Plasma Material Interaction In Controlled Fusion

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Atomic and Plasma-material Interaction Data for Fusion 1991
Physics of Plasma-Wall Interactions in Controlled Fusion D. E. Post 2013-11-21 Controlled thermonuclear fusion is one of the possible candidates for long term energy sources which will be indispensable for our highly technological society. However, the physics and technology of controlled fusion are extremely complex and still require a great deal of research and development before fusion can be a practical energy source. For producing energy via controlled fusion a deuterium-tritium gas has to be heated to temperatures of a few 100 Million °c corres ponding to about 10 keV. For net energy gain, this hot plasma has to be confined at a certain density for a certain time One pro mising scheme to confine such a plasma is the use of i~tense mag netic fields. However, the plasma diffuses out of the confining magnetic surfaces and impinges on the surrounding vessel walls which isolate the plasma from the surrounding air. Because of this plasma wall interaction, particles from the plasma are lost to the walls by implantation and are partially reemitted into the plasma. In addition, wall atoms are released and can enter the plasma. These wall atoms or impurities can deteriorate the plasma performance due to enhanced energy losses through radiation and an increase of the required magnetic pressure or a dilution of the fuel in the plasma. Finally, the impact of the plasma and energy on the wall can modify and deteriorate the thermal and mechanical pro perties of the vessel walls.
Fusion Energy Update 1978
Plasma-surface Interactions in Controlled Fusion Devices Walter Bauer 1992
Plasma-surface Interactions in Controlled Fusion Devices Samuel Alan Cohen 1987
Plasma Science and Technology Haikel Jelassi 2019-02-27 Usually called the "fourth state of matter," plasmas make up more than 99% of known material. In usual terminology, this term generally refers to partially or totally ionized gas and covers a large number of topics with very different characteristics and behaviors. Over the last few decades, the physics and engineering of plasmas was experiencing a renewed interest, essentially born of a series of important applications such as thin-layer deposition, surface treatment, isotopic separation, integrated circuit etchings, medicine, etc. Plasma Science
Plasma Surface Interactions in Controlled Fusion Devices Anthony Leonard 2011
Plasma Interaction in Controlled Fusion Devices Sadruddin Benkadda 2010-07-07 The IISS2009 focuses on the various edge plasma and divertor physics and materials challenges faced by the upscale to ITER. These include steady state and transient plasma transport in the edge region, particle and heat exhaust, including material mixing and fuel inventory. All are tightly interlinked, establishing the plasma boundary as one of the most challenging areas of tokamak physics.
Plasma-surface Interactions in Controlled Fusion Devices 1989
Plasma-surface Interactions in Controlled Fusion Devices 1989
Plasma Surface Interactions in Controlled Fusion Devices A. Miyahara 1984
Plasma-surface Interactions in Controlled Fusion Devices 14 2001
Atomic and Plasma-Material Interaction Data for Fusion Vol. 15 Author) 2012 Current designs for nuclear fusion reactors call for the use of the hydrogen isotopes deuterium and tritium as the fuel for energy producing fusion reactions. The use of tritium must be carefully controlled due to its cost and radioactivity, and there will be strict limits on the tritium inventory in fusion experiments or in a reactor. These concerns led the IAEA Nuclear Data Section to organize a coordinated research project on the tritium inventory in fusion reactors, which brought together specialists in fusion materials and plasma-material interaction for exchange of information and coordination of research activities on the interaction of tritium with plasma-facing materials. This volume of Atomic and Plasma-Material Interaction Data for Fusion is a result of that project. The key topics are tritium retention in fusion wall materials, measurements of tritium inventory and means to remove trapped tritium.
Plasma-Material Interactions in a Controlled Fusion Reactor Tetsuo Tanabe 2021 This book is a primer on the interplay between plasma and materials in a fusion reactor, so-called plasma-materials interactions (PMIs), highlighting materials and their influence on plasma through PMI. It aims to demonstrate that a plasma-facing surface (PFS) responds actively to fusion plasma and that the clarifying nature of PFS is indispensable to understanding the influence of PFS on plasma. It describes the modern insight into PMI, namely, relevant feedback to plasma performance from plasma-facing material (PFM) on changes in a material surface by plasma power load by radiation and particles, contrary to a conventional view that unilateral influence from plasma on PFM is dominant in PMI. There are many books and reviews on PMI in the context of plasma physics, that is, how plasma or plasma confinement works in PMI. By contrast, this book features a materials aspect in PMI focusing on changes caused by heat and particle load from plasma: how PFMs are changed by plasma exposure and then, accordingly, how the changed PFM interacts with plasma.
Introduction to Plasma Physics and Controlled Fusion Francis F. Chen 2013-03-09 TO THE SECOND EDITION In the nine years since this book was first written, rapid progress has been made scientifically in nuclear fusion, space physics, and nonlinear plasma theory. At the same time, the energy shortage on the one hand and the exploration of Jupiter and Saturn on the other have increased the national awareness of the important applications of plasma physics to energy production and to the understanding of our space environment. In magnetic confinement fusion, this period has seen the attainment 13 of a Lawson number nTE of 2 x 10 cm -3 sec in the Alcator tokamaks at MIT; neutral-beam heating of the PL T tokamak at Princeton to KTi = 6. 5 keV; increase of average ß to 3%-5% in tokamaks at Oak Ridge and General Atomic; and the stabilization of mirror-confined plasmas at Livermore, together with injection of ion current to near field-reversal conditions in the 2XIIß device. Invention of the tandem mirror has given magnetic confinement a new and exciting dimension. New ideas have emerged, such as the compact torus, surface-field devices, and the EßT mirror-torus hybrid, and some old ideas, such as the stellarator and the reversed-field pinch, have been revived. Radiofrequency heat ing has become a new star with its promise of dc current drive. Perhaps most importantly, great progress has been made in the understanding of the MHD behavior of toroidal plasmas: tearing modes, magnetic Vll Vlll islands, and disruptions.
Plasma-surface Interactions in Controlled Fusion Devices B. E Keen 1990
Atomic and Plasma-material Interaction Processes in Controlled Thermonuclear Fusion Ratko K. Janev 1993 Atomic and plasma-material interaction processes play an important role in thermonuclear fusion plasmas and the knowledge of these processes has a significant impact on fusion energy research and development. The present volume provides a comprehensive survey of atomic and plasma-material interaction aspects of

controlled thermonuclear fusion. The review articles included in this volume describe the role of atomic and plasma-material interaction processes in the currently most active fusion research areas and emphasize the need for accurate quantitative information on these processes for resolving many outstanding issues in fusion research and reactor design development such as plasma energy balance, particle transport and confinement, impurity control, thermal power and helium exhaust, plasma heating and fuelling, edge plasma physics, development of fusion reactor plasma facing components and plasma diagnostics and modelling.

Plasma-Material Interactions in a Controlled Fusion Reactor Tetsuo Tanabe 2021-03-08 This book is a primer on the interplay between plasma and materials in a fusion reactor, so-called plasma–materials interactions (PMIs), highlighting materials and their influence on plasma through PMI. It aims to demonstrate that a plasma-facing surface (PFS) responds actively to fusion plasma and that the clarifying nature of PFS is indispensable to understanding the influence of PFS on plasma. It describes the modern insight into PMI, namely, relevant feedback to plasma performance from plasma-facing material (PFM) on changes in a material surface by plasma power load by radiation and particles, contrary to a conventional view that unilateral influence from plasma on PFM is dominant in PMI. There are many books and reviews on PMI in the context of plasma physics, that is, how plasma or plasma confinement works in PMI. By contrast, this book features a materials aspect in PMI focusing on changes caused by heat and particle load from plasma: how PFMs are changed by plasma exposure and then, accordingly, how the changed PFM interacts with plasma.

Nuclear Fusion Research Robert E. H. Clark 2006-01-20 It became clear in the early days of fusion research that the effects of the containment vessel (erosion of "impurities") degrade the overall fusion plasma performance. Progress in controlled nuclear fusion research over the last decade has led to magnetically confined plasmas that, in turn, are sufficiently powerful to damage the vessel structures over its lifetime. This book reviews current understanding and concepts to deal with this remaining critical design issue for fusion reactors. It reviews both progress and open questions, largely in terms of available and sought-after plasma-surface interaction data and atomic/molecular data related to these "plasma edge" issues.

Plasma-surface Interactions in Controlled Fusion Devices 12 1997

Plasma surface interactions in controlled fusion devices International Conference on Plasma Surface Interactions in Controlled Fusion Devices 1980

Plasma-surface Interactions in Controlled Fusion Devices 12 1997

Plasma Physics and Fusion Energy Jeffrey P. Freidberg 2008-07-10 There has been an increase in interest worldwide in fusion research over the last decade and a half due to the recognition that a large number of new, environmentally attractive, sustainable energy sources will be needed to meet ever increasing demand for electrical energy. Based on a series of course notes from graduate courses in plasma physics and fusion energy at MIT, the text begins with an overview of world energy needs, current methods of energy generation, and the potential role that fusion may play in the future. It covers energy issues such as the production of fusion power, power balance, the design of a simple fusion reactor and the basic plasma physics issues faced by the developers of fusion power. This book is suitable for graduate students and researchers working in applied physics and nuclear engineering. A large number of problems accumulated over two decades of teaching are included to aid understanding.

Plasma-Material Interaction in Controlled Fusion Dirk Naujoks 2006-08-25 This book deals with the specific contact between the fourth state of matter, i.e. plasma, and the first state of matter, i.e. a solid wall, in controlled fusion experiments. A comprehensive analysis of the main processes of plasma-surface interaction is given together with an assessment of the most critical questions within the context of general criteria and operation limits. It also contains a survey on other important aspects in nuclear fusion.

Plasma-surface Interactions in Controlled Fusion Devices Walter Bauer 1992

On the Edge of Magnetic Fusion Devices Sergei Krasheninnikov 2020-09-07 This book reviews the current state of understanding concerning edge plasma, which bridges hot fusion plasma, with a temperature of roughly one million degrees Kelvin with plasma-facing materials, which have melting points of only a few thousand degrees Kelvin. In a fact, edge plasma is one of the keys to solution for harnessing fusion energy in magnetic fusion devices. The physics governing the processes at work in the edge plasma involves classical and anomalous transport of multispecies plasma, neutral gas dynamics, atomic physics effects, radiation transport, plasma-material interactions, and even the transport of plasma species within the plasma-facing materials. The book starts with simple physical models, then moves on to rigorous theoretical considerations and state-of-the-art simulation tools that are capable of capturing the most important features of the edge plasma phenomena. The authors compare the conclusions arising from the theoretical and computational analysis with the available experimental data. They also discuss the remaining gaps in their models and make projections for phenomena related to edge plasma in magnetic fusion reactors.

Fusion Garry McCracken 2012-04-09 Fusion: The Energy of the Universe, 2e is an essential reference providing basic principles of fusion energy from its history to the issues and realities progressing from the present day energy crisis. The book provides detailed developments and applications for researchers entering the field of fusion energy research. This second edition includes the latest results from the National Ignition Facility at the Lawrence Radiation Laboratory at Livermore, CA, and the progress on the International Thermonuclear Experimental Reactor (ITER) tokamak programme at Caderache, France. Comprehensive coverage— basic principles, detailed developments and practical applications Wide accessibility, but with sufficient detail to keep the technical reader engaged Details the initial discovery of nuclear fusion, current attempts to create nuclear fusion here on earth and today's concern over future energy supply Color illustrations and examples Includes technical notes for aspiring physicists

