book reviews

Chemistry to build reactors

The Chemistry of Fusion Technology. Edited by Dieter M. Gruen. Pp. xiv+394. (Proceedings of an American Chemical Society Symposium held in Boston, Mass., in April 1972.) (Plenum: New York and London, 1972.) $22.50.

THE possibility of creating conditions in which the nuclear energy of light elements might be released in controlled nuclear fusion reactions emerged from the advances in nuclear physics in the period 1930–50. To bring these ideas to fruition, it has been necessary first to establish a major new branch of physics, high temperature plasma physics; second, this new knowledge has to be applied to potentially practical systems; and third, the technology of such systems has to be established.

With the growing progress in plasma physics and in its application to the magnetic confinement of high temperature plasmas (a turning point was the publication in *Nature* of the results of the joint Soviet–United Kingdom experiments on the Russian Tokamak magnetic confinement device in 1969) and with a growing awareness of the acute nature of the potential energy shortage, much more interest is being shown worldwide in the third area—the technology of future fusion reactors. Since very large resources have been accumulated over the years in nuclear fission technology, there is no shortage of experienced and resourceful researchers able and anxious to tackle the new technological challenge: and it is now possible for the energetic student to attend perhaps half a dozen symposia a year in which the problems of the technology of fusion reactors are scanned and discussed. Moreover, large sums of money are forecast to be available, particularly in the United States and Germany, to tackle what in 1946 George Gamow described as a problem of almost unsurpassable technical difficulty.

The present volume is a record—and a good one—of one of the most constructive of such symposia. It discusses, at a foundation level, the problems of chemical engineering which will have to be dealt with if the current physical idea proves correct: that controlled fusion reactors will be fuelled by deuterium and lithium and based on thermonuclear reactions between deuterium and tritium in an isolated high temperature plasma. No particular system of plasma confinement or control is envisaged, so that the meat of the volume is of value whichever of the current systems advocated on physics or engineering grounds turns out to be the most practicable.

J. D. Lee of the University of California is a leading authority on the breeding of tritium in the lithium-bearing blankets, and his article (40 pages) on tritium breeding and direct energy conversion summarises authoritatively the main results of his group on neutronics of the blanket, together with short discussions of the chemical and electrochemical problems of using liquid lithium metal as a coolant in a high magnetic field. The section on direct conversion is, disappointingly, confined to a secondhand presentation of one particular system—the direct conversion of the mirror energy leakage, by R. F. Post. The review of the chemical, physical and thermal properties of lithium (70 pages, 111 references) by Cairns, Cafasso and Maroni of the Argonne National Laboratory, is a fundamental and authoritative collation of data particularly valuable because of critical assessment of the data and the extensive bibliography; it includes data on topics ranging from natural abundance, thermodynamics and physical properties to corrosion rates of selected high temperature materials in lithium. Likewise, W. R. Grimes and S. Cantor of Oak Ridge on the use of molten lithium-bearing salts as coolant and breeder (28 pages, 36 references) cover important data on one of the major alternative constituents of the blanket, and their article is based on Oak Ridge experience of the Molten Salt Reactor. E. F. Johnson of Princeton—another leading authority—deals (22 pages, 21 references) with the chemical problems of tritium extraction from the blanket, but rather too briefly and qualitatively to be of lasting value. His article does, however, give a useful summary of the Princeton reference design model reactor which provides the non-specialist reader with a concrete example of present-day reactor concepts.

D. M. Gruen provides a useful and interesting account (24 pages, 57 references) of the often-neglected chemical effect of plasma interaction with thermonuclear reactor surfaces, together with a brief review of more familiar surface topics. R. E. Stickney provides a major and critical account (78 pages, 110 references) of the permeation of hydrogen isotopes through high temperature materials—a matter of great importance to the assessment of the spread of tritium around and through the components of envisaged reactors. Finally, the chemical content of the volume is completed by a short (16 pages, 31 references) article by G. G. Libowitz on condensed-metal hydrogen systems, and a rather superficial article on superconducting materials.

To the fusion reactor specialist, the main value of the book rests in the bringing together of today's main chemical knowledge relevant to fusion reactors, or at least fusion reactor blanket systems. To the chemist, the book indicates the main areas of chemical technological interest provoked by current fusion reactor concepts. The impression for the non-specialist is likely to be that each individual problem of chemical technology so far raised and discussed has outline solutions, but the sum total of the problems constitutes a serious technological barrier which—as in the case of fission reactors—can seem daunting in the initial stages. There is clearly a great need to improve much of the chemical data and understanding, particularly in the difficult areas of corrosion (where the effects of trace elements are not understood), permeation and radiation chemistry.

R. S. PEASE

Solid electrolytes

Physics of Electrolytes. Edited by J. Hladik. (Transport Processes in Solid Electrolytes, and In Electrodes vol. 1. Pp. xiii+516. (Academic: New York and London, August 1972.) £11.00; $34.

THIS series of review articles was presumably intended to provide the background knowledge required for investigating the properties of ionically conducting solids, a field which is currently attracting considerable interest. The topics covered in this volume are grouped into two sections; "Solid Electrolytes and Electrodes" and 'Transport Processes".

The first section contains a rather heterogeneous collection of articles. In the first two chapters, Hladik discusses electronic theories of the solid state, interatomic distances, the cohesive energy in ionic crystals and also gives a gen-