Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (R. F. Bryan, Department of Chemistry, University of Virginia, McCormick Road, Charlottesville, Virginia 22901, USA). As far as practicable, books will be reviewed in a country different from that of publication.

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Organic molecular crystals: interaction, localization and transport phenomena.

By EDWARD A. SILINSH and VLADISLAV ČÁPEK. Pp. xxiv + 402. Oxford: Oxford University Press/American Institute of Physics, 1994. Price £48.00. ISBN 1-56396-069-9.

In 1951, A. S. Davydov's influential book *Theory of Absorption of Light in Molecular Crystals* (Kiev: Ukrainian Academy of Sciences) was published and in 1962 it was translated from the Russian into English by M. Kasha and M. Oppenheimer under the title *Theory of Molecular Excitons* (New York: McGraw Hill Book Co. Inc.). It contained accounts of work by physicists in the Soviet Union who earlier had made measurements on exciton properties of molecular crystals at low temperatures. The major thrust into molecular crystal research by chemists in the West began in the 1950's. Their immediate interest was in understanding the energy transfer and the origins of the Davydov splitting and electronic spectra from a molecular viewpoint. At low temperatures, crystals of even relatively complex molecules were found to exhibit vibrationally resolved spectra. They naturally became important objects for the discovery of new paradigms in the fields of spectroscopy, molecular structure, intermolecular forces and dynamics, in much the same way that supersonic jet spectroscopy contributed in recent years to our understanding of the behavior of isolated molecules. This was a rich field, combining theory and experiment, and it yielded discoveries of great value in understanding and controlling molecular excited-state properties and excitation-energy dynamics. There is great current interest in applying ideas founded on research with crystals to biological systems. One example is the light-harvesting complex of photosynthesis, with its beautiful circular arrangements of chlorophyll molecules reminiscent of nanoscale molecular crystals. In parallel with these developments, there were efforts to understand how electrons and holes are generated by optical excitation of molecular solids, and the properties of the charge separated states. This phase of molecular crystal research generated an enormous number of results that were difficult to reconcile into a coherent picture. Indeed, the development of methods for the synthesis of ultrapure materials, reminiscent of the evolution of solid-state electronic devices, was a necessary prerequisite before the precise mechanisms of charge transfer and the controlling features of photoconductivity in ordered and disordered molecular systems could be elucidated with confidence. Moreover, the recent advances in developing novel molecular materials in which charge transport and excited-state properties are intimately coupled, *e.g.* in light-emitting diodes, rely heavily on the knowledge gained from studies of molecular crystals.

This monograph by Silinsh & Čápek therefore appears at a time when there is much intense activity in a number of new research areas that rely heavily on previous work on molecular solids. The book brings us up to date in a number of topics chosen from what has continued to be an active field of research that has significant impact on other areas of chemical physics. It begins with accounts of those properties that distinguish molecular crystals from other materials. A treatment of exciton theory in rigid lattices is followed by a discussion of the coupling of excitations, electrons and holes with lattice vibrations. The book contains a very thorough treatment, ranging over many of the chapters, of the effects of nuclear motion on exciton, electron and hole dynamics and spectra, including theoretical treatments of self trapping and polarons. One of the book's unique features is that it develops most of the many theoretical approaches and provides critical and comparative discussions of them. Another useful feature is that detailed experimental results and comparisons between theory and experiment are brought in whenever possible. The remainder of the book is concerned with charge carrier generation and transport. A remarkably complete treatment is given as the authors connect the plethora of experimental facts to a wide range of theories.

This book should be useful to chemists, physicists and biophysicists interested in energy transfer and charge separation in molecular aggregates. It is a research monograph without 'help menus' so only those with knowledge of the appropriate quantum mechanics, in particular the methods of second quantization, will derive maximum benefit from it. However, for the less theoretically inclined, the extensive critical presentations and discussions of experimental results, especially in the areas of charge generation and dynamics, taken together with the 417 entries in the bibliography (through 1993) should prove to be very useful. The authors are to be congratulated for compiling such an extensive and insightful survey of a field whose concepts are useful in many areas of molecular and materials science.

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Physics and chemistry at oxide surfaces.

By CLAUDINE NOGUERA. Pp. xv + 223. Cambridge: Cambridge University Press, 1996. Price £40.00 (US $64.95). ISBN 0 521 47214 8.

In this book, Noguera presents the current state of the art for the theory of oxide surfaces. In the first chapter, the ionic model of the bonding in oxides is presented with an illuminating discussion of the definition and relative importance of ionic and covalent interactions. The modern, quantum-mechanical, simulation techniques used in quantitative studies are briefly re-