CONTENTS

Preface

Organization

Research Summaries

Group I: Reactor Materials and Plasma-wall Interactions

I. 1	Fusion reactor materials and plasma-wall interactions	1
I. 2	Defect structures and mechanical properties of RTNS-II fusion neutron irradiated	
	materials	2
I. 3	Plasma surface interactions of low-Z compound materials with hydrogen isotope ions \ldots	4
I. 4	Effects of proton irradiation on the embrittlement of ferritic steels	6
I. 5	Retention and release of hydrogen isotopes implanted into low-Z materials	8
I. 6	Irradiation effects on mechanical behavior of nuclear fusion materials	10
I. 7	Irradiation effects of fast neutron and ion beam on high polymers and organic composite	
	materials for nuclear fusion reactor	12
I. 8	Surface effect on the plasma-driven hydrogen permeation of the first wall of fusion	
	devices	14
I. 9	Development and evaluation of ceramic materials for fusion reactors	16
I.10	Plasma-wall interactions for long burn fusion devices	18
I.11	Particle and Energy Balance in hydrogen recycling in fusion reactor materials	19
I.12	Radiation behaviour of low-Z ceramics	21
I.13	Stability of ceramic oxides under very low oxygen partial pressure	23
I.14	Thermal fatigue and thermal shock tests of low-Z coating material	25
I.15	Evaluation of properties of high-pressure bonded ceramic/metal joints at elevated	
	temperatures	27
I.16	Damages of ceramics materials for the first wall of fusion reactor due to large thermal	
	load	29
I.17	Heavy irradiation effects of ferritic stainless steels	31

Group II: Science, Technology and Biological Effects of Tritium

II.	1	Cooperative works on fundamental works on tritium technology, behavior of tritium in	
		environment, and biological effects of tritium	33
II.	2	The development of new techniques for measurement, storage and transportation of high	
		activity tritium	35
II.	3	Calorimetric measurement of tritium in high-activity	37
II.	4	Tritium measurement by photon counting	39
II.	5	Detection and separation of hydrogen isotopes with drift tube technique	41
II.	6	Determination of tritiated waters by means of infrared spectroscopy	43

II. 7	The measurement of tritium using calcium fluoride scintillator	45
II. 8	An explanation of the tritium memory-effect	47
II. 9	Removal of adsorbed tritiated water by photon irradiation	49
II.10	Storage-supply of tritium and tritium recovery from tritiated water by Zr-alloy getters	51
II.11	Effect of plasma driven permeation on tritium leakage through the first wall	53
II.12	Plasma driven permeation using tritium plasma	55
II.13	Safety confinement of tritium	57
II.14	Simulation of air detritiation operations by bench-scale experiment and computer	
	modeling	59
II.15	Gas permeability of poly(ethylene-co-vinyl alcohol) membranes to hydrogen and	
	deuterium	61
II.16	Hydrogen isotope effects at desorption of water from desiccants-IV	63
II.17	Electron microautoradiographic observation of tritium distribution in aluminum alloys	65
II.18	Hydrogen depth profiles in reactor materials damaged by He-ion irradiation	67
II.19	Behavior of hydrogen isotopes in Al-Mg-Li alloys	69
II.20	Fundamental works on tritium blanket	71
II.21	In-situ tritium release from lithium oxide under neutron irradiation at high temperatures .	73
II.22	Formation of tritium compounds in LiF and LiV_2O_5 crystals and luminescence spectrum	
	measurements	75
II.23	Separation of hydrogen isotopes by permeation through metal plate formed by sintering	
	of powder	77
II.24	Absorption breakthrough of hydrogen isotopes in inert gas mixture and desorption	
	characteristics with zirconium-nickel alloy particle bed	79
II.25	Permeation of tritium through iron and isotope separation by electrochemical method	81
II.26	Tritium recovery from liquid lithium	83
II.27	Study group on environmental tritium for regional and time variation with its chemica	
	forms	85
II.28	Variation of environmental tritium and its geochemical analysis	87
II.29	Tritium in pine needles and its significant sources in the environment	89
II.30	Environmental tritium considerations in view of design and operation of fusion facilities	
	– Database development and methods –	91
II.31	Isotopic analysis of ground water He	93
II.32	Determination of tritium contents in spring and underground waters	95
II.33	Migration of tritium in environment in the vicinity of nuclear facilities	97
II.34	Ecological behaviour of tritium in the vicinity of nuclear facilities in Japan	99
II.35	Tritium concentrations in environmental samples around Tokai	101
II.36	Tritium content of environmental waters from the Toyama region, Japan	103
II.37	Tritium concentration in the environment around Wakasa	105

II.38	Tritium content of environmental water in Aichi prefecture
II.39	Tritium background of environment waters in the southern Osaka 109
II.40	Biomedical effects of tritiated water
II.41	Fixation of tritium gas by intestinal microbe
II.42	Intake of environmental tritium into the body and estimation of absorption dose 114
II.43	Measurement of the absorbed dose correction factor in the cell nuclei exposed to the
	beta-rays from the tritiated water
II.44	Tritium simulator and its use in biological experiments
II.45	Incorporation of tritium into the biomacromolecules in tissue and organs and the
	estimation of their absorption doses
II.46	In vivo somatic mutation in mice induced by tritium
II.47	Single-strand breaks in DNA induced by tritiated water
II.48	Biological effects of tritium on experimental animals and cultured mammalian cells 121
II.49	Effect of tritiated water on the development of fertilized eggs of mice

