

AUTHORS — JULY 1994

PLASMA ENGINEERING

INITIAL BORONIZATION OF PBX-M USING ABLATION FROM SOLID BORONIZED PROBES / *H. W. Kugel, Yoshi Hirooka, J. R. Timberlake, Ronald E. Bell, A. C. England, R. C. Isler, Stephen E. Jones, R. Kaita, S. Kaye, M. Khandagle, M. Okabayashi, S. Paul, Hironori Takahashi, William Tighe, S. von Goeler, A. P. Post-Zwicker*

H. W. Kugel (top right) (PhD, nuclear physics, University of Notre Dame) is a principal research physicist at the Princeton Plasma Physics Laboratory (PPPL). His interests include neutral beam operations and diagnostics, infrared temperature measurements, high-heat-flux-facing materials, plasma/surface interactions, impurity control, divertors, and disruption avoidance control. **Yoshi Hirooka** (top left) (PhD, nuclear engineering, Osaka University, 1981) is the principal investigator of the PISCES program, an experimental plasma/surface interaction research program, at the Institute of Plasma and Fusion Research (IPFR), University of California, Los Angeles (UCLA). He worked at the Japan Atomic Energy Research Institute from 1981 to 1984 and then joined IPFR-UCLA in 1984. His current activity is focused on the development of plasma-facing components for the International Thermonuclear Experimental Reactor (ITER). **J. R. Timberlake** (second from top right) (BS) is a senior engineer at PPPL. He has worked on edge physics of the Poloidal Divertor Experiment (PDX) and the Tokamak Fusion Test Reactor (TFTR) using the laser blowoff technique and probes, and alpha-particle collection and tritium measurements on TFTR. His special interests include boronization techniques and impurity gettering on the Princeton Beta Experiment-Modified (PBX-M) and TFTR and mechanisms of impurity removal in tokamak plasmas. **Ronald E. Bell** (center left) (PhD, physics, The Johns Hopkins University, 1983) is a research physicist at PPPL. His interests include spectroscopic diagnostics, plasma control systems, and lower hybrid current drive. He has worked on the Thomson scattering systems of the Princeton Large Torus (PLT) and PBX-M, and the charge-exchange recombination spectroscopy system of TFTR. He has been involved with tokamak operations and the lower hybrid current drive programs of both PLT and PBX-M and has responsibility for the plasma-shaping control system of PBX-M. **A. C. England** (third from top right) (PhD, University of Rochester, 1961) is a staff member in the Oak Ridge National Laboratory (ORNL) Fusion Energy Division. He has worked on mirrors at ORNL and at the Max-Planck-Institut für Plasmaphysik; tokamak at ORNL and at PPPL; and on the Advanced Toroidal Facility. His recent interests include TVTS and neutron measurements of PBX-M. **R. C. Isler** (bottom left) (PhD, physics, The Johns Hopkins University, 1963) is a senior research staff member in the ORNL Fusion Energy Division. His primary field of research is spectroscopic analysis of high-temperature plasmas. **Stephen E. Jones** (bottom right) (PhD, physics, Cornell University, 1991) is a sponsored research postdoctoral staff member with the Center for Space Research, Massachusetts Institute of Technology (MIT).



