

# CONTENTS

## I. Physics

Small modular reactor concept sustainable in a carbon-neutral society ..... Toru Obara, Ren Horikoshi, Sambuu Odmaa and Jun Nishiyama	1
Coolant void coefficient in a sodium-cooled rotational fuel-shuffling breed-and-burn fast reactor ..... Tsendsuren Amarjargal, Jun Nishiyama and Toru Obara	5
Comparison of burnup performance between lead coolant and LBE coolant in Rotational Fuel-shuffling Breed-and-Burn fast reactor ..... Xucheng Zhao, Jun Nishiyama and Toru Obara	9
Breed and burn reactor concept to maximize uranium utilization without fuel shuffling ..... Tomohiro Yamashita and Naoyuki Takaki	14
Core concept of innovative small SFR with metal fuel for deployment in Japan ..... Sho Fuchita, Koji Fujimura, Daisuke Watanabe, Hirotaka Nakahara, Kazuhiko Matsumura, Hirokazu Ohta and Masatoshi Iizuka	20
Study on load following of a molten salt fast reactor ..... Hiroyasu Mochizuki and Masahiko Nakase	27
Development of a passive safety shutdown device to prevent core damage accidents in fast reactors; performance of the device in reactivity control and nuclear material management ..... Hiroshi Sagara, Masatoshi Kawashima, Koji Morita, Wei Liu, Tatsumi Arima, Yuji Arita, Isamu Sato, Haruaki Matsuura and Yoshihiro Sekio	34
Development of a method for the determination of spontaneous fission nuclides in irradiated fuel and applicability to Pu quantification in fuel debris by dual time neutron measurements ..... Taketeru Nagatani, Yoshihiro Kosuge, Hiroshi Sagara, Sho Nakaguki, Takayoshi Nohmi and Keisuke Okumura	41
Once-through high burnup fuel management strategy with dual neutron energy spectrum core in high-temperature gas-cooled reactor ..... Hong Fatt Chong and Hiroshi Sagara	47

## II. Measurements

CFD analysis of thermal radiation effects on large containment CIGMA vessel with Weighted Sum of Gray Gases (WSGG) model ..... Ari Hamdani, Shu Soma, Satoshi Abe and Yasuteru Sibamoto	53
Mobile radiation measurement system by multiple small gamma-ray detectors	

for radioisotope detection and identification supporting responders in the field of nuclear detection and nuclear security	Yoshiki Kimura and Tomoki Yamaguchi	60
Characterization of water Cherenkov neutron detector with high efficiency, availability, and affordability for nuclear security	Kosuke Tanabe, Masao Komeda, Yosuke Toh and Hiroshi Sagara	67
A new detection method of charged-particle emission reactions for the development of molten salt reactors	Tatsuya Katabuchi, Takaaki Ogiso, Hideto Nakano and Yu Kodama	74
Neutron capture cross section measurement of Palladium-107 using J-PARC	Hideto Nakano, Tatsuya Katabuchi, Kazushi Terada, Atsushi Kimura, Shoji Nakamura, Shunsuke Endo, Gerard Rovira and Yu Kodama	78
Measurements of keV-Energy neutron capture cross section of $^{243}\text{Am}$ using neutron filter	Yu Kodama, Tatsuya Katabuchi, Gerard Rovira, Hideto Nakano, Yaoki Sato, Atsushi Kimura, Shoji Nakamura, Nobuyuki Iwamoto, Shunsuke Nakamura and Kazushi Terada	83
Ultrasonic propagation analysis for new water level measurement method using clamp-on ultrasonic transducers	Takeshi Suzuki, Shuichi Omori, Naruki Shoji, Hideharu Takahashi and Hiroshige Kikura	87
Measurement system requirements for photofission signal detection with coincidence neutron counting method	Kim Wei Chin, Hiroshi Sagara, Jun-ichi Hori and Yoshiyuki Takahashi	91
Fundamental research on the integrated measurement method using laser and ultrasound for fuel debris investigation	Yuan Chen, Naruki Shoji, Hideharu Takahashi and Hiroshige Kikura	97
Development of a gas flowrate measurement system in gas–liquid two-phase flow using pulsed ultrasound	Naruki Shoji, Hideharu Takahashi, Hiroshige Kikura, Koji Teramoto and Hideki Kawai	103
Development of passive neutron emission tomography robust to its various inhibiting factors and its applicability to nuclear safeguards	Katsuyoshi Tsuchiya, Hiroshi Sagara and Chi Young Han	110
Stroboscopic X-ray imaging technique with optically chasing accelerator operation for mechanically driven sample	Tatsunori Shibuya, Yuya Koshiba, Yuichi Tadenuma, Sena Maru, Masakazu Washio, Takeshi Fujiwara, Ryunosuke Kuroda and Nagayasu Oshima	117

