

The timetable of the 183rd ISIJ Online Meeting  
(March 15-17, 2022)

| Session Room                | Mar. 15 (Tue.)  |  | Mar. 16 (Wed.)  |   | Mar. 17 (Thu.)  |  |
|-----------------------------|---|--|---|---|---|--|
|                             | AM  | PM   | AM  | PM  | AM  | PM   |
| Awards Ceremony Room        | --  | Ceremony of conferment of the honorary membership and prize awarding, Special lecture meeting (14:00-16:20) [Charge-Free]                    | --  | --  | --  | --   |
| Session Room 1              | Blast Furnace [1-4] (10:40-12:00)   | --   | Physico-chemical properties of high temperature melts 1-2 [J12-J17] (9:30-11:50)  | ISIJ and JIM joint session Physico-chemical properties of high temperature melts 3-4 [J18-J23] (13:30-15:50) / Properties of liquid materials [17-20] (16:10-17:30) | Inclusion / Slag and dust treatment [30-36] (9:20-12:00)  | Electric furnace and scrap / Hot metal treatment, converter and secondary refining [37-43] (13:00-15:40) |
| Session Room 2              | Young engineer session of coke-making 1-2 [5-11] (9:00-11:40)   | --   | --  | Sintering process 1-2 / Sinter [21-29] (13:00-16:40)  | High phosphorus iron / Coal and coke [44-50] (9:00-11:40)   | Carbonization and reduction / Hydrogen reduction ironmaking [51-56] (13:00-15:20)                        |
| Session Room 3              | Thermodynamics [12-16] (10:00-11:40)  | Quantitative analysis of solidification phenomena related to macrosegregation (13:00-16:35) [Charge-Free]                                    | --  | Data science for deterioration diagnosis of infrastructure II (13:00-17:00) [Charge-Free]   | Solidification and structure Control 1-2 [57-62] (9:40-12:00)   | Continuous casting and solidification / Property of cast metals [63-68] (13:00-15:20)                    |
| Session Room 4              | CO <sub>2</sub> reduction and detoxification [69-71] (9:00-10:00)   | --   | Green energy technologies contributing to the resolution of resource-energy-environmental problems in the ironmaking process 1-2 [72-80] (9:00-12:20) | Steel industry's co-products / History of steels [81-86] (13:30-15:50)  | --  | --   |
| Session Room 5              | --  | --   | --  | Instrumentation and automation 1-2 [87-93] (13:00-15:40)  | Recent trends on systems resilience to realize both maximum efficiency and operational stability [D1-D5] (9:00-12:15)               | --   |
| Session Room 6              | Deformation and additive manufacturing / Rolling [94-98] (10:00-12:00)  | --   | Advanced technologies in steel sheet forming and issues [D6-D13] (10:00-16:00)  |   | Needs for tubes with uneven thickness and their manufacturing and forming techniques 3 [D14-D19] (9:00-12:00)                       | Heating and cooling / Fracture characteristics and life elongation [102-106] (13:00-15:00)               |
|                             |   |  | Manufacturing technology of high quality and high functional bar and wire [99-101] (16:30-17:30)  |   |   |  |
| Session Room 7              | Hydrogen embrittlement 1-2 [107-114] (9:00-12:00)   | --   | Importance of plasticity-driven fracture and its required analytical techniques [D20-D28] (9:30-16:30)  | Hydrogen embrittlement 3-4 [169-176] (9:00-12:00)   | Hydrogen embrittlement 5-6 [177-184] (13:20-16:20)  |  |
| Session Room 8              | High-strengthening theory in high-temperature materials III (10:00-16:30) [Charge-Free]   |  | Stainless steel [125-126] (11:00-11:40)   | Hot-dip coating / Chemical property [127-136] (13:00-16:40)   | Elucidation of bio-corrosion mechanism and development of diagnosis /deterrence technology for bio-corrosion [D29-D34] (9:00-12:20) | --   |
| Session Room 9              | Applicability of friction welding technology for steel bridges and infrastructures~Mechanical properties and corrosion resistance of FSW-LFW joints~ (9:00-11:45) [Charge-Free] | --   | Diffusional transformation and diffusionless transformation 1-2 [137-144] (9:00-12:00)  | Diffusional transformation and diffusionless transformation 3 / Microstructural observation and analysis [145-152] (13:00-16:00)                                    | Fatigue property [185-187] (10:00-11:00)  | --   |
| Session Room 10             | Aging and precipitation 1-2 [115-122] (9:00-12:00)  | --   | Toughness and deformability 1-2 [153-159] (9:00-11:40)  | Heat resistant steels / Heat resistant alloys [160-168] (13:00-16:20)   | Recrystallization and texture / Modeling and simulation [188-195] (9:00-12:00)  | --   |
| Session Room 11             | Machine structural steel [123-124] (11:00-11:40)  | "Multi-scale characterization of crystalline materials forum" symposium ~Stress, strain and mechanical property~ (13:00-17:15) [Charge-Free] | Crystal structure analysis [210-214] (10:00-11:40)  | Surface and state analysis / Elemental analysis and others [215-222] (13:00-16:00)  | Strength and deformation behavior 1-2 [196-202] (9:00-11:40)  | Strength and deformation behavior 3-4 [203-209] (13:00-15:40)  |
| Session Room 12             | --  | --   | --  | Micro-analysis of corrosion phenomena on stainless steels (13:00-15:40) [Charge-Free]   | --  | --   |
| JIM Room F (Zoom)           | --  | --   | --  | --  | ISIJ and JIM joint session Titanium and its alloys 1-2 [J1-J9] (9:00-12:10)   | --   |
| JIM Room O (Zoom)           | --  | ISIJ and JIM joint session Ultrafine grained materials - fundamental aspects for ultrafine grained structures [J10-J11] (15:00-15:40)        | --  | --  | --  | --   |
| Poster Session for Students | --  | --   | Poster Session for Students (11:45-14:45) [Charge-Free] / Poster Session Award Ceremony (19:00-20:30) [Charge-Free]                                   |   | --  | --   |

[ ] : Lecture Number  
( ) : Lecture Time  
■ : Free Event

# Program of the 183<sup>rd</sup> ISIJ Meeting (March 15-17, 2022)

## Discussion Sessions

### Instrumentation, Control and System Engineering

| Lecture No. | Discussion Session  | Title  | Speaker       | Page |
|-------------|---|--|---------------|------|
|             | <b>Recent trends on systems resilience to realize both maximum efficiency and operational stability</b> |  |               |      |
|             | <b>9:00-9:30</b>  |  |               |      |
|             | D1  | Prospects for research group on systems resilience to realize both maximum efficiency and operational stability (The 2nd report)   | N. Fujii      | 1    |
|             | <b>9:30-10:00</b>   |  |               |      |
|             | D2  | Iron and steel-making process model for research discussions in “Resilient operations under aggressive environment” research group   | H. Narazaki   | 3    |
|             | <b>10:00-10:30</b>  |  |               |      |
|             | D3  | An agent-based logistics simulator in an iron and steel-making plant taking account of stable deviation phenomenon   | I. Ono        | 5    |
|             | <b>10:45-11:15</b>  |  |               |      |
|             | D4  | (ISIJ Research Promotion Grant) Toward enhancing resilience in steel production scheduling (Fundamental model based on resource-constrained project scheduling problem with inventory and resource consumption and reproduction) | H. Suwa       | 7    |
|             | <b>11:15-11:45</b>  |  |               |      |
|             | D5  | Analysis of deviation from stable state of steelmaking subprocess by stochastic automata model   | K. Sakakibara | 11   |

### Processing for Quality Products

#### Advanced technologies in steel sheet forming and issues

|  |                    |   |               |    |
|--|--------------------|---|---------------|----|
|  | <b>10:10-11:00</b> |   |               |    |
|  | D6                 | (Keynote Lecture) Formability and microstructure of high strength steel sheets for automotive: their development with transition of production technology | K. Tsuzaki    | 15 |
|  | <b>11:00-11:30</b> |   |               |    |
|  | D7                 | (Invited Lecture) Improvement of press forming simulation for high design of automobile body shape  | N. Ichijo     | 19 |
|  | <b>11:30-12:00</b> |   |               |    |
|  | D8                 | (Invited Lecture) Increase of prediction accuracy of material flow using higher-order friction coefficient  | T. Murata     | 20 |
|  | <b>13:00-13:30</b> |   |               |    |
|  | D9                 | Issues about stamping of automobile outer panels  | H. Kaneda     | 24 |
|  | <b>13:30-14:00</b> |   |               |    |
|  | D10                | Enhancement of accuracy of forming simulation considering various deformation characteristics of high strength steel sheets for automobile                | N. Noma       | 28 |
|  | <b>14:10-14:40</b> |   |               |    |
|  | D11                | Effect of material anisotropies of high-strength steel sheet on localized deformation behavior in circular and oval hole expansion                        | T. Suzuki     | 32 |
|  | <b>14:40-15:10</b> |   |               |    |
|  | D12                | Improvement of forming simulation accuracy for high strength steel and analytical technology for springback reduction                                     | Y. Kariyazaki | 36 |
|  | <b>15:10-15:40</b> |   |               |    |
|  | D13                | Evaluation of Die durability in shearing of 1.5GPa grade high tensile strength steel sheet  | N. Mizuta     | 40 |

#### Needs for tubes with uneven thickness and their manufacturing and forming techniques 3

|  |                    |   |              |    |
|--|--------------------|---|--------------|----|
|  | <b>9:05-9:50</b>   |   |              |    |
|  | D14                | Wall thickness eccentricity in the tube making process and its possible utilization   | H. Sato      | 44 |
|  | <b>9:50-10:10</b>  |   |              |    |
|  | D15                | Welding of tubes using explosive welding techniques and its application to produce tubes of uneven thickness                        | A. Mori      | 48 |
|  | <b>10:10-10:30</b> |   |              |    |
|  | D16                | Development of local thickening method of metal tube subjected to combined shear-compression stresses                               | K. Minemura  | 50 |
|  | <b>10:45-11:05</b> |   |              |    |
|  | D17                | Free hydraulic bulging and sinking for providing tubes with thickness distribution  | A. Shirayori | 54 |
|  | <b>11:05-11:25</b> |   |              |    |
|  | D18                | Effects of process parameters on microstructural of low carbon steel in die-less mandrel drawing for various thickness distribution | K. Wang      | 56 |
|  | <b>11:25-11:45</b> |   |              |    |
|  | D19                | Optimization of forming load of tube edge thinning  | Y. Yoshida   | 58 |

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## Microstructure and Properties of Materials

### Importance of plasticity-driven fracture and its required analytical techniques

9:35-10:20

D20 Research subjects in non-uniform deformation and damage in advanced high-strength steels Y. Okitsu . . . 60

10:30-11:00

D21 Lüders deformation of 5Mn-0.1C steels monitored by *in-situ* synchrotron X-ray diffraction under tensile loading S. Morooka . . . 62

11:00-11:30

D22 Visualization of strain distribution in the final fracture region by using digital image correlation method on replica films N. Koga . . . 66

11:30-12:00

D23 (Invited Lecture) Full-field strain analysis of titanium alloys by sampling moiré method Q. Wang . . . 70

13:00-13:30

D24 Microstructural and mechanical characterisation of fatigue crack propagation in lath martensite carbon steel using miniature specimen S. Ueki . . . 74

13:30-14:00

D25 Small fatigue crack growth in a lath martensite microstructure characterized by in situ SEM using a FIB-notched specimen M. Koyama . . . 75

14:00-14:30

D26 Microscale mechanisms and influencing environmental factors of hydrogen-assisted intergranular fatigue crack propagation in BCC iron Y. Ogawa . . . 77

14:40-15:10

D27 Dislocation dynamics simulation under the influence of hydrogen S. Taketomi . . . 81

15:10-15:55

D28 Fracture basing on the interaction between a crack and dislocations. M. Tanaka . . . 82

### Elucidation of bio-corrosion mechanism and development of diagnosis /deterrence technology for bio-corrosion

9:05-9:30

D29 Corrosion behavior of SUS304 stainless steel contacting with agar film containing sodium chloride or sodium thiosulfate T. Haruna . . . 83

9:30-9:55

D30 Interaction between Cu concentration in stainless steel weld metals and microbial activity Y. Miyano . . . 85

9:55-10:20

D31 MIC cases and immersion tests of metals in industrial water environment T. Sunaba . . . 86

10:40-11:05

D32 Transition of microbial communities during the progression of corrosion S. Wakai . . . 87

11:05-11:30

D33 Iron corrosion with nitrite reduced from nitrate by two novel *Prolixibacter* species T. Iino . . . 91

11:30-11:55

D34 Isolation of methanogen inducing EMIC from freshwater environment S. Hirano . . . 95

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## High Temperature Processes

| Lecture No.                                    | Title   | Speaker      | Page |
|--|---|--------------|------|
| <b>Plenary Session</b>                         |   |              |      |
| <b>Blast Furnace</b>                           |   |              |      |
| 1  | (Sawamura Award) Gas permeability evaluation of granulated slag particles packed bed during softening and melting stage with Fanning's equation   | K. Ohno      | 97   |
| 2  | Effect of FeO concentration in iron ore sinter on reduction behavior in hydrogen enriched blast furnace condition   | K. Ohno      | 98   |
| 3  | Reduction disintegration behavior of iron ore sinter in blast furnace under high hydrogen condition and its modeling  | T. Murakami  | 99   |
| 4  | Technology for accelerating pulverized coal gasification by natural gas injection under oxygen blast furnace conditions   | Y. Morita    | 100  |
| <b>Young engineer session of coke-making 1</b> |   |              |      |
| 5  | Stabilization of operation by relativity centered maintenance analysis for coke oven machines   | H. Muraki    | 101  |
| 6  | Increase heat at the end flue by adjusting the pulling pressure of the exhaust gas outlet   | K. Nishino   | 102  |
| 7  | Three-dimensional shape measurement of multiple coke particles using a medical X-ray CT scanner   | S. Matsuo    | 103  |
| <b>Young engineer session of coke-making 2</b> |   |              |      |
| 8  | Measurement of coking pressure with increasing ratio of briquette for use of non/slightly caking coals  | T. Takashima | 104  |
| 9  | Determining the opening/closing of the top cover and collecting valve of the coke oven rising pipe using image analysis   | T. Kawai     | 105  |
| 10   | Measures against accumulation of sulfur particles (desulfurization drainage) in the tank  | K. Nimata    | 106  |
| 11   | Renovation of Fukuyama No.3 coke oven battery   | T. Nakashima | 107  |
| <b>Thermodynamics</b>                          |   |              |      |
| 12   | (Nishiyama Commemorative Prize) Thermochemical properties of heterogeneous steelmaking slags  | M. Hasegawa  | 108  |
| 13   | Thermodynamic properties of sulfur in the CaO–AlO <sub>1.5</sub> –CeO <sub>1.5</sub> slag system at 1873 K  | M. Higuchi   | 109  |
| 14   | Deoxidation and desulfurization equilibria of molten iron with Lanthanum at 1873 K  | H. Kaido     | 110  |
| 15   | Activity of Cr <sub>2</sub> O <sub>3</sub> and phase equilibrium relationship in the CaO–SiO <sub>2</sub> –Cr <sub>2</sub> O <sub>3</sub> ternary system  | R. Yamauchi  | 111  |
| 16   | Investigation into relevance of solid electrolyte surface to emf measurement in Cr/Cr <sub>2</sub> O <sub>3</sub> -type zirconia sensor   | N. Saeki     | 112  |
| <b>Properties of liquid materials</b>          |   |              |      |
| 17   | (Scientific Achievement Merit Prize) Physicochemical properties of high temperature oxide melts   | K. Nakashima |      |
| 18   | (Sawamura Award • ISIJ Research Promotion Grant) Influence of fluorine and nitrogen addition on viscosity of silicate melts   | S. Sukenaga  | 113  |
| 19   | (ISIJ Research Promotion Grant) Derivation of sintering rate equation for oxide particle in liquid metal in in-situ observation of sintering behavior through single crystal Al <sub>2</sub> O <sub>3</sub> | M. Nakamoto  | 114  |
| 20   | (Nishiyama Commemorative Prize) Investigation of quench point during water cooling of steel sheet based on thermophysical properties of oxide scale   | R. Endo      | 115  |
| <b>Sintering process 1</b>                     |   |              |      |
| 21   | (Nishiyama Commemorative Prize) Development of manufacturing process and quality designing of agglomerate for blast furnace   | K. Higuchi   | 116  |
| 22   | Effect of introducing slit type burner as re-ignition furnace on sinter product yield Development of REMO-tec (Re-ignition method for optimization of total energy consumption) - 5                         | M. Matsumura | 117  |
| 23   | Effect of applying REMO-tec to Murooran No.6 sintering machine Development of REMO-tec (RE-ignition Method for Optimization of Total Energy Consumption) - 6  | Y. Onuma     | 118  |
| <b>Sintering process 2</b>                     |   |              |      |
| 24   | Technology for productivity improvement in composite sintering process for fine iron ore  | K. Horita    | 119  |
| 25   | (ISIJ Young Researcher Award) In situ monitoring of the sinter bed, and H <sub>2</sub> production in the presence of H <sub>2</sub> S   | K. Taira     |      |
| 26   | Effect of granulation conditions of raw materials on the emission amount and composition of particulate matters in the iron ore sintering bed   | D. Maruoka   | 120  |

