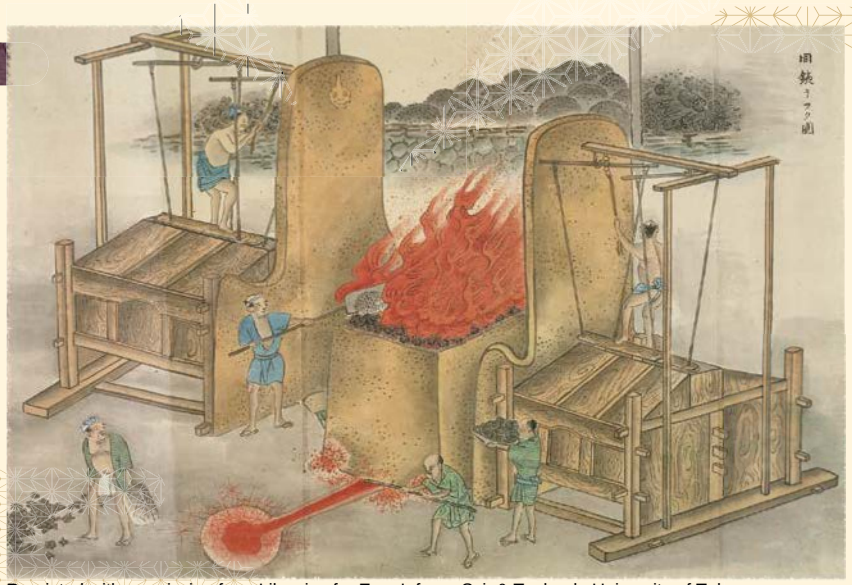
Program

The 1st International Symposium on Iron Ore Agglomerates (SynOre2022)

November 22-26, 2022

KUNIBIKI MESSE
Shimane Prefectural Convention Center, Japan

https://synore2022.com



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In the early modern times through the Edo period, “Tatara” ironmaking technology had significantly developed in “Chugoku District around Izumo-Matsue Region”, Shimane prefecture. “Tatara” means a stepping bellows to blow air to the furnace.

Organized by:
The Iron and Steel Institute of Japan, ISIJ

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Welcome Message

On behalf of the organizing committee of the 1st International Symposium on Iron Ore Agglomerates (SynOre2022), I would like to heartily welcome you to the symposium to be held in Matsue City, Japan, from November 22nd to 26th in 2022. Matsue is a typical mythological region located in the northern region of Western Japan. The traditional ironmaking technology called “Tatara” has been alive there since long ago, which has produced high-quality steel, known as “Tama-Hagane”.

The major themes of the symposium are past, current and future progresses of the R&D on the iron ore agglomeration technologies, such as sintering and pelletizing, to improve their energy-efficiency, resource-flexibility and environmental conformity. It will be sure to provide the valuable opportunity for the participants to focus on the comprehensive and dedicated presentations and discussions regarding the iron ore agglomeration processes and the properties of agglomerates. It will also contribute the further advancement of the agglomeration technologies of iron ores not only vital for high efficiency operation of the blast furnace but also innovative ironmaking processes fit to the future carbon neutral society.

Eiki, Kasai

Chair of SynOre2022
Tohoku University

Organizers / Committes

Organizers

Organized by

The Iron and Steel Institute of Japan, ISIJ

Sponsored by

The Consortium for Scientific and Engineering Research on Ironmaking Processes
Hyuga Memorial Grant for International Conference

Organizing Committee Members

Chair

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Takahide, Higuchi (JFE Steel Corporation)

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Yoshiaki, Kashiwaya (Kyoto University)

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Koichiro, Ohno (Kyushu University)

Koji, Osuga (Kobe Steel, Ltd.)

Shin, Sugiyama (Nippon Steel Corporation)

Shigeru, Ueda (Tohoku University)

Eiji, Yamasue (Ritsumeikan University)

Cooperative Organizations

Associação Brasileira de Metalurgia, Materiais e Mineração (ABM)

The Chemical Society of Japan (CSJ)

The Chinese Society for Metals (CSM)

The Institute of Life Cycle Assessment, Japan (ILCAJ)

The Japan Institute of Energy (JIE)

The Japan Institute of Metals and Materials (JIM)

The Japan Research and Development Center for Metals (JRCM)

The Japan Society of Mechanical Engineers (JSME)

The Korean Institute of Metals and Materials (KIM)

The Mining and Materials Processing Institute of Japan (MMIJ)

The Society of Chemical Engineers, Japan (SCEJ)

Society of Environmental Science, Japan (SES)

The Swedish Steel Producers Association (Jernkontoret)

General Information

Registration Desk

OPENING HOURS:
Wednesday, Nov 23 **13:00-18:00**
Thursday, Nov 24 **8:00-17:00**
Friday, Nov 25 **8:00-16:00**

Passport and Visa

A valid passport is required to enter Japan. Participants from certain countries may be required to obtain a visa to enter Japan. Visa applications need to be made at least three months before the symposium. If you are uncertain about your requirements, please consult your nearest Japanese Embassy or Consulate, or visit the website of the Ministry of Foreign Affairs of Japan.

Climate and Clothing

During November, the average temperature in Matsue is around 12-16 degrees Celsius (54-60 degrees Fahrenheit).

Currency

Only Japanese Yen is acceptable at regular store and restaurants. Foreign currency can be changed into Japanese yen (¥) at major banks, hotels, and airports.

Credit Cards

Credit cards are widely accepted. Commonly recognized cards include Visa, MasterCard, and American Express.

Tipping

There is no custom of tipping anywhere in Japan, even at hotels and restaurants. On certain occasions, however, a service charge is added to the bill.

Electrical Appliances

The voltage in Japan is 100 - 110 volts for electrical appliances. Electrical sockets usually accept only two-pronged (vertical) plugs.

Special Requirements

Please give details of any special diet or disability assistance required on your registration form.

Insurance

The organizer cannot accept responsibility for accidents which might occur. It is recommended that participants take out adequate medical, travel and personal insurance prior to the commencement of travel.

Social Program

Plant Tour

***Scheduled Date: November 22nd (Tuesday)**

JFE Steel West Japan Works is integrated steelworks located in Fukuyama City and Kurashiki City.
The plant tour will guide you to the main facilities of the ironmaking processes;
Sintering Machine, Blast Furnaces etc. of the Fukuyama works.

No.3 Sintering Machine

Blast Furnaces

Excursion

***Scheduled Date: November 26th (Saturday)**

Symposium excursion will take place on Saturday 26 November, 2022. Buses will pick up the participants at Matsue Excel Hotel Tokyu and will visit to “Izumo Taisha Grand Shrine”, “Historical Museum of Iron in Tetsu-no-Rekishimura”, and then “Live Tatara Performance”.
After that, the buses will be back to Matsue JR Station via Izumo Airport.

- Izumo Taisha Grand Shrine
  https://www.izumo-kankou.gr.jp/english/4760
- Historical Museum of Iron in Tetsu-no-Rekishimura
  http://www.tetsