BOOK REVIEWS

TRILOGY ON HEAVY ELEMENTS

Title The Nuclear Properties of the Heavy Elements:
Vol. I Systematics of Nuclear Structure and Radioactivity
Vol. II Detailed Radioactivity Properties
Vol. III Fission Phenomena

Author Volumes I & II Earl K. Hyde, Isadore Perlman and Glenn T. Seaborg
Volume III Earl K. Hyde

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Vol. III xlii plus 519

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Vol. II $25.00
Vol. III $18.00

All three volumes contain numerous graphs and figures. Volumes I and II contain their own subject and author indices. Volume II indexes subjects and authors as well as isotopes for Volumes I and II.

Reviewer Paul Fields

The first volume of this three-volume collection presents a general discussion of radioactivity and nulear structure of the heavy elements. It has approximately 400 pages and is well organized into five chapters. Because of the general nature of Volume I, the highlights of each chapter are described very briefly below.

In the first chapter the authors discuss the semiempirical mass formulas of Weizacker, Levy, and Bohr-Wheeler as an introduction to the calculations of alpha- and beta-decay energies. The effective parameters for each type of mass formula are given for the heavy-element region. A plot of all the known alpha-decay energies is given to illustrate the systematic variation of this decay energy with mass number. The plot also includes the predicted alpha-decay energies for the isotopes of elements 100 through element 104.

The second chapter acquaints the reader with the concept of closed decay-energy cycles and presents the cycles in the form of four large diagrams representing the 4n, 4n+1, 4n+2, and 4n+3 series, which contain all the heavy nuclides. Using closed energy cycles the masses of all the known heavy nuclides have been calculated and tabulated, and the masses of unknown nuclides are calculated by the same technique employing extrapolated values for alpha- and beta-decay energies. Neutron- and proton-binding energies are also given.

Chapter three is devoted to a summary of the pertinent features of nuclear models such as the shell model of Mayer and Jensen and the unified model of Bohr and Mottelson. This chapter is the longest and perhaps the most interesting one in the book. This discussion will be very helpful to chemists who would like to understand the general outline of the unified model and how it applies to deformed nuclei.

Chapter four discusses the theory of alpha decay and gives a complete listing of the heavy-element isotopes and their alpha-decay characteristics such as exact energies, abundances of the alpha groups, half-lives, etc.

The last chapter, five, is devoted to the techniques of synthesizing the heavy nuclides and gives valuable tables of charged-particle cross sections, barrier heights, energies of various reactions, neutron cross sections, and build-up curves useful in calculating expected yields for a given nuclear reaction.

Volume I is an excellent mixture of heavy-element nuclear data, their systematic correlation, and the presentation of the theoretical foundation for these correlations. The authors give references to the original literature, and a bibliography of books and review articles is listed at the end of almost every chapter. The bibliography usually contains pertinent comments about the contents of the listed articles.

There are a few somewhat adverse comments which should be mentioned: The data used in calculating the closed energy cycles, and therefore the exact masses in Chapter 2, are based on 1958 data and not on the more recent data presented in Volume II. A similar comment applies to the data on alpha decay (Table 4.1, Chapter 4). This table is based on data compiled in January 1961 and in a few instances is in disagreement with the more recent data presented in Volume II. In the latter case the authors point out this discrepancy in a lengthy explanation of the table on the pages which follow, but this fact could easily escape the reader who is unfamiliar with the field. The subject index should have been expanded to help locate specific subjects and tables.

Whereas Volume I was a more general survey of the nuclear properties of the heavy elements, Volume II discusses in great detail the properties of all the known nuclides from lead (element 82) through the heaviest known element, lawrencium (element 103). This volume contains the detailed data which formed the basis for the subject matter presented in Volume I.

The book contains five chapters covering 700 pages. The first 200 pages are devoted to a brief history of radioactivity, a discussion of the three naturally occurring radioactive series and the synthetic 4n+1 series (neptunium series), and finally a description of the eight collateral series produced artificially by nuclear bombardments. In the remaining 500 pages, the properties of isotopes are treated individually under each element. The history, preparation, nuclear properties such as half-lives, branching ratios, and decay schemes and their interpretation in terms of nuclear models are given for all the heavy nuclides.