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## Sinter

|    |  |              |       |     |
|----|--|--------------|-------|-----|
| 27 | Structural analysis of atomic arrangement in multicomponent calcium ferrite  | K. Takehara  | • • • | 121 |
| 28 | D pore analysis of sinter ore by image processing of X-ray CT images   | T. Takayama  | • • • | 122 |
| 29 | Phase equilibria involving SFCA on the 5mass%Al <sub>2</sub> O <sub>3</sub> and the CaFe <sub>6</sub> O <sub>10</sub> -Ca <sub>4</sub> Si <sub>3</sub> O <sub>10</sub> -CaAl <sub>6</sub> O <sub>10</sub> at 1240°C in air | A. Takahashi | • • • | 123 |

## Inclusion

|    |   |              |       |     |
|----|---|--------------|-------|-----|
| 30 | (Nishiyama Commemorative Prize) Attractive force acting among inclusion particles at gas-liquid interface | S. Kimura    | • • • | 124 |
| 31 | Investigation of inclusion refinement in molten steel by Mg addition                                      | K. Nishinaka | • • • | 125 |
| 32 | Experimental study on the secondly inclusion of Fe-36mass%Ni Alloy  | H. Fukaya    | • • • | 126 |

## Slag and dust treatment

|    |   |            |       |     |
|----|---|------------|-------|-----|
| 33 | Soft soil improved by steelmaking crusher-run slag gravel   | A. Uehara  | • • • | 127 |
| 34 | Full use of a steelmaking slag using industrial waste   | M. Nakaura | • • • | 128 |
| 35 | Phosphorus recovery as hydroxyapatite precipitate from steelmaking slag by hydrothermal treatment | M. Suzuki  | • • • | 129 |
| 36 | Dissolution behavior of phosphorus from P-concentrated slag                                       | T. Iwama   | • • • | 130 |

## Electric furnace and scrap

|    |   |            |       |     |
|----|---|------------|-------|-----|
| 37 | Measurement of arc plasmas on molten iron for clarification of nitrogen absorption behavior into molten iron by arc plasmas | H. Muneoka | • • • | 131 |
| 38 | Interaction coefficients of Cu and Sn with Mn in molten iron  | H. Ito     | • • • | 132 |
| 39 | Anodic reaction behavior of copper-containing molten carbon saturated iron-molten oxide interface                           | S. Natsui  | • • • | 133 |

