that attempt to probe into the nuclear structure and nuclear forces: "Deep Inelastic Electron Scattering," "Nuclear Level Densities," and "The Nucleon-Nucleon Effective Range Expansion Parameters." All three articles try to bring out the balance between theories and experiments and hope that some of the unanswered questions may eventually be cleared up. These articles are only of academic interest to nuclear engineers. However, the topic discussed by Nix is probably of more direct interest to nuclear engineers, at least to reactor physicists, since it discusses the fission barriers in heavy and super heavy nuclei. If one has to give credit for the number of references cited, this would carry the first prize since it has by far the largest number of references cited (410). I would very strongly recommend to everyone that they read this article to see the progress that has been made in the past six years in our understanding of fission and other phenomena associated with nuclear shape changes. In these days of neglected support for scientific research, it is amusing to observe that there are still optimists in the field! Nix's reference to the speculation that in the coming years we will witness a shift in emphasis to studies involving nuclear fusion rather than fission and that "we are likely to make far more important discoveries than an island beyond the tip of a peninsula" is extremely optimistic. I hope somebody in Washington, D.C. takes note of this and channels appropriate efforts toward this rather enthusiastic as well as worthwhile suggestion.

Three articles are related to applications of nuclear science. The importance of ESR spectroscopy has been decidedly brought forth in Box's review of the subject, "Radiation Damage Mechanisms as Revealed Through Electron Spin Resonance Spectroscopy." I am sure that all of the nuclear community will be eagerly looking forward to the optimism expressed by this author in the hope that ESR spectroscopy may contribute significantly to the foundations of radiation biology. Let us hope that the mysteries of radiation biology will be solved one way or the other before too long. The article "Nuclear Applications in Art and Archaeology" is not only interesting but rather impressive. It is rather gratifying to note that nuclear science not only holds promise for the future but also unravels the secrets of the past as well. The subject of "Thermal Breeder Reactors" is of direct interest to nuclear engineers. The authors have made a convincing case for the thermal breeders. Although the thermal breeder reactor program, as suggested in this article, may be looked upon primarily as an insurance policy by the United States, it may be of significance to other nations that have not wholly committed themselves to the LMFBR program. In particular, I am thinking of nations such as India, Brazil, etc., where they have an abundance of thorium supplies; from their point of view it may be advantageous to get into the thermal breeder reactor program.

This volume, like all of its predecessors, measures up to the high standards. An additional feature of this series, which I like very much, is the cumulative index of both authors as well as chapter titles that have appeared in the previous volumes of this series. I am hoping that this feature will not be discontinued in the future. The editorial board, as well as the Annual Reviews, Inc., deserves very high praise in bringing a fund of knowledge, compiled by experts in the field, every year in a compact and easily accessible form. It has been a pleasure reviewing this book.

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The Chemistry of Fusion Technology

Editor	Dieter M. Gruen, Argonne National Laboratory
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Reviewer	J. S. Watson

The Chemistry of Fusion Technology is a compilation of papers presented at the Symposium on the Role of Chemistry in the Development of Controlled Fusion during the American Chemical Society meeting held at Boston in April 1972. The appearance of the book at this time is opportune. Currently, there is much optimism in the fusion development community; and, at the same time, our society is becoming increasingly aware of the shortage of cheap, environmentally acceptable fuel and the concomitant need for new energy sources. Recent success in the magnetic confinement of plasma indicates that devices which produce, or are capable of producing, more electrical energy than they consume (i.e., they meet the Lawson criteria) may be available in less than a decade. Meanwhile, others are just as actively pursuing the development of inertially confined plasmas heated by powerful lasers. The likelihood of success in these programs appears to be high. However, demonstrations that plasmas can be heated to desired temperatures, with sufficient densities and residence times to release useful quantities of fusion energy, still do not mean that practical reactors will be available immediately. All reactor concepts currently under study will require the solution of major technological problems; many of these problems will remain to be solved after the Lawson criteria are met. Technological problems could be the deciding factor in determining which confinement method is eventually developed for use in commercial systems, assuming that more than one method can successfully meet the feasibility criteria. In the years that follow, many books and articles on the technological aspects of fusion are likely to be published.

This book contains articles covering a wide range of chemical problems inherent in fusion reactors. The authors are recognized experts in their fields, and the material is generally up-to-date. Most of the articles are largely reviews; all contain extensive literature lists. The level of difficulty varies. The introductory paper by Gough is very general and outlines the need for fusion power and recent progress in confinement studies. Later articles become more specific and are thus more detailed. However, anyone with a nuclear or a chemical background should have little difficulty understanding any of the papers.

A large portion of the book deals with blanket materials and with permeation studies, perhaps the most obvious chemical problems associated with fusion reactors. J. D. Lee reviews the neutronics of various blanket materials and configurations. For lithium metal blankets, potential tritium breeding ratios are higher and doubling times are shorter than those expected in fission breeder reactors. Cairns, Cafasso, and Maroni examine the pertinent properties of lithium metal, the most likely blanket material. The compilation of data on *H*, *D*, and *T* solubilities in lithium at various pressures is particularly significant. Grimes and Cantor examine the properties of molten fluoride salts, which are alternate breeding materials. The most important shortcoming of molten salts for fusion reactor blankets involves their neutronics (breeding ratio). It is even likely that the most studied molten salt, Li_2BeF_4, will not yield a breeding ratio greater than unity; nevertheless, uncertainties of these breeding ratios are still considerable. Molten salts, however, would have some advantages because of their lower electrical conductivity. Pressure drops when crossing magnetic field lines would be less than those experienced with lithium, and turbulent eddies would not be suppressed when flow is parallel to field lines; turbulent flow would improve heat performance. Other weaknesses and advantages of molten salts are also discussed. E. Johnson surveys the processes for recovering tritium from blanket or coolant fluids.

The permeation of hydrogen isotopes in metals is reviewed in detail by R. Stickney and more briefly by G. Libowitz. The latter author discusses only tritium solubility in metals, but Stickney's comments include data on both solubility and diffusion coefficients which contribute to the permeability. Possible surface effects are also discussed.

The three remaining papers cover individual topics. Radiation damage will be a major problem in fusion reactors. D. Gruen reviews some (but not all) of the aspects of this problem—surface effects, sputtering, and ion trapping. These effects may be important to the first wall surrounding the plasma and to diverter collection surfaces if these are required. M. Bowman provides a historical review of the search for new superconducting materials. The needs and difficulties of finding and fabricating new materials are discussed. Finally, M. Lubin reviews laser-induced fusion. Although this is not primarily a chemistry problem, the paper is interesting. Conceptual methods for recovering heat from these systems and the behavior of particles upon sudden heating are discussed. Little is said about laser development.

In summary, the book is timely and should be recommended to most technical libraries. Perhaps the principal weakness of the book lies in its balance of presentation. A short collection of symposium papers is not likely to provide the consistency possible under single authorship. On the other hand, this is significant only if the reader desires to use the book as an introduction to the subject. The chemistry-related aspects less thoroughly covered in the book are materials problems, particularly radiation damage and corrosion.

J. S. Watson (BS, 1958; MS, 1962; and PhD, 1967, chemical engineering, University of Tennessee) has been a member of the Chemical Technology Division of the Oak Ridge National Laboratory (operated by Union Carbide Corporation for the U.S. Atomic Energy Commission) since 1958. He has been involved in several aspects of nuclear fuel process development, and most recently he has worked on evaluating and developing processes for the handling and recovery of tritium in fusion reactors. Since 1967, he has also served as a part-time member of the Chemical Engineering Department at the University of Tennessee.

Corrigenda

STEPHEN A. McGUIRE and JOSÉ G. MARTÍN, "A Monetary Correction Model of Economic Analyses Applied to Nuclear Power Costs," *Nucl. Technol.*, 18, 257 (1973).

In Ref. 21 on p. 266, the spelling of a name should be corrected from L. Cintra do Pardo to L. Cintra do Prado.

J. L. STRAALSUND and C. K. DAY, "Effect of Neutron Irradiation on the Elastic Constants of Type-304 Stainless Steel," *Nucl. Technol.*, 20, 27 (1973).

On p. 32 the error is in Eq. (9). As presently written, Eq. (9) is

$$\frac{K}{K_0} = 1 - \frac{3(1 - \nu_0)}{2(1 - \nu_0) + (1 + \nu_0) S} \quad .$$

The equation should be as follows:

$$\frac{K}{K_0} = 1 - \frac{3(1 - \nu_0) S}{2(1 - 2\nu_0) + (1 + \nu_0) S} \quad .$$