higher temperatures detracts from the utility of the book. Since thermal conductivity is probably the most important single physical property to the fuel design engineer, inclusion and critical evaluation of this property would have been an extremely valuable feature. However, from the standpoint of raising unsettled questions as to the magnitude of the contribution to k(T) by the several modes of heat conduction through $UO_{2\pm x}$ material, the discussion is valuable, though somewhat out of date.

Data on electrical conduction and related properties are handled somewhat better. Certainly those scientists or engineers interested in thermoelectric devices or other applications, where the semiconductive behavior of UO_2 material is of interest, should be familiar with the material covered. More data are included in this section, including an article on the effect of radiation on electrical conductivity.

The section on diffusional properties is adequate considering the purposes of the report. It serves as a good critical review of the literature up to the cutoff date at which the reporting panel was convened.

Chapter VI, "Practical Implications", is quite brief for so important a subject. However, the panel has managed to summarize a number or very important aspects of urania fuel systems in an acceptable fashion. The discussion of clad-fuel interaction with the related aspects of thermal cracking and accommodation of strain by plastic deformation is worthy of thoughtful perusal by any fuel technologist. The discussion of fission-induced swelling was obviously written with fuels of low enrichment in mind and is already hopelessly out of date. The behavior of fission gases is barely touched upon. The "Symposium on Release of Fission Gases from UO_2" held at the 11th Annual Meeting of the ANS at Gatlinburg, June 22, 1965, brings this important subject up to date and extends the summarized information in Chapter VI. One paragraph, however, still stands out as a major piece of foresight; this is one in which emphasis is put upon need for definitive in-pile work in the fields of thermal conductivity, phase equilibria, and material transport processes. To these, this reviewer would add the additional need for contact conductance measurements, studies of urania disproportionation, and more especially strong efforts to establish values of plastic or viscous flow strength and kindred mechanical properties of uranium as a function of temperature, fission rate, and depletion. These important properties were not considered by the panel in their report.

The brief chapter (VII, 2 pages) labeled "Conclusions" is a very good statement of the problems existing in 1963. Most of these problems have continued to the present time and give promise of vexing designers well into the future. As a final statement this reviewer might reiterate his regret that the panel limited its deliberations to such a narrow scope, leaving out many of the practical accumulations of data that were available even two years ago. Critical evaluation of existing high-temperature thermal-conductivity data, as an example, is a job that sorely needs doing. The major regret, however, is the unavoidable feeling that the field ran away from the panel before they could finish their deliberations; this is not to their discredit, but it is rather an expression of the fantastic rate at which all the nuclear arts are progressing in our sometimes confusing modern world.

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A PRACTICAL WORKING TOOL

Title Fundamentals of Vacuum Science and Technology

Author Gerhard Lewin

Publisher McGraw-Hill Book Co., 1965

Pages xiii + 248

Price $11.50

Reviewer R. L. Jepsen

Despite the relative spate of recent books on various aspects of vacuum science and technology, Lewin's book contains a sufficient amount of additional and supplemental information to make it a worthwhile acquisition for many personal and laboratory libraries. To a considerable extent the book appears to mirror the author's own personal work experience in high and ultrahigh vacuum as applied to plasma physics and thermonuclear fusion. It is intended primarily as a practical working tool rather than as an exhaustive and scholarly treatise.

Any user of vacuum soon discovers that the pumpdown of a vacuum system proceeds much more slowly through the high and ultrahigh vacuum regions than would be expected on the basis of pumping speed and system volume. The reason for this is that desorption of 'surface' gas predominates—often by many orders of magnitude—over 'volume' gas. An illuminating illustration of this point is given on page 2 of the "Introduction".

In the first chapter the standard equations from the kinetic theory of gases are presented in useful form. On page 8 a rather interesting example of a 'high pressure vacuum' is noted. The pertinent equations for gas flow and for conductance of orifices and of tubes of circular cross section are summarized in Chapter 2, and conductance in the viscous-flow, molecular-flow, and transition ranges is treated.

Some workers will find that Chapter 3, "Surface Effects", alone is well worth the purchase price of the book. Topics treated include: gas permeation, gas diffusing from a semi-infinite slab, diffusion of gas from a finite slab, adsorption and thermal desorption, evaporation and dissociation, ion-surface interactions, desorption by electrons, photon desorption, production of gaseous compounds by surface reactions, and gassing and degassing of surfaces. Honig's vapor-pressure curves are included, and more than 70 references, many of recent vintage, are given.