## Hot metal treatment, converter and secondary refining

|    |   |              |       |     |
|----|---|--------------|-------|-----|
| 40 | (Nishiyama Commemorative Prize) Research and development of high-productivity refining process in steelmaking | K. Naito     | • • • | 134 |
| 41 | (Tawara Award) Effect of wettability on penetration and flotation behavior of a particle in refining process  | A. Matsuzawa | • • • | 135 |
| 42 | Utilization of flame spectrometry for observation of reaction in converter                                    | T. Sugino    | • • • | 136 |
| 43 | Role of solid/liquid fraction in the flux on desulfurization efficiency in KR process                         | Y. Kang      | • • • | 137 |

## High phosphorus iron

|    |  |             |       |     |
|----|--|-------------|-------|-----|
| 44 | Quantification of each form of phosphorus in iron ore  | R. Murao    | • • • | 138 |
| 45 | Chemical state analysis of phosphorus adsorbed goethite in iron ore by microscopic FT-IR method        | S. Kawanami | • • • | 139 |
| 46 | Dephosphorization from high phosphorus iron ore mixed with magnetite using microwave heating           | K. Shinjo   | • • • | 140 |
| 47 | Physical separation technique using high-voltage pulse crushing for low temperature reduction iron ore | E. Shibata  | • • • | 141 |

## Coal and coke

|    |   |              |       |     |
|----|---|--------------|-------|-----|
| 48 | (Nishiyama Commemorative Prize) Improvement of blending theory based on novel evaluation method for coal thermoplasticity | K. Fukada    | • • • | 142 |
| 49 | (ISIJ Research Promotion Grant) Release behavior of mercury during heat treatment of coal and iron Ore                    | N. Tsubouchi | • • • | 143 |
| 50 | Adaptivity of new binder to Ferro-coke  | R. Kobori    | • • • | 144 |

## Carbonization and reduction

|    |  |              |       |     |
|----|--|--------------|-------|-----|
| 51 | The comparison of iron-precipitation from hematite with silicon-nitride and boron-nitride                        | N. Ishikawa  | • • • | 145 |
| 52 | Effects of temperature and sulfur content on the carbonization rate of reduced iron pellet by Boudouard reaction | S. Kobayashi | • • • | 146 |
| 53 | Effect of biomass components on reduction of carbon-iron ore composite   | R. Higashi   | • • • | 147 |

## Hydrogen reduction ironmaking

|    |  |             |       |     |
|----|--|-------------|-------|-----|
| 54 | Evaluation of reduction rate of fine hematite ore for H <sub>2</sub> reduction ironmaking  | H. Hayashi  | • • • | 148 |
| 55 | Investigation of direct reduction process with shaft furnace by pre-heating raw material development of adiabatic counter current moving bed for shaft furnace reaction simulator -3 | M. Mizutani | • • • | 149 |
| 56 | 3D DEM-CFD reaction analysis of shaft furnace of high hydrogen injection condition   | T. Iwanaga  | • • • | 150 |

# Program of the 183<sup>rd</sup> ISIJ Meeting (March 15-17, 2022)

## Solidification and structure control 1

|    |   |            |       |     |
|----|---|------------|-------|-----|
| 57 | Temperature dependence of solid-liquid interfacial energy of pure metals by metadynamics  | K. Ueno    | • • • | 151 |
| 58 | (ISIJ Research Promotion Grant) Effect evaluation of natural convection on dendrite fragmentation using high-performance phase-field lattice Boltzmann simulation | T. Takaki  | • • • | 152 |
| 59 | (ISIJ Research Promotion Grant) Numerical simulation of solidification grain structure of arc welding for stainless steel by cellular automaton method            | Y. Natsume | • • • | 153 |

## Solidification and structure control 2

|    |  |           |       |     |
|----|--|-----------|-------|-----|
| 60 | In-situ observation using X-ray radiography of solidification in Fe-22Mn-0.7C alloys   | T. Narumi | • • • | 154 |
| 61 | Measurement of changes in volume and the lattice constant of pure Fe and Fe-C alloys as a function of temperature by using 4D-CT and XRD   | T. Narumi | • • • | 155 |
| 62 | Size effect in solidification and $\delta$ - $\gamma$ phase transformation of Fe-0.18C steels: discovery of solidification conditions without $\delta$ - $\gamma$ phase transformation | M. Doi    | • • • | 156 |

## Continuous casting and solidification

|    |   |          |       |     |
|----|---|----------|-------|-----|
| 63 | (Nishiyama Commemorative Prize) Parameter estimation for segregation simulations based on data assimilation   | M. Ohno  | • • • | 157 |
| 64 | (Nishiyama Commemorative Prize) Research and development to prevent surface defects during the process from continuous casting to rolling                   | Y. Ohba  | • • • | 158 |
| 65 | (ISIJ Research Promotion Grant) Effects of $\gamma$ grain size on the behavior of deformation and stress generation during immersion cooling of steel bloom | K. Isobe | • • • | 159 |

## Property of cast metals

|    |   |            |       |     |
|----|---|------------|-------|-----|
| 66 | (Mishima Medal • Distinguished Article Award) Numerical simulation on inclusion and bubble entrapment in solidified shell in model experiment and in mold of continuous caster with DC magnetic field | Y. Miki    | • • • | 160 |
| 67 | Improvement of uneven solidification in hypo-peritectic steel by heat flux control mold   | K. Furumai | • • • | 161 |
| 68 | Effect of solidification condition on sulfide morphology in free machining austenitic stainless steel   | K. Azuma   | • • • | 162 |

## Sustainable Systems

| Lecture No.  | Title  | Speaker      | Page      |
|--|--|--------------|-----------|
| Plenary Session                                    |  |              |           |
| <b>CO<sub>2</sub> reduction and detoxification</b> |  |              |           |
| 69   | (Scientific Achievement Merit Prize) Study on the kinetic analyses of reactions in blast furnace                                 | Y. Kashiwaya |           |
| 70   | Leaching and carbonation of Ca in coarse-grained steelmaking slag using a wet ball mill in a CO <sub>2</sub> atmosphere          | E. Kusaka    | • • • 163 |
| 71   | (ISIJ Research Promotion Grant) Removal and concentration of phosphate ions from waste water by bipolar membrane electrodialysis | T. Sugimoto  | • • • 164 |

## Green energy technologies contributing to the resolution of resource-energy-environmental problems in the ironmaking process 1

|    |   |                |           |
|----|---|----------------|-----------|
| 72 | Performance evaluation of CO <sub>2</sub> electrolysis of metal supported solid oxide electrolysis cell for carbon recycling technology     | S. Kuzukami    | • • • 165 |
| 73 | Development of chemical heat pump using magnesium chloride/ammonia for utilization of low-quality waste heat                                | T. Enosawa     | • • • 166 |
| 74 | Future estimates of resource efficiency associated with the introduction of hydrogen steelmaking under CO <sub>2</sub> emission constraints | S. Kashiwakura | • • • 167 |
| 75 | Fabrication of PdCu-based H <sub>2</sub> -permeable composite membrane by reverse build-up method   | Y. Shinoda     | • • • 168 |
| 76 | Effect of alkali on hydrogen production in the reaction of Si with water using Si sludge  | T. Kagawa      | • • • 169 |

## Green energy technologies contributing to the resolution of resource-energy-environmental problems in the ironmaking process 2

|    |   |            |           |
|----|---|------------|-----------|
| 77 | Effect of recycling materials addition on the composition and emission amount of particulate matters during packed bed combustion process of carbonaceous materials | T. Fukuchi | • • • 170 |
| 78 | The possibility and process of the use of upgraded coal from lignite coal in the iron making process  | Y. Matsui  | • • • 171 |
| 79 | Concept of a new ironmaking process using ammonium salt as a sub-material   | H. Kubo    | • • • 172 |
| 80 | Changes in steel resource efficiency with the expansion of electric furnace crude steel production in China   | T. Liang   | • • • 173 |