His current research interests include fast electron transport, hard X rays, and current profile control in tokamak plasmas. **R. Kaita** (top right) (PhD, nuclear physics, Rutgers University) is a principal research physicist at PPPL. He is head of the diagnostics program for PBX-M. He has performed extensive studies of charge-exchange ion temperatures and beam ion thermalization effects in PDX, PBX, and TFTR. His recent interests include q-profile measurements using the motional stark effect and the development of fluctuation diagnostics. **S. Kaye** (top left) (PhD, earth and space sciences, UCLA) is a research physicist at PPPL. He has performed transport studies of PDX, PBX, and TFTR plasmas; probe measurements of PBX edge plasmas; magnetohydrodynamic (MHD) magnetics analysis; and PBX tokamak operation. His recent interests include correlation studies of PBX and PBX-M high confinement and high-beta plasma regimes. **M. Khandagle** (second from top left) (PhD, physics, University of Poona, India, 1991) is a staff member of the PISCES program at IPFR. Her previous work involved plasma-assisted thin film deposition. Currently, she is responsible for the operation of electron microprobe facilities to characterize plasma-bombarded materials. **M. Okabayashi** (second from top left) (PhD, University of Tokyo, Japan) is a principal research physicist at PPPL. He is head of the PBX-M physics research program. His current interests include advanced tokamak designs for operation in the high-beta regime of second stability and disruption avoidance control. **S. Paul** (third from top right) (PhD, Columbia University, 1981) is a research physicist at PPPL. He has performed spectroscopic measurements of impurity radiation in high-temperature plasmas. His recent interests include measurements of density fluctuations in plasmas using spectroscopic measurements of neutral beam fluorescence. **Hironori Takahashi** (third from top left) (ScD, aeronautics and astronautics, MIT, 1970) is a research physicist at PPPL. He began his research work in plasma physics at the Institute for Plasma Physics, University of Stuttgart, Federal Republic of Germany, in 1971 and has been at Princeton University since 1974. His current interest is in radio-frequency (rf) current drive of PBX-M and magnetic diagnostics of PBX-M and TFTR. **William Tighe** (fourth from top right) (PhD, electrical engineering, University of Alberta, Canada, 1985) is a research physicist at PPPL. Previously, he was a short pulse laser physicist with the X-ray laser project at PPPL. He has been involved with spectroscopic measurements, ion Bernstein heating, and rf synergy experiments of PBX-M. He is currently a spectroscopist for TFTR, investigating effects of neutron irradiation on heated optical fibers in collaboration with the Joint European Torus (JET) project. **S. von Goeler** (bottom left) (PhD, Marburg University, Germany) is a principal research physicist at PPPL. His special interests include X-ray emission and X-ray diagnostics of plasmas. He has worked extensively on MHD instabilities (sawtooth oscillations), impurity radiation (X-ray line emission), on suprathreshold and runaway electrons (hard X-ray imaging during lower hybrid current drive), and many other areas of plasma physics. **A. P. Post-Zwicker** (bottom right) (PhD, physics, Johns Hopkins University, 1992) is a post-doctoral researcher under the post-doctoral cooperative program of Oak Ridge Associated Universities assigned to the ORNL Fusion Energy Division. His current interest is the study of impurity transport in tokamak plasmas.



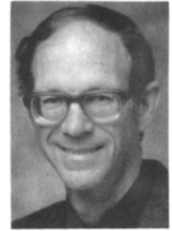
BLANKET ENGINEERING

NEUTRONIC INVESTIGATION OF INERTIAL FUSION ENERGY BLANKETS FOR HYLIFE-II AND MAGNETOHYDRODYNAMIC APPLICATIONS / Sümer Şahin, Ralph W. Moir, Joseph D. Lee, Sabahattin Ünal

Sümer Şahin (right) (MS, mechanical engineering, 1967, and PhD, nuclear engineering, 1970, University of Stuttgart, Germany; habilitation, physics, University of Ankara, Turkey, 1973) has worked at the Radiation Shielding Information Center, Oak Ridge National Laboratory, with a postdoctoral NATO fellowship; at the Institute of Nuclear Energy of the Swiss Federal



Institute of Technology in Lausanne, Switzerland, as an advanced research scientist; at the King Saud University in Riyadh, Saudi Arabia, as professor; and also as professor and dean of the Faculty of Engineering at the University of Erciyes, Kayseri, Turkey. In 1987, he served as secretary general of the Turkish Scientific and Technical Research Council (TÜBİTAK) and was elected vice-chair of the United Nations Intergovernmental Committee on Science and Technology for Development. He was chair of the special commission of the State Planning Organization of Turkey for the Mainframe Planning of Scientific Research and Technology. Currently, he is a professor at Gazi University, Ankara, Turkey. His research field covers neutron transport theory, fusion-fission (hybrid) reactors, thermionic spacecraft reactors, and radiation shielding. **Ralph W. Moir** (top) (ScD, nuclear engineering, Massachusetts Institute of Technology, 1967) joined Lawrence Livermore National Laboratory (LLNL) in 1968. He has specialized in magnet design (yin-yang magnet concept), development of direct conversion of fusion plasma energy to electrical energy, and power plant design. He is currently project leader for the HYLIFE-II inertial fusion energy production project. **Joseph D. Lee** (center) (BSEE, Duke University, 1961; MS, nuclear engineering, University of New Mexico, 1966) has been involved in LLNL's fusion programs since 1968. His work has included nucleonics analysis and design as well as design and system analysis of fusion and fusion-fission reactor studies for both magnetic confinement fusion and ICF. **Sabahattin Ünalın** (bottom) (BS, 1986, and MS, 1988, mechanical engineering, and PhD, 1992, nuclear engineering, University of Erciyes, Turkey) has been a member of the faculty at the University of Erciyes. His interests include fusion technology, computer science, and mathematical methods in engineering.



ELECTROMAGNETIC CONTROL OF FLOW DISTRIBUTION BETWEEN PARALLEL DUCTS OF LIQUID-METAL-COOLED BLANKETS / *Nancy Ma,*

John Walker, Tess Moon, Thanh Hua, Basil Picologlou

Nancy Ma (top right) (MS, University of Illinois at Urbana-Champaign, 1993) is currently a PhD candidate in mechanical engineering at the University of Illinois. Her research focuses on heat transfer and fluid mechanics in energy conversion and materials processing. **John Walker** (top left) (PhD, Cornell University, 1970) is a professor of mechanical engineering at the University of Illinois at Urbana-Champaign. His research focuses on liquid-metal magnetohydrodynamics. **Tess Moon** (center right) (PhD, University of Illinois at Urbana-Champaign, 1989) is a professor of mechanical engineering at the University of Texas at Austin. Her research interests include liquid-metal magnetohydrodynamic (MHD) applications in materials processing and manufacturing. **Thanh Hua** (bottom left) (PhD, University of Washington, 1986) is a member of the Fusion Power Program of the Technology Development Division at Argonne National Laboratory (ANL). His current research activities include MHD/thermal-hydraulic analysis and design for the International Thermonuclear Experimental Reactor (ITER) liquid-metal-cooled breeding blanket, erosion/redeposition and related analysis for divertor and other plasma-facing components, and electromagnetic effects in first-wall blanket and shield and divertor. **Basil Picologlou** (bottom right) (PhD, Purdue University, 1972) is a staff member of the Technology Development Division at ANL. His current research interests include fluid mechanics, thermal sciences, and magnetohydrodynamics, and their application toward improved industrial processes in the metals industry.



SIMILARITIES AND DIFFERENCES BETWEEN SINGLE-SIDE AND UNIFORM HEATING FOR FUSION APPLICATIONS—I: UNIFORM HEAT FLUX /

Ronald D. Boyd

Ronald D. Boyd (BS, mechanical engineering, Tuskegee University, 1967; PhD, mechanical engineering, University of Michigan, 1976) is currently the Honeywell Endowed Professor in Engineering and the director of the Thermal Science Research Center at Prairie View A&M University. He is conducting

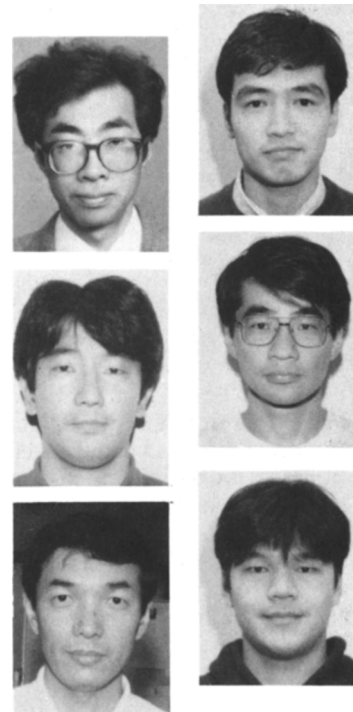


research on high-heat-flux removal from fusion reactor components, space cold plate enhancement, mixed convection in plumes, and natural convection in enclosures. He has also taught at the Universities of Michigan and New Mexico. For 10 years at Sandia National Laboratories, he was a principal investigator and heat transfer consultant for the high-heat-flux materials and fusion component development, the liquid-metal fast breeder reactor spent-fuel transportation, the waste isolation pilot plant, and reactor safety programs. From 1968 to 1971, he was a research engineer at Los Alamos National Laboratory. His interests include theoretical and experimental (including optical) analyses of thermal transfer and transport processes.

