Book Reviews

Solid State Physics. Fullerenes. Edited by Henry Ehrenreich and Frans Spaepen (Harvard University). Academic Press: San Diego, CA. 1994. xii + 434 pp. ISBN 0-12-606048-7.

It is a real testimony to the interdisciplinary nature of fullerene research that a book review of a volume entitled *Solid State Physics. Fullerenes* should appear in the *Journal of the American Chemical Society*. Since the production of bulk crystalline samples of fullerene material from arc-processed carbon deposits in 1990—five years after the materials were first discovered—fullerene research has taken off at an exhilarating pace. The materials excited the imagination of diverse classes of scientists, resulting in a truly interdisciplinary field. Many of our old, seemingly well-founded, preconceptions in carbon science had to be radically altered or totally abandoned, as a new round world of chemistry, physics, and materials science began to unfold. Unique carbon materials like the nanotubes, the buckyonions, and the endohedral metallofullerenes have been discovered, while fullerene derivatives show a plethora of interesting properties, ranging from inhibition of the HIV-1 protease to superconductivity and ferromagnetism.

The present book attempts to focus—and does so very successfully—on the solid state properties of fullerenes and fullerene-based materials. There are five independent extensive articles, addressing key issues in fullerene solid state research.

In the first article, entitled Solid State Properties of Fullerenes and Fullerene-Based Materials, John Weaver and Derrick Poirier give one of the most concise overviews of C_{60} and its derivatives found in the fullerene literature; the authors start with the properties of fullerenes in the gas phase, cover exhaustively the properties of solid C_{60} and its alkali and alkaline earth metal doped derivatives, and pay particular attention to thin film and bulk crystal growth. There is a strong emphasis on the information available about the electronic structure of the systems as a function of the degree of oxidation or reduction and how the electronic and vibrational properties are eventually related to the appearance of metalic behavior and superconductivity.

Subsequent chapters deal with (i) the preparation of fullerenes, of their metal intercalated derivatives as well as of endohedral fullerenes and carbon nanotubes (Lieber and Chen), (ii) the structural and dynamical properties of crystalline C_{60} in both its high-temperature orientationally disordered plastic phase and its low-temperature orientationally ordered "ratchet" phase (Axe, Moss and Neumann), (iii) the theoretical framework necessary to interpret the observed transport, thermodynamic, electronic, and vibrational properties—here the experimentally observed properties of the superconducting state are detailed and their rationalization in terms of the competing theoretical models (electron-phonon coupling versus electronic) is presented (Pickett), and (iv) the physical properties of the fulleride superconductors (especially those of K_3C_{60} and Rb_3C_{60}) in both the normal and the superconducting state, together with an extensive discussion of the attempts to understand the microscopic mechanism of superconductivity in these materials (Lieber and Zhang).

By providing this timely collection of articles on the solid state properties of fullerenes and their derivatives, the editors succeeded admirably in producing an excellent reference book, covering exhaustively the first three years of solid state fullerene research. One unmistakable impression that the reader derives is that, even though there is a plethora of still unresolved issues, our understanding stands on remarkably solid experimental foundations for such a young research field. The present volume is a useful addition to the fullerene literature and belongs to the bookshelves of all chemists, physicists, and material scientists interested in this remarkable family of molecular solids.

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