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## Steel industry's co-products

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| 118 | (ISIJ Research Promotion Grant) Effects of alloying elements on precipitation of $\text{Fe}_2\text{M}$ on eutectoid type reaction path: $\delta\text{-Fe} \rightarrow \gamma\text{-Fe} + \text{Fe}_2\text{M}$ in Fe-Cr-M (M: Hf, Ta) ternary alloys | Z. Yuan     | • • • | 206 |

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| 135 Investigation of pH change mechanism driven by ammonium thiocyanate aq. during electrolytic hydrogen charge (2)      | M. Akahoshi  | • • • | 221 |
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| 138 (Sawamura Award) Partitioning of solute elements and microstructural changes during heat-treatment of cold-rolled high strength steel with composite microstructure | T. Nakagaito  | • • • | 224 |
| 139 (Sawamura Award) Control of core-shell type second phase formed via interrupted quenching and intercritical annealing in a medium manganese steel                   | T. Tsuchiyama | • • • | 225 |
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| 142 Effects of manganese content on martensitic transformation behavior in 0.1 mass% carbon steels  | K. Ueno      | • • • | 227 |
| 143 Microstructure and deformation induced transformation behaviors of a TRIP-type multi-phase steel  | Y. Kinoshita | • • • | 228 |
| 144 (Asada Medal) Development of ferrous alloys with prolonged fatigue life and its application in seismic dampers.   | T. Sawaguchi |       |     |

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| 146 Investigation of atomic modeling for grain boundaries within martensitic microstructure   | K. Matsubara | • • • | 229 |
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| 155 Proposal of new MOTE evaluation methods for determination of representative fracture toughness | T. Ozawa     | • • • | 238 |

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| 161 Influence of creep ductility on Monkman-Grant relation for modified 9Cr-1Mo steel               | F. Abe        | • • • | 243 |
| 162 Microstructural changes of HAZ formed in Gr.91 weld metal during aging                          | K. Sato       | • • • | 244 |
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| 165 | Grain boundary precipitation strengthening due to P phase in creep of Ni-Cr-Mo alloys                      | Y. Mitsuya   | • • • | 247 |
| 166 | Effects of the precipitates on the mechanical properties and creep strength of Ni-Cr-Mo alloy              | T. Yanagiya  | • • • | 248 |
| 167 | Effect of baseplate-preheating temperature on Ni-base superalloy Alloy718 built by selective laser melting | Y. Shinoda   | • • • | 249 |
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| 178 | (ISIJ Research Promotion Grant) Fatigue crack propagation behavior of eutectoid steels in high-pressure gaseous hydrogen environment      | Y. Ogawa    | • • • | 260 |
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| 183 | Prevention of hydrogen embrittlement in Al-Zn-Mg-X alloys by trace element X  | K. Shimizu   | • • • | 265 |
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| 186 | (ISIJ Research Promotion Grant) Relationship between cell development and crack initiation during fatigue of an Fe-3 mass%Si alloy at room temperature | T. Fujii    | • • • | 268 |
| 187 | Fatigue and fracture of 22Cr-13Ni-(Mn,Mo,Nb,V) austenitic stainless steel at 77 K  | T. Kato     | • • • | 269 |

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| 198 Dynamic analysis of microstructural evolution during tensile deformation in ferrite single-phase steel      | S. Namizaki | • • • | 279 |
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| J2   | (ISIJ Research Promotion Grant) Thermal oxidation and nitridation of Ti-5Al-2Sn-2Zr-4Mo-4Cr (Ti-17) alloys with added Si in atmospheric treatment                                     | T. Narushima | • • • 304 |
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| J4   | Achieving ultrahigh yield strength and large uniform elongation in ultrafine-grained titanium containing nitrogen   | Y. Chong     | • • • 306 |
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