

the Perkin-Elmer Corporation, are responsible for chapters on instrumentation and experimental techniques. The individual components of a spectrophotometer and their influence on the observed spectra are described together with sample-handling techniques and some of the accessories available for particular applications. They include many practical suggestions for minimizing errors and obtaining reliable, reproducible data. By digesting this material and beginning spectroscopist can save much time and effort and an experienced practitioner will be reminded of the most suitable operational methods. There is, unfortunately, no discussion of some of the newer instruments, such as interferometers, which are now commercially available and which offer some advantages over the more conventional prism or grating instruments.

Approximately two-thirds of the book is concerned with infrared theory and the use of characteristic group frequencies in structural analysis. This material was prepared by the principal author, Herman Szymanski, who has firsthand experience of the problems and difficulties encountered by spectroscopists through the well known Infrared Spectroscopy Institutes held at Canisius College. There is an excellent, non-mathematical introduction to the origins of the fine structures of vibration-rotation bands of molecules and to some of the perturbations that may affect band positions and contours. The symmetry properties of molecules and group theory are used to relate the observed bands to molecular structures. Examples of the methods for identifying the structural groups present in a compound are given, together with brief accounts and listings of the characteristic frequencies associated with the principal structural groups found in organic molecules.

An interesting feature is the set of 20 loose spectra in a folder at the end of the book. These allow the reader to examine in detail some of the spectral features described. Besides a representative list of references at the end of each chapter there are also compilations of books on infrared spectroscopy, abstracting services and sources of reference spectrograms and spectral retrieval systems. A listing of the principal suppliers of instruments and accessories would have been useful.

Overall, the book is well written and attractively produced. There are some minor criticisms: there are no ordinates to the energy level diagrams and some sketches of spectra do not have an abscissa label. This may cause confusion, because other examples of spectra which are given may have either frequency (cm^{-1}) or wavelength increasing to the right. There are oc-

casional ambiguities in the text that should not cause difficulty to most readers, and some portions of the theory section are catalogs of unsupported statements of the relations between observed spectra and molecular structure.

The book merits a place in any chemical laboratory with an infrared spectrometer. It may not be suitable as the sole text for a course in chemical spectroscopy unless the instructor limits the number of topics covered and is prepared to expand on them and unless some laboratory experience is also available.

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Color Centres and Imperfections in Insulators and Semiconductors

P. D. Townsend, J. C. Kelly
229 pp. Crane, Russak, New York, 1973.
\$16.50

In the majority of applications of solids, it is impurities and defects that determine or at least limit the properties of the solids. Examples such as doping of semiconductors with donors or acceptors, the importance of trace "activators" and "sensitizers" in phosphors and the role of dislocations and other defects in determining mechanical properties are all widely appreciated. Less well known are the application of defects in determining mechanical properties are all widely appreciated. Less well known are the application of defects in photochromic memory systems or the use of thermoluminescent traps to date archeological samples or to estimate the formation temperature of stony meteorites.

In traditional introductory solid-state physics courses the importance of defects and impurities is considered briefly if at all. Thus most students are surprised to find how large a role defects play in applications and they are usually appalled at the apparent witchcraft used to prepare desired defect distributions in practice.

It is this shortcoming in traditional course work that Peter Townsend and John Kelly have set out to correct in writing this book about imperfections in insulators and semiconductors. The book is based on lectures prepared for both final-year undergraduates and for required graduate curricula at the Universities of Sussex and New South Wales. The authors' aim was to prepare a book that begins at a level comprehensible to final-year undergraduates, but which provides a summary of recent discoveries for more advanced workers. Both authors have had

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strong research interests in the field, and in recent years their work has included studies in ion implantation, sputtering, electron passage through matter, thermoluminescence, and channeling and atomic collisions in solids.

The book begins with a discussion of direct observation of point defects or defect clusters using magnetic and optical properties including luminescence, thermoluminescence and photoconductivity. The authors discuss extended defects, dislocations and grain boundaries along with indirect methods of defect observation such as inter-

nal friction and ionic conductivity. Then specific defect models and defect formation are covered. The book ends with a unique chapter on defect applications, which, in these days of relevance, should prove a useful resource for anyone seeking justifications for basic research in the field.

The authors' approach is primarily descriptive and the book has a strong empirical flavor. This has the advantage of allowing the authors to cover a large number of phenomena in various materials in a short space. However, its weakness is that experiment and theory are not well integrated. For-

mulas are not always related to specific models and are often introduced without derivation, even when that could be done with the tools available to the undergraduate. Although the reader is assumed to have mastered a course in solid-state physics, this leaves many phenomena inadequately related to general principles for much of the intended audience. This shortcoming is particularly apparent in the description of magnetic resonance experiments in the second chapter. The treatment is so brief that students unfamiliar with the methods would get little out of the readings. However, these defects could be easily remedied with supplementary lectures or by some collateral reading in the numerous references supplied at the end of each chapter.

The book has a very good range of coverage, includes a great deal of up-to-date material and is well illustrated. It appears best suited for a special topics course and as a source for those preparing undergraduate and lower-level graduate courses. The text may be read rapidly and serves as a quick up-to-date orientation in the field of defects in insulators and semiconductors. It is, however, not a book that ties up all the loose ends. Rather, it is somewhat like a research paper which encourages the reader to fill in blanks and delve further in the literature.

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Space and Time in the Microworld

D. I. Blokhintsev

330 pp. D. Reidel, Dordrecht, Holland, 1973. \$39.50

In this book D. I. Blokhintsev, an elementary-particle theorist, presents a survey of approaches to the problems of geometry and causality at very small distances, which includes his own contributions to these subjects.

Starting with geometric measurements in the microworld and in the macroworld, he goes over to discussions of how to perform meaningful measurements if special relativity is taken into account, including the positive energy requirement. He discusses the roles of finite size, of form factors and of elementary particles, and then goes on to the concept of causality in quantum theory. He finishes up by discussing possible generalizations of causal relationships and of geometry at levels below the dimensions of the Bohr atom.

In several places the author is briefly commenting on the possible contribu-

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