PLASMA HEATING SYSTEMS

106-GHz ELECTRON CYCLOTRON HEATING SYSTEM FOR HELIOTRON-E / Kazunobu Nagasaki, Motoyasu Sato, Masashi Iima, Sakuji Kobayashi, Kinzo Sakamoto, Hideki Zushi

Kazunobu Nagasaki (top right) [Dr., engineering, Kyoto University (KU), Japan, 1992] is a member of the KU Plasma Physics Laboratory (KUPPL) research staff. He is working on electron cyclotron heating (ECH) technology and plasma physics in Heliotron-E. **Motoyasu Sato** (top left) (Dr. Eng., electrical engineering, KU, Japan, 1976) is a member of the KUPPL research staff. He has been responsible for electron cyclotron resonance heating (ECRH) experiments on Heliotron-E since 1980 and also for research and development on high-power ECRH systems. **Masashi Iima** (center right) (Dipl. Eng., Takamatsu Technical College, Japan, 1978) is a member of the KUPPL research staff. He is currently working on the development of a high-power ECRH system. **Sakuji Kobayashi** (center left) (BS, science and engineering, Ritsumeikan University, Japan, 1984) is a KUPPL staff member. His interests are the ECRH system and high-vacuum and cryogenic technologies. **Kinzo Sakamoto** (bottom right) is a member of the KUPPL research staff. He is in charge of the high-power ECH system in Heliotron-E. **Hideki Zushi** (bottom left) is a member of the KUPPL research staff. He has done experimental work on magnetohydrodynamic instabilities.



TRITIUM SYSTEMS

GUIDELINES FOR VALVES IN TRITIUM SERVICE / William W. Weaver

William W. Weaver (MS, nuclear engineering, Massachusetts Institute of Technology, 1975) is the Functional Safety Manager for Systems Engineering in the U.S. Department of Energy (DOE) Office of Nuclear Safety within the Office of Environment, Safety, and Health. He has over 19 years of nuclear experience. He is the U.S. representative to the International Atomic Energy Agency Working Group on Robotic Applications of Nuclear Power Plants. His current interests are associated with tritium safety. He was a member of the Secretary of Energy's Tritium Task Force in 1991 and has led numerous assessments of DOE nuclear facilities. He possesses certifications as both a quality engineer and a reliability engineer from the American Society for Quality Control.



IMPROVED PERMEATION BARRIERS FOR TRITIATED WASTE PACKAGING / *G. Vassallo, R. van den Bergh, K. S. Forcey, A. Perujo*

Photographs and biographies of the authors were unavailable.

FUSION REACTORS

A 14-MeV HIGH-FLUX NEUTRON SOURCE BASED ON MUON-CATALYZED FUSION—A DESIGN STUDY / *Claude Petitjean, Francis Atchison, Gerd Heidenreich, Hans Kristian Walter, Franco Amelotti, Roberto Andreani, Francesco De Marco, Stefano Monti, Mario Pillon, Marcello Vecchi, Valery E. Markushin, Leonid I. Ponomarev, Carsten Niebuhr*

Claude Petitjean (PhD, physics, University of Basel) is science coordinator at Paul Scherrer Institute (PSI). His interests include muon physics and muon-catalyzed fusion. **Francis Atchison** is a physicist at PSI and is responsible for the neutronic design of spallation neutron sources. **Gerd Heidenreich** (PhD, physics, University of Basel) is in charge of the design and operation of pion production targets at PSI. **Hans Kristian Walter** is a professor of physics at ETH Zürich and is also director of the Department of Nuclear and Particle Physics at PSI. **Franco Amelotti** is an engineer in nuclear technology and is leader of the Fusion Engineering Division at ENEA Bologna. **Roberto Andreani** is an engineer in nuclear technology and is director of the fusion sector of ENEA. **Francesco De Marco** (PhD, physics) is head of the nonconventional fusion project at ENEA Frascati. **Stefano Monti** is a nuclear engineer in the Neutronic Division at ENEA Bologna. **Mario Pillon** (PhD, nuclear engineering, University of Rome) works with designs of neutron diagnostics and neutron transport calculations in the Neutronic Division at ENEA Frascati and is responsible for the operation of the 14-MeV neutron source at Frascati. **Marcello Vecchi** is a nuclear engineer in the Nuclear Fusion Division at ENEA Bologna. **Valery E. Markushin** (PhD, theoretical physics) has done theoretical work at the Russian Scientific Center Kurchatov Institute in nuclear and particle physics, especially muon-catalyzed fusion. **Leonid I. Ponomarev** is a professor of theoretical physics and is leader of the Atomic and Molecular Physics Division at the Russian Scientific Center Kurchatov Institute. **Carsten Niebuhr** (PhD, experimental physics, Zürich University) is a high-energy physicist at DESY, Hamburg. Photographs of the authors were unavailable.

SAFETY ENVIRONMENTAL ASPECTS

COMPREHENSIVE SAFETY ANALYSIS CODE SYSTEM FOR NUCLEAR FUSION REACTORS I: MODEL AND ANALYSES OF OVERPOWER EVENTS FOR THE INTERNATIONAL THERMONUCLEAR EXPERIMENTAL REACTOR / *Takurou Honda, Tatsuhiko Uda, Koichi Maki, Takashi Okazaki, Yasushi Seki, Isao Aoki*

Takurou Honda (top) (BS, 1987; MS, 1989; and Dr. Eng., 1992, nuclear engineering, University of Kyushu, Japan) is a researcher at the Energy Research Laboratory (ERL), Hitachi, Ltd. He has studied burn characteristics of inertial confinement fusion plasmas. His current research interest is safety for nuclear fusion reactors. **Tatsuhiko Uda** (center) (BS, pharmacology, 1970, and MS, agricultural engineering, 1972, University of Kyoto; Dr. Eng., nuclear engineering, Tokyo Institute of Technology, 1992) is a senior researcher at ERL, Hitachi, Ltd. Currently, he works in the department of the International Thermonuclear Experimental Reactor (ITER) project at the Japan Atomic Energy Research Institute (JAERI). His interests are safety evaluation, regulation, and tritium problems concerning a fusion experimental reactor. **Koichi Maki** (bottom) (BS,



1968, and Dr. Eng., 1985, nuclear engineering, University of Tokyo, Japan; MS, nuclear engineering, Kyoto University, Japan, 1971) is a senior researcher at ERI, Hitachi, Ltd. He has worked on nuclear force and fast breeder reactor physics. His current interests are neutronics and plasma transport simulation in fusion reactors. **Takashi Okazaki** (top) (Dr. Sci., physics, Waseda University, Japan, 1980) is a senior researcher at ERL, Hitachi, Ltd., where he is a fusion group leader. He worked in the fields of nonlinear oscillations and relativistic electron beam for plasma physics. His current interests include reactor design, plasma heating, current drive, neutronics, and safety for nuclear fusion. **Yasushi Seki** (center) (BS, 1967, and Dr. Eng., 1977, nuclear engineering, University of Tokyo, Japan) is a principal scientist in the Department of Fusion Engineering Research at JAERI. He has worked in the areas of fast breeder reactor nuclear design, fusion reactor nuclear design, and shielding analysis. He is currently in charge of fusion power reactor design and fusion reactor safety analysis and research and development coordination. **Isao Aoki** (bottom) (Ibaraki Polytechnic College, 1964) is an engineer in the Department of Fusion Engineering Research at JAERI. He has worked in the area of instrumentation technology of experimental nuclear data acquisition systems. He is currently in charge of fusion reactor design and fusion reactor safety analysis.



NUCLEAR REACTIONS
IN SOLIDS

ON THE NONSTATIONARY QUANTUM-MECHANICAL ORIGIN OF NUCLEAR REACTIONS IN SOLIDS / *V. A. Chechin, V. A. Tsarev*

Photographs and biographies of the authors were unavailable.