This is the most comprehensive collection of the nuclear properties of the heavy elements that has appeared in print. Volume II is essentially an encyclopedia of heavy-element data and is extremely useful to scientists working in this field. Unlike Volume I, which is designed to acquaint the reader with the systematic nuclear properties of the heavy elements, Volume II is more suitable as a reference book for the expert in the field who is interested in the detailed nuclear properties and how they were measured.

The third and final volume is devoted to the subject of fission. This volume contains 500 pages, comprising thirteen chapters, with the subject matter divided into two sections; Part I includes low-energy fission, and Part II is devoted to moderate- and high-energy fission. Low-energy fission encompasses spontaneous and thermal-neutron-induced fission while moderate- and high-energy fission refers to fission induced by particles with energies of 1 MeV or more.

Embodied in Part I is a discussion of the theory of fission largely devoted to the liquid-drop model, including the recent work of Swiatecki, Fong's statistical theory, and a brief mention of the application of the unified model to fission. This section also summarizes the available information on the charge, mass, and energy distribution in fission and many of the properties of particles and photons emitted during the fission process.

Included in Part II is a discussion of heavy-ion, meson-, and gamma-ray-induced fission. This section of the book also discusses the statistical approach to fission cross sections at moderate energies, the angular distribution of fission fragments, and the competition between fission and neutron emission from the compound nucleus. At very high energies, the Serber model and Monte Carlo calculations are considered as a possible explanation of the experimental data.

Characteristically, this volume has valuable and interesting tables and graphs. Many of the recent experiments are discussed and their contribution to the field pointed out.

Organizing the materials and writing these three volumes was an immense task, and the authors are to be congratulated for undertaking the project and doing such a good job. The authors were very adroit at describing complex experiments and results in a language that can be readily understood. These books will enable almost any scientist to bring himself up to date on the nuclear properties of the heavy elements. For those who can afford the price and have an interest in the nuclear properties of the heavy elements, these three volumes will be a valuable acquisition.

Paul Fields is a Senior Chemist in the Chemistry Division, Argonne National Lab, Argonne, Ill. Joining the old "Metallurgical Laboratory" of Manhattan Project days in 1943, he has been in the nuclear field since then, except for one year at Standard Oil (Indiana) in 1946. His main interests for the past 20 years have been the nuclear and chemical properties of the heavy elements, an area in which he has published about 70 papers and been codiscoverer of two of these new elements. A member of Phi Beta Kappa, he received a BS degree (1941) from the University of Chicago, where he subsequently completed a year of graduate work.

RUSSIAN APPROACH TO FATIGUE

Title Problems of Metal Fatigue

Author V. I. Belyaev

Publisher Daniel Davey & Co., 1964

Pages iii plus 78

Price $3.95

Reviewer W. A. Wood

The author in this short but well-translated book has strung together results of his personal research on a set of roughly related problems in metal fatigue. The book is addressed to mechanical engineers, but the problems it deals with are old ones in which there is already extensive literature in the West. Accordingly for Western engineers its interest will be in seeing how a Russian worker, apparently without much reference to Western research, handles some familiar problems.

The author confines himself mainly to the study of carbon steels and structural alloy steels. He begins with metallographic observations designed to prove that fatigue cracks often begin in those parts of a grain where slip movements have concentrated. Here the Western reader might be pardoned for reflecting that he has seen better demonstrations in the classic paper by Ewing and Humfrey published in **The Proceedings of the Royal Society**, dated 1903, and many times since.

The author then goes on to study how the surface hardness of his trip specimens changes as they are fatigued in a machine that bends them to and fro at 1500 min. He finds that those areas where stresses are highest at first harden slightly, then soften, and that when they soften they begin to show signs of cracking. He concludes that this softening causes the cracking, although the critical reader might wonder whether, conversely, cracking might not cause the softening.

Next the author, utilizing this conclusion, extends the life of his fatigue specimens by removing their surface layers, polishing or grinding them away at intervals during a test. From these experiments he draws the familiar inference that fatigue damage commonly begins at the surface of a metal. However, in his bending type of test it would be rather surprising if damage began elsewhere.

The author then turns to the problems of prestressing and overstressing. In prestressing, he follows the approach of early Western workers, subjecting specimens for so many cycles to amplitudes just less than the fatigue limit, then to higher and higher amplitudes, and reaches the well-known conclusion that the apparent