### III. Chemistry

Thermochemical conversion of uranium oxides for pretreatment of nuclide analysis	
..... ZhuoRan Ma, Yoshiya Homma, Kenji Konashi and Tatsuya Suzuki	122
Mutual actinides separation by column separation method using impregnated resin for high accurate actinides analysis	
..... Fauzia Hanum Ikhwan, Chikage Abe, Kenji Konashi and Tatsuya Suzuki	129
Development of high performance clarification system for spent MOX fuel reprocessing	
..... Masayuki Takeuchi, Takeshi Takata, Keita Saito and Takahiro Chikazawa	135
Dissolution of thorium dioxide in aqueous solution by using thermochemical conversion	
..... Feng Yin, ZhuoRan Ma, Chihiro Tabata, Satoshi Fukutani, Tomoo Yamamura and Tatsuya Suzuki	142
A basic study for radioactive nuclides recovery from spent PUREX solvent using adsorbents	
..... Tsuyoshi Arai, Fumiya Nakamura, Ryoji Abe, Fuga Ueno, Noriaki Seko, Yoichi Arai and Sou Watanabe	147
Valence separation of Fe and removal of $\text{Sn}^{2+}$ by solvent extraction as a potential method to determine $\text{Fe}^{2+}$ in glass containing $\text{Sn}^{2+}$	
..... Naoki Kanno, Masahiko Nakase, Yoshitaka Saijo, Daiju Matsumura, Takuya Tsuji, Kenji Takeshita and Takehiko Tsukahara	154
Temperature-swing gelification recovery of U recovery from leaching solution of U wastes	
..... Sou Watanabe, Youko Takahatake, Madoka Saito, Toshihiro Iwamoto, Masayuki Watanabe, Akihiko Kajinami, Asuki Naruse and Tekehiko Tsukahara	161
Achievements and status of the STRAD project for radioactive liquid waste management	
..... Yoichi Arai, Sou Watanabe, Masaumi Nakahara, Tomomasa Funakoshi, Takanori Hoshino, Yoko Takahatake, Atsushi Sakamoto, Haruka Aihara, Kenta Hasegawa, Toshiki Yoshida, Toshihiro Iwamoto, Takeshi Ohsugi, Takumi Taniguchi, Junya Sato and Masayuki Watanabe	168
Development of treatment method for analytical waste solutions in STRAD project - Role of trace chloride ion in ammonium ion oxidation with the presence of Co(II) ion	
..... Haruka Aihara, Sou Watanabe, Shinichi Kitawaki and Yuichi Kamiya	175
Effect of nitrogen admixture to underwater argon arc discharge plasma for nuclear decommissioning	
..... Hiroshi Akatsuka, Ryo Nakanishi, Atsushi Nezu and Shinsuke Mori	182
Effect of pH on water radiolysis enhanced by Zirconium oxide particles	
..... Yoshinobu Matsumoto, Tatsuya Suzuki and Ryuji Nagaishi	189
New filter concept for removal of fine particle generated in high level radioactive solution	
..... Youko Takahatake, Sou Watanabe, Masayuki Watanabe, Yuichi Sano and Masayuki Takeuchi	195
Chromatographic separation properties of metal ions from simulated high-level liquid waste using sulfur-containing amic acid-functionalized silica gel	
..... Naoki Osawa, Tatsuya Ito, Taiga Kawamura, Hao Wu and Seong-Yun Kim	199

## IV. Materials

Helium gas release behavior of highly microstructure-controlled B <sub>4</sub> C-based ceramics irradiated with helium ion beam	
..... Katsumi Yoshida, Ryosuke Maki, Jelena Maletaskic, Anna Gubarevich, Tatsuya Katabuchi, Tohru S. Suzuki and Tetsuo Uchikoshi	207
Rapid sintering of SiC ceramics assisted by high-frequency induction heating	
..... Alin Yoshida, Anna Gubarevich and Katsumi Yoshida	214
Effects of sintering atmosphere and form of Al and B addition on thermal and electrical properties of silicon carbide ceramics	
..... Ying Chung, Anna V. Gubarevich and Katsumi Yoshida	221
Oxidation behavior of Al <sub>4</sub> SiC <sub>4</sub> -based ceramics at 1623K	
..... Atsuko Tanaka, Anna Gubarevich, Toshiyuki Nishimura and Katsumi Yoshida	228
Development of corrosion-stable dual-Si-layered membranes for hydrogen production via thermochemical iodine-sulfur process	
..... Odtsetseg Myagmarjav, Nobuyuki Tanaka, Hiroki Noguchi, Yu Kamiji, Masato Ono, Chihiro Sugimoto, Hajime Kon, Mikihiro Nomura and Hiroaki Takegami	235
Novel fiber reinforced concrete based on liquid metal technology toward resource recycling society	
..... Masatoshi Kondo, Yuki Kano, Nobuhiro Chijiwa and Minh Oh	243
Novel seawater desalination technology with liquid metal fluid	
..... Toranosuke Horikawa and Masatoshi Kondo	250
Study on behavior of ablation plasma from liquid metal target for laser ion source	
..... Kazumasa Takahashi, Naoto Harukawa, Kaoru Ishikuro, Shinya Ishikawa, Kakeru Miyazaki, Toru Sasaki and Takashi Kikuchi	257

## V. Energy

Fabrication of palladium-copper alloy membrane for hydrogen purification using a reverse build-up method	
..... Yasunari Shinoda, Kohei Harada, Ryu Hamamura, Hiroki Takasu and Yukitaka Kato	261
A numerical study on Carnot Battery using chemical heat storage/pump and brayton cycle	
..... Massimiliano Zamengo, Kazuo Yoshida and Junko Morikawa	267
Effect of electrolyte particle size on CO <sub>2</sub> electrolysis performance of metal-supported solid oxide electrolysis cells prepared by atmospheric plasma spraying method	
..... Kosuke Umeda, Yuko Maruyama, Sho Kuzukami, Shuzo Tominaga, Yukitaka Kato and Hiroki Takasu	273
High reactivity and durability of silicone-supported magnesium chloride composite material for ammonia using thermochemical energy storage	
..... Tetta Enosawa, Saki Yoshida, Hiroki Takasu and Yukitaka Kato	279

Power-density enhancement of composite materials using open-cell foams for thermochemical energy storage	
..... Kyosuke Mochizuki, Shigehiko Funayama, Massimiliano Zamengo, Hiroki Takasu and Yukitaka Kato	286

## VI. Systems, Safety and Security

Dynamic modeling of HTGR-renewable hybrid system for power grid simulation	
..... Hiroyuki Sato and Xing L. Yan	293
Scenario analysis of future nuclear energy use in Japan:	
(1) Methodology of Nuclear fuel cycle simulator: NMB4.0	
..... Takumi Abe, Akito Oizumi, Kenji Nishihara, Masahiko Nakase, Hidekazu Asano and Kenji Takeshita	299
Scenario analysis of future nuclear energy use in Japan:	
(3) Promotion of Plutonium utilization by RBWR-Backfit	
..... Kenji Nishihara, Akito Oizumi, Tetsushi Hino and Hideo Soneda	305
Lightbridge nuclear fuel recycling to strengthen nuclear nonproliferation	
..... Braden Goddard and Sunil S. Chirayath	311
Evaluation for proliferation resistance of small and medium modular LWRs with $U_3Si_2$ fuel	
..... Natsumi Mitsuboshi and Hiroshi Sagara	318
Proliferation resistance analysis of Offshore Floating Nuclear Power Plant	
..... Daisuke Hara and Hiroshi Sagara	324
Safeguards approach and design of transuranium fuel cycle with accelerator-driven system based on material attractiveness	
..... Akito Oizumi and Hiroshi Sagara	331
Safety and proliferation resistance of small-sized sodium-cooled fast reactors with passive shutdown devices	
..... Haruka Okazaki, Masatoshi Kawashima and Hiroshi Sagara	338
India-Japan civil nuclear cooperation:	
Scenario analysis of nuclear energy systems and role of the QUAD framework	
..... Saurabh Sharma and Masako Ikegami	345

## VII. Accelerator and Application

ZMH crystals addition to prevent ZMH encrustation in Mo-Zr-Te $HNO_3$ solution	
..... Kasumi Sue, Kensuke Kamoi, Masayuki Takeuchi, Yasunori Miyazaki and Izumi Hirasawa	351
Conceptional design of a He beam accelerator system for $^{211}At$ production	
..... Daisuke Nagae, Aki Murata, Shota Ikeda, Shosuke Kikuchi, Ryoichi Yoshimura, Yoichi Ma, Daigo Narita and Noriyosu Hayashizaki	357

Investigation of high energy particle dynamics in a linear inertial electrostatic confinement fusion device by particle-in-cell Monte Carlo collision method	Kazuhiro Matsuda and Jun Hasegawa	364
Development of a long-life laser ion source using a cryogenic solidified gas target	Yuji Inoue, Jun Hasegawa, Naoki Matsubara, Kazumasa Takahashi, Jun Tamura, Kazuhiko Horioka and Ken Takayama	371
Radiobiological characterization of neutron irradiation field of UTR-KINKI for the research utility toward boron neutron capture therapy: Cell killing effect and its enhancement by 4-borono-L-phenylalanine	Shoji Imamichi , Yoshihisa Matsumoto , Toshiro Matsuda, Satoshi Nakamura, Mikio Shimada, Hirokuni Yamanishi, Mitsuko Masutani and Minoru Suzuki	377
Study of proton distribution in the backing material of accelerator neutron source solid target by ERDA analytical techniques	Hong-Fu Liu, Naoto Hagura, Tomohiro Kobayashi and Jun Kwarabayashi	381
Development status of the accelerator system for transportable compact neutron source RANS-III	Shota Ikeda , Tomohiro Kobayashi, Yoshie Otake and Noriyosu Hayashizaki	388
High charge and pulse duration tunable electron gun system for pulsed X-ray source	Daisuke Satoh, Hidetoshi Kato, Takeshi Fujiwara, Masahito Tanaka and Ryoichi Suzuki	395
Cooling simulation of RFQ linac with three-layer structure for high duty cycle operation	Aki Murata	400