60.00.—ISBN 978-0-19-512258-9

The title of this book is a compliment to Chris Walsh’s original *Enzymatic Reaction Mechanisms* (ERM), published in 1979, which has been the backbone of myriad courses in chemical enzymology, and is still in print today. Walsh put together the first comprehensive single-volume text on the subject, creatively applying the established mechanistic classification of organic reactions to the broad sweep of enzyme chemistry, with the explicit intention of providing “a simple chemical framework for the study and analysis of enzyme-catalyzed reactions”. If vast numbers of organic