Group III: Fundamentals of Reactor Plasma Control

III. 1	Fundamental researches on fusion plasma control (Coordinating committee) 123
III. 2	Beam probe-laser spectroscopy for measurements of impurities in high temperature
	plasmas
III. 3	A basic study of LIB and REB technology for inertial confinement fusion
III. 4	Antennas and related problems for wave heating in plasmas
III. 5	Studies of high β compact TORI
III. 6	Development of Schottky diode detector/mixers for high temperature plasma diagnostic . 137
III. 7	Optical measurement of high- β plasma with a high temporal- and spatial resolution 139
III. 8	Time resolved measurements of electron energies and their distributions in REB-excited
	gases
III. 9	Theoretical research on pellet design
III.10	Evaluation of amplifier characteristics of HF chemical lasers and KrF excimer lasers
	pumped by a electron beam
III.11	High harmonic gyrotron and gyro-peniotron
III.12	Efficient heating by rf wave and associated nonlinear phenomena
III.13	Experiment on Alfven wave heating using helical antenna
III.14	New antenna for wave heating
III.15	Combination heating and confinement control in fusion plasmas
III.16	Cooperative development of computer simulation codes for nuclear fusion plasma
	research
III.17	Formation of tandem potential and thermal barrier
III.18	Confinement of translated FRC plasma

III.19	Experiment toward formation of field reversed configuration with a pulse intense ion
	beam
III.20	Formation and confinement of non circular RFP

Group IV: Technology of Superconducting Magnet

IV. 1	Basic aspects of R & D of superconducting magnet technology (The fourth group) $\ldots 167$
IV. 2	Superconducting A-15 compound conductors
IV. 3	Relations between the quench of a coil and the slip of superconducting magnet
	components
IV. 4	Generation of superconducting $PbMo_6S_8$ wires with high critical magnetic field
IV. 5	Direct observations of damage structure in superconducting composite materials
	neutron-irradiated at low temperatures
IV. 6	Structural materials for superconducting magnets in a fusion reactor (Static and dynamic
	fracture toughness at cryogenic temperature)
IV. 7	Performance study on superconducting magnet materials under thermonuclear fusion
	conditions
	- Comparative evaluation of radioactivation and radiation degradation $-$
IV. 8	Development of Nb ₃ Sn wires in <i>in-situ</i> fabrication
IV. 9	Stability and controlled heat transfer in magnet cooling by pool boiling
IV.10	Electromagnetic properties of superconducting multifilamentary wires and conductors 185
IV.11	Cryostatic stabilization of superconducting magnets
IV .12	Quench phenomena of superconducting magnets
IV.13	Magneto-fracture mechanics approach on structural integrity assessment system of
	super-conducting magnet for fusion reactor
IV.14	Stress effect in reinforced composite superconductors
IV.15	Microstructure of A15 type superconductors and their influence on pinning force 195
IV.16	Dielectric strength of insulating materials in superconducting magnet systems
IV.17	Improvement of flux-pinning characteristic in high-field superconductor
IV.18	Pulsed heat transfer in superfluid helium
IV.19	Ac losses and stability of fine NbTi multifilamentary composite conductors

Group V: Fusion Reactor Blanket Engineering

V.	1	Fusion reactor blanket engineering
V.	2	Basic experiments on tritium breeding and neutron multiplication
V.	3	Gas cooling heat transfer in a coolant duct of first wall with non-uniform and/or unsteady
		high heat flux
V.	4	Gas cooling heat transfer in a coolant duct of first wall with non-uniform and/or unsteady

high heat flux

	- Non-uniform and steady heat fransfer in a non-circular cross section duct $\ldots \ldots 211$
V . 5	Subcooled flow boiling of water for high heat flux cooling
V . 6	Benchmark experiment of DT neutron transmission through fusion reactor materials and
	development of the method for cross section sensitivity and uncertainty analysis 215
V . 7	Lifetime analysis of first wall of fusion reactor
V . 8	Thermohydrodynamic assessments of helium, liquid lithium and helium-lithium
	two-phase mist flow coolings of first wall in MCFR
V. 9	Neutron-induced gamma-ray production from fusion reactor materials
V.10	Strength of blanket materials under the influence of heavy neutron irradiation and high
	temperature
V .11	Study on knock-on atom spectra for fusion materials irradiated with 14 MeV neutrons 225
V.12	Natural convection heat transfer of liquid lithium under transverse and parallel magnetic
	fields
V.13	Pulsative composite stress on blanket materials
V.14	High temperature of blanket materials
V.15	Radiation damage studies on fusion materials and other utilizations by using rotating
	target neutron source II

Group VI: Design and Evaluation of Fusion Reactor

VI. 1	Fundamentals of fusion reactor design and assessment (Coordinating committee) 235
VI. 2	Concept definition of an advanced fusion fuel cycle reactor
VI. 3	Assessment of nuclear fusion reactor
VI. 4	Development of new methods for fusion theory
VI. 5	Materials data base as an interface between fusion reactor design and materials
	development
VI. 6	Ignition and burn dynamics of D-D fusion reactors
VI. 7	Estimation of nuclear data and their accuracy for design of nuclear fusion reactor blanket
	by Bayesian method
VI. 8	An advanced ICF reactor "Takanawa-I" with low radioactivity and tritium self-breeding
	in the pellet
VI. 9	Investigation, analysis and evaluation of fusion safety research
VI.10	Evaluation of structural strength of fusion reactor first wall