In Chapter 4, "The Pumping Process", evacuation equations are developed for a 'lumped volume' system. In addition, equations for pressure as a function of time and of position in a 'distributed volume', with both volume gas and surface gas present, are derived. Chapter 5 contains descriptions of a number of types of gauges for measuring both total and partial pressures. Leak detection, measurements of pumping speed and conductance, and calibration of pressure gauges are also discussed.

Vacuum pumps are treated in a somewhat cursory fashion in Chapter 6. Although refrigerated sorption roughing pumps and getter-ion pumps are discussed, they are not emphasized to a degree commensurate with their growing use in many high and ultrahigh vacuum applications. The recent books by Barrington and by Roberts and Vanderslice provide a more complete description of these newer types of pumps.

Vacuum equipment components, including flanges, valves, electrical and mechanical feedthroughs, and gas purifiers, are the subject of Chapter 7. In this treatment the author draws extensively on his own work and that of others at the Plasma Physics Laboratory of Princeton University.

A short survey of the commonly used materials for vacuum systems is given in Chapter 8, while Chapter 9 contains a substantial amount of useful information on "Joining and Preparatory Treatment of Components". Examples of good and bad designs of brazed and welded joints are exhibited on pages 206 and 211. Techniques for making seals among various combinations of glass, ceramic, and metal are described.

The final chapter considers briefly the requirements and design of vacuum systems, and several examples are given.

Robert L. Jepsen is Director of the Central Research Laboratories of Varian Associates, where, since 1951, he has served in various capacities guiding research and development in microwave tubes, vacuum physics, plasma physics, and the company's vacuum products. The first recipient of a Varian Advanced Study Grant, which enabled him to spend the 1957–1958 academic year at Harvard studying ferrites and ferromagnetic insulators, he has developed theories for microwave tube design, ion oscillations in electron beams, harmonic generation and frequency mixing in ferromagnetic insulators, and the electron physics of magnetically confined cold-cathode gas discharges under ultrahigh vacuum conditions. With over 20 publications and 25 patents to his credit, he is co-inventor of the Vaclon® Electronic High Vacuum Pump and of the VacSorb® Vacuum Pump. He received his BS degree (electrical engineering, 1944) from Washington State College and his PhD degree (physics, 1951) from Columbia.

BOOK ANNOUNCEMENTS

Although the following books will not be reviewed, they may be of interest to some of our readers:

Mossbauer Effect: Principles and Applications, Gunther K. Wertheim, Academic Press, 1964, 116 pp, $5.50

Radioactive Fallout—Soils, Plants, Food, Man, Eric B. Fowler, ed., Elsevier Publishing Co., 1965, 317 pp, $14.00

Project Engineering, Victor G. Hajek, McGraw-Hill Book Co., Inc., 1965, 192 pp, $8.50

Introduction to Basic Fortran Programming and Numerical Methods, William Prager, Blaisdell Publishing Co., 1965, 203 pp, $6.00

Radiochemical Methods of Analysis, International Atomic Energy Agency, 1965, vol. I, 433 pp, $9.00; vol. II, 522 pp, $11.00

Nuclear Excavation: Hirhway Research Record No. 50, National Academy of Sciences—National Research Council, 1964, 53 pp, $1.20

Radioisotopes in Animal Nutrition and Physiology, International Atomic Energy Agency, 1965, 874 pp, $9.00

Nuclear Engineering, part XIV, J. W. Langhaar and L. B. Shappert, co-editors, American Institute of Chemical Engineers, 1965, 93 pp, $3.00, $15.00 to nonmembers

Methods of Surveying and Monitoring Marine Radioactivity, International Atomic Energy Agency, 1965, 95 pp, $2.00

Bibliography on Uranium Carbides, Nitrides and Silicides, International Atomic Energy Agency, 1965, 174 pp, $4.00

The Management of Radioactive Wastes Produced by Radioisotope Users, International Atomic Energy Agency, 1965, 58 pp, $1.50

Polymers: Structure and Bulk Properties, P. Meares, D. Van Nostrand Co., Inc., 1965, 381 pp, $12.50

Proceedings of the Second All-Union Conference on Radiation Chemistry, translators: A. Aladjem, J. Brown, and I.P.S.T. staff, Israel Program for Scientific Translations, (for USAEC and National Science Foundation), 1964, 800 pp, $11.15

Lattice Defects in Quenched Metals, R. M. J. Cotterill, M. Doyama, J. J. Jackson, M. Meshii, eds., Academic Press, 1965, 807 pp, $22.00