classification of transition-metal compounds according to the scheme he proposed in 1953. In this well-known approach, based on the acceptor-donor relationship between transition-metal and non-metal additives, he relates the electron-dependent properties of these phases to principal quantum number, number of electrons in unfilled "*d*" shells, and ionization potentials of the non-metals. Despite its qualitative nature, the approach correlates with experimental data and has successfully predicted properties of refractory nitrides, carbides, and borides. A short paper by Shulishova presents a method of calculating crystal lattice energy for inorganic compounds. Another short paper is devoted to a quantum mechanical derivation of an approximate expression for residual resistivity of alloys composed of a transition and a non-transition metal. Dudkin presents an extensive study of the nature of metallic and semiconductive properties of transition-metal compounds. He proposes criteria for predicting the formation of semiconducting phases in these systems from crystal-chemical analysis and knowledge of the electronic structure of the transition-metal component. Successful application of the criteria to compounds of several structure types is demonstrated.

• The remaining 15 papers in the collection present results of various experimental studies on a number of transition-metal compounds. Thirteen of these papers deal with physical property measurements and interpretation of the results in terms of crystal and electronic structures. Four papers discuss x-ray emission and absorption spectra for transition metals and the changes that occur in the spectra as a result of compound formation. Individual papers are devoted to absorption spectra of compounds of chromium with carbon, silicon, and germanium; *L*-series spectra in refractory niobium compounds; impurity effects on *L*-series spectra in refractory niobium compounds; impurity effects on *L*-series emission spectra of germanium; and an excellent, extensive review paper by Nesphor on interatomic bonding in carbides, nitrides, borides, and silicides of the transition metals as deduced from x-ray spectral analysis. Other papers discuss such topics as electromigration of components in iron-base alloys; electrical properties of rare-earth hexaborides, molybdenum silicides, and the highly refractory carbides and borides of the transition elements of groups IV to VI; and, finally, thermionic emission properties of scandium and gadolinium borides. Three papers are devoted to structural analyses of crystal phases in the Fe-Si system and measurement of their electrical properties.

Two papers are outside the general theme of the book. One is devoted to preparation of lanthanum hexaboride and the second is a summary of intermetallic compounds crystallizing with the β-uranium structure. With these exceptions, the central unifying theme of the series is preserved.

In general, the papers are well written, though in some cases somewhat succinct, perhaps because of their "progress report" nature. In several papers there are few references and in one case, none at all (even though the author refers to pertinent work by a number of other authors in his text).

The English translation reads smoothly. The editors have thoughtfully included a subject index, a useful item often neglected in a book of this type.

The collection, then, is a valuable summary of contributions by a number of Russian scientists to the understanding of refractory transition-metal compounds. It should be a worthwhile addition to the library of the researcher concerned with fundamental studies on materials for advanced high-temperature applications.

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Effects of Radiation on Semiconductors. By Victor Sergeevich Vavilov, Consultant Bureau, (1965). 225 pages, $25.00.

To English-speaking readers for whom the term "radiation effects" has a special connotation, the title of Vavilov's book can be quite misleading. Reinforced by the fact that the author is perhaps the leading Soviet exponent of radiation damage in semiconductors, it is quite natural to assume that the English usage applies, and that the entire volume is concerned with permanent effects produced by exposure of semiconductors to energetic radiation. Such is not the case. Of the book's five chapters, only the last one deals with the problem of the influence of radiation-induced defects on semiconducting behavior; this amounts to less than a third of the volume.

The first four chapters treat primarily photoelectric phenomena, and ionization processes due to high-energy charged particles. Chapter I concerns absorption of photons by semiconductors and the physical processes that dominate optical absorption in the various spectral ranges (intrinsic or fundamental absorption, adsorption by localized states of imperfections, free carrier absorption, and the excitation of lattice vibrations by photons). Also discussed are the effects of external parameters (pressure, temperature, and magnetic fields) on the various absorption processes. Chapter II treats photoconductivity due to both photo-ionization of localized states and band-gap excitation. Also included is a rather sketchy treatment of the recombination and trapping kinetics of photocarriers. A brief discussion of photo-intensity effects and other complicating factors is added to the end of the chapter.

Interaction of high-energy charged particles with semiconductors forms the topic of the third chapter with the primary emphasis on ionization processes. The main import here is a discussion of the experimental and theoretical aspects of the yield of electron-hole pairs created by the high-energy charged particles, i.e., the energy consumed per electron-hole pair produced for a variety of semiconductors. Unfortunately, the author did not discuss the very important application of this research to nuclear particle spectrometry through the use of semiconductor-junction particle detectors, and the very interesting problems associated therewith. Chapter IV

introduces quite another topic—recombination luminescence in semiconductors and its potential application in semiconductor junction lasers.

The final chapter deals directly with radiation damage in semiconductors and is divided into two parts: Part A is a general treatment of radiation-damage theory for the creation of defects in crystalline lattices; Part B treats, specifically, radiation effects in various elemental and compound semiconductors. An attempt is made in Part A to bring in atomic displacement processes that take account of the positioning of atoms on a lattice. To demonstrate that the displacement energy is not a fixed constant, a naive computation of the energy required to displace an atom in the diamond to various neighboring positions is made on the basis of the energy required to break covalent bonds and the energy of small atomic displacements obtained from elastic constants. Although focusing collisions are alluded to, these are discussed primarily in terms of the replacement collision concept of Kinchin and Pease, rather than in terms of the low-energy consumption replacement-sequence process. In Part B of this chapter, a brief review of the various techniques that have been employed to investigate the electronic nature of radiation induced defects is given, and the various defect energy levels established for irradiated silicon and germanium are discussed and summarized. A few remarks concerning annealing of damage are also included.

This volume gives one the initial impression of being hurriedly written, an impression that is not dispelled by more careful study. A number of references are not particularly apt, and the relationship between the material in the various chapters is not clearly indicated. Moreover, many points, upon which the author is eminently qualified to expand, were treated in a perfunctory fashion. For example, one might expect that the author, who comes from the P. N. Lebedev Institute, which is the home of the outstanding Soviet work on stimulated emission, would have given a more complete treatment to the topic of injection lasers. In addition, there are omissions of several interesting aspects of radiation damage, one being the creation of disordered regions by fast-neutron bombardment, and another being radiation enhanced diffusion. However, in view of the amount of space allotted to the topic, such omissions are understandable.

It is difficult to assess this monograph as a review, since it is neither comprehensive nor does it treat the topics in a critical fashion. According to the author's aim, as expressed in the preface, the most typical problems encountered in the interaction of radiation with semiconductors were to be considered; hence, those topics chosen and the relative emphasis given to them reflect the opinions and judgment of the author. Therefore, perhaps the main value of this survey is the insight it gives to problems in this general area that are deemed important by our Soviet colleague.

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