Plasma Surface Interactions in Controlled Fusion Devices International Conference on Plasma Surface InteractionsinControlled Fusion Devices 1982

Plasma-surface Interactions 18 2009

Plasma Surface Interactions in Controlled Fusion Devices 1980

Physical Processes of the Interaction of Fusion Plasmas with Solids Wolfgang O. Hofer 1996 The recent development of large fusion devices achieving near energy break-even scientifically proves the viability of fusion as an energy source. The challenge now facing fusion researchers is surmounting engineering obstacles to make fusion energy practical. Physical Processes of the Interaction of Fusion Plasmas with Solids discusses problems associated with plasma-surface interactions which represent a key issue in achieving engineering as opposed to scientific success. Unlike previous books on the subject, this text is directly related to the broad range of plasma-surface interactions problems encountered in fusion devices. Physical Processes of the Interaction of Fusion Plasmas with Solids provides the specialized international fusion community with a resource that covers the interesting new developments that have occurred with the advent of the larger fusion plasmadevices that have demonstrated near break-even energy. This book addresses problems that are useful for design and fabrication of such devices. The edge plasma Physical sputtering and radiation-enhanced sublimation Chemical erosion Electron emission from solids Control of plasma-surface interactions by thin films Thermal stability Radiation damage in metallic structural materials Radiation damage in carbon materials

Plasma-surface Interaction 16 B. Lipschultz 2005

Plasma Physics and Controlled Nuclear Fusion Research 1978

The Interaction of High-Power Lasers with Plasmas Shalom Eliezer 2002-08-16 The Interaction of High-Power Lasers with Plasmas provides a thorough self-contained discussion of the physical processes occurring in laser-plasma interactions, including a detailed review of the relevant plasma and laser physics. The book analyzes laser absorption and propagation, electron transport, and the relevant plasma waves in detail. It al

The Dynamics of Electrons in Linear Plasma Devices and Its Impact on Plasma Surface Interaction Michael Hubeny 2019-02-15 Turbulence in plasma surface interaction holds crucial uncertainties for its impact on material erosion in the operation of fusion reactors. In this thesis, the design, development and operation of a Thomson scattering diagnostic and its novel implementation with fast visual imaging created a versatile tool to investigate intermittently occuring plasma oscillations. Specifically, ballistic transport events in the plasma edge, constituting turbulent transport, have been targeted in this thesis. With the help of a custom photon counting algorithm, the conditional averaging technique was applied on Thomson scattering for the first time to allow spatial and pseudo-time-resolved

measurements. Since plasma turbulence and the emerging transport phenomena are comparable in most magnetized devices, the diagnostic development and the results from the linear plasma device PSI-2 are useful for an implementation of similar techniques in larger fusion experiments. Furthermore, the obtained results indicate a strong enhancement of erosion with turbulent transport and thus underline the importance of dedicated experiments investigating plasma turbulence in the framework of erosion in future fusion reactors.

Plasma Surface Interactions in Controlled Fusion Devices R.W. Cahn 1980

Atomic and Plasma-material Interaction Data for Fusion 2003

Plasma-surface Interactions in Controlled Fusion Devices 13 1999

Plasma Science National Academies of Sciences Engineering and Medicine 2021-02-28 Plasma Science and Engineering transforms fundamental scientific research into powerful societal applications, from materials processing and healthcare to forecasting space weather. Plasma Science: Enabling Technology, Sustainability, Security and Exploration discusses the importance of plasma research, identifies important grand challenges for the next decade, and makes recommendations on funding and workforce. This publication will help federal agencies, policymakers, and academic leadership understand the importance of plasma research and make informed decisions about plasma science funding, workforce, and research directions.

PLASMA SURFACE INTERACTIONS IN CONTROLLED FUSION DEVICES : PROCEEDINGS OF THE ... INTERNATIONAL CONFERENCE ON PLASMA SURFACE INTERACTIONS IN CONTROLLED FUSION DEVICES .. 1982