IMPROVED COULOMB BARRIER TRANSMISSION COEFFICIENT FOR NUCLEAR FUSION CROSS SECTIONS / *Yeong E. Kim, Alexander L. Zubarev*

Yeong E. Kim (top) (BS, chemistry and mathematics, Lincoln Memorial University, 1959; PhD, physics, University of California, Berkeley, 1963) has been a professor of physics at Purdue University since 1967. His interests are in theoretical nuclear physics, gravitational theory, theoretical geophysics, and nuclear fusion. **Alexander L. Zubarev** (BS, physics and mathematics, 1963, and MS, physics, Tashkent State University, Uzbekistan; PhD, physics, 1971, and Dr. Sci., nuclear physics, 1981, Joint Institute for Nuclear Research, Russia) has been a professor of physics at Hebrew University of Jerusalem since 1992. His interests are in theoretical nuclear physics, nuclear structure and reactions, muon-catalyzed fusion, and electron beam dynamics.



ANOMALOUS EFFECTS INVOLVING EXCESS POWER, RADIATION, AND HELIUM PRODUCTION DURING D₂O ELECTROLYSIS USING PALLADIUM CATHODES / *Melvin H. Miles, Benjamin F. Bush, Joseph J. Lagowski*

Melvin H. Miles (top) (PhD, physical chemistry, University of Utah, 1966) is a research chemist at the Naval Air Warfare Center Weapons Division. His research interests include electrochemistry, electrochromic materials, kinetics and catalysis, lithium batteries, molten salts, and thermodynamics. **Benjamin F. Bush** (bottom) (PhD, chemistry, University of Texas, Austin, 1988) was working with Prof. J. J. Lagowski when he (BUSH) proposed the analysis of the electrolysis off-gas, from Dr. M. H. Miles's calorimetric studies of the D₂O/Pd system, for helium as a nuclear reaction product. The relationship



between power generation and ^4He production was established to better than 99.9% confidence, based on controls. Ensuing work revealed that the amounts of ^4He versus heat suggested nuclear fusion. His current research is intended to identify the causative process quantitatively. **Joseph J. Lagowski** (right) (PhD, chemistry, Michigan State University, 1957; PhD, CANTAB, chemistry, Cambridge University, 1959) is professor of chemistry at The University of Texas, Austin. His long-term interests have been in electrochemistry, solution species, and equilibria especially in nonaqueous solvents such as liquid ammonia and molten salts.



ELECTROLYTIC DEVICES

AN ISOPERIBOLIC CALORIMETER TO STUDY ELECTROCHEMICAL INSERTION OF DEUTERIUM INTO PALLADIUM / *Turgut M. Gür, Martha Schreiber, George Lucier, Joseph A. Ferrante, Jason Chao, Robert A. Huggins*

Turgut M. Gür (top right) (PhD, materials science and engineering, Stanford University, 1976) is the technical director for the Center for Materials Research at Stanford University. Formerly, he was a senior research associate in the Department of Materials Science and Engineering, Stanford University. His research interests include gas/solid heterogeneous electrocatalysis, solid oxide fuel cells, ionic transport in solids, sensors, gas separation membranes, and chemical vapor deposition of thin films. **Martha Schreiber** (top left) (PhD, inorganic chemistry, Technische Universität, Wien, Austria, 1983) has been a research scientist at the Daimler-Benz Forschungszentrum, Ulm, Germany, since 1991. She formerly was a research associate in the Department of Materials Science and Engineering, Stanford University. **George Lucier** (bottom right) (BSc, chemistry, Stanford University, 1990) is currently a graduate student in the Department of Chemistry at the University of California, Berkeley. His research interests are in the synthesis of high oxidation state inorganic compounds and delocalized electron solids. Photographs and biographies for **Joseph A. Ferrante** and **Jason Chao** were unavailable. **Robert A. Huggins** (bottom left) (ScD, metallurgy, Massachusetts Institute of Technology, 1954) is a professor of materials science and engineering at Stanford University and is currently the chief scientist at the new Center for Solar Energy and Hydrogen Research, in Ulm, Germany. His interests include defects in solids, solid-state ionics, electrochemistry of hydrogen, lithium and oxygen-conducting systems, and materials aspects of advanced batteries and fuel cells.

