ATOMIC-HYDROGEN POWER GENERATION AND TECHNOLOGY*

Reviewed by Yu. I. Koryakin

In recent years, considerable attention has been devoted to hydrogen, due mainly to the hope and desire, by means of its extensive utilization, of overcoming certain difficulties in satisfying rapidly growing power requirements. The use of hydrogen as a secondary energy resource precedes its production. In solving the problem associated with the considerable costs of primary power, an important if not decisive role is assigned to atomic energy, more precisely, to high-temperature nuclear reactors.

The book being reviewed, of which the essence of the contents is well reflected in its title, is perhaps the first attempt to introduce the reader to the essence of the main questions of the atomic-hydrogen problem. This attitude and aim of the editorial staff, which is headed by V. A. Legasov, is logically and categorically justified. An attempt to completely and comprehensively answer the numerous questions of atomic-hydrogen technique and technology would "dissolve" the principal key scientific–technical problems, not to mention that the volume of the book would increase sharply.

The realization of such attitude is not always simple, and especially in this case, when the book is not a monograph, but represents a collection of papers of a quite large assembly of authors. In this case, one is frequently involved with the difficulty of coordination or balancing of the sometimes subjective attitudes of individual authors in relation to the position and importance of "his" problem and questions on the general aspects of the problem as a whole. It is precisely this problem that is solved quite well. The introductory paper by the President of the Academy of Sciences of the USSR, A. P. Aleksandrov, concerning the prospects of the use of atomic energy for power generation and the foreward by the editor-in-chief of the book, contribute in no small measure to the fundamental attitude. Strictly, they also state its principal directive, and define the problems and the boundaries of the atomic hydrogen problem in all their diversity.

In accordance with this, in 11 of the papers which constitute the main content of the book, the following principal topics are highlighted: methods and special features of hydrogen production, assessment of a nuclear reactor as a technical means for achieving this from the position of the necessary transformation or obtaining temperature, nuclear-physics, and material-study characteristics, and the possible spheres of introduction of nuclear reactors into power technology.

The editorial staff of the collection well know that perhaps paramount in the whole problem is the conformity of the possibilities of high-temperature reactor techniques with the power–technological requirements, mainly temperature. Therefore, the account of the principal considerations concerning the feasibility of this confirmity and the engineering feasibilities is assigned an important place. Hopes of its achievement, obviously are encouraging and the authors show this, by describing not only the existing experience but also by assessing the different paths for solving the main problem.

The use of a large list of Soviet and foreign literature references (about 300 entries) relates to the positive aspects of the data given.

On the whole, it is impossible not to agree with the preface to the book, in which the hope is expressed that the collection will extend the participants in the solution of the exceptionally important and promising atomic-hydrogen problem.

*Issue 1, Atomizdat, Moscow (1978), 246 pp., 2 figures, price – 80 kopecks.

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ACTION OF IRRADIATION ON THE GRAPHITE IN NUCLEAR REACTORS*

Reviewed by A. P. Sirotkin

Graphite, as a result of its exceptional properties, finds extensive application in reactor technology. The book being reviewed is the second monograph in the Russian language, and is being issued 10 years after the first monograph "Nuclear Graphite," by S. E. Vyatkin et al. During this time, many papers have been published, devoted to the investigation of the characteristics of reactor graphite. Work is continuing on the creation of new grades. As its properties depend on the raw materials used and the special features of technology, then the physicomechanical properties of Soviet reactor graphites under irradiation, given in the book, are of special interest.

The book describes the technologies of producing graphite with a density of 1.65 to 1.9 g/cm^3, and the crystal structure and physical properties are considered, including the dependence of the rate of oxidation on the processing temperature, creep, and nonuniformity of properties. The main attention is devoted to the change of physical properties during neutron irradiation. The principal factors affecting the material during irradiation are considered, as are methods of determining the neutron fluence damaging the graphite. It is noted that graphite is one of the most sensitive materials to a change not only of the fluence, but also to the flux density and the neutron spectrum. Radiation defects and the degree of change of its properties are determined by the number of displaced atoms, which is the result of the combined action of both irradiation and annealing. Unfortunately, the authors do not make recommendations, beyond that energy to calculate the neutron fluence when estimating the effect of irradiation of graphite: above 0.18 MeV, 50 keV or with respect to the equivalent fission neutron flux.

Great attention is paid to the dimensional deformation of graphite during irradiation the description of oxidation, consideration of the design and operating conditions of nuclear reactor stacks, their shielding and efficiency with the inclusion of experimental data. In this book, which includes a large list of literature references, the specific stage of the investigations is summarized. It will be of undoubted interest for designers, operators and scientific workers occupied with graphite reactors.

*Atomizdat, Moscow (1978), 272 pp., 3 figures.

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A. B. Mikhailovskii

PLASMA INSTABILITIES IN MAGNETIC TRAPS*

Reviewed by A.M. Fridman

Recent achievements in the heating and containment of a thermonuclear plasma in tokamaks have involved special attention to the processes taking place in the plasma. The complex geometry of magnetic surfaces in traps, formed by a system of external and internal currents, determines the diverse and at times nontrivial physical mechanics of instabilities, the most active of which are interpreted by collective processes. The initial stage of the majority of collective processes, as a rule, is associated with the development of some or other instability (or several at once). Therefore, the importance of constructing a theory of plasma instabilities, taking into account the actual geometry of operating facilities, or facilities under construction, is obvious. The book being reviewed is devoted to an account of the central divisions of this theory, which have been formulated in recent years.

The book describes the theory of the principal plasma instabilities in both open (adiabatic) and closed (toroidal) traps. The stability of the tokamak plasma is discussed in the greatest detail. The author draws the attention of the readers to the following circumstances. When investigating the stability of the tokamak plasma in the approximation of a circular plasma cylinder or by the model of a plane plasma layer in a gravity field, disregarding the existing effects, the following can be found: shear, magnetic well, bottle effects, effects of finite orbits, and magnetic particle drift. These effects in some way or other are associated with the curvature of the magnetic surfaces of the tokamak, and are investigated in detail in the book by A. B. Mikhailovskii. The author has noted and studied the role of Alfvén waves in the plasma dynamics of the tokamak.

Great attention in the book is devoted to the description of the effect of various stabilizing factors: ellipticity and triangularity of cross section, and the effects of a finite β. The investigation of the stabilizing influence of the latter at present is acquiring special interest because of the analysis of the energy balance carried out at the I. V. Kurchatov Institute of Atomic Energy. Analysis showed the necessity of having a plasma in reactor-tokamaks with the maximum possible β. As mentioned, despite the fact that instabilities represent the greatest danger in a low-pressure plasma, and are stabilized in a finite-pressure plasma, the stabilizing role of such factors as the temperature gradient, collisions between particles, the longitudinal current gradient (shear), groups of fast particles, and certain other factors, as a rule increases with increase in β. Hence, it would be hasty to draw a conclusion about the stabilizing effect of a finite β. Following the logic of the author, we conclude that increases in plasma stability can be achieved by optimization of the destabilizing factors and not by a reduction of β.

One of the conclusions of the author is given here, which is important for the physicist–experimenter. In our opinion, other no less useful conclusions can also be cited.

The urgency of the publication of the monograph is clear. For specialists it will become a reference book, and it will assist students and graduate students to master new efficient methods of investigating plasma instabilities.

*Atomizdat, Moscow (1978), 295 pp., 2 figures. Price — 50 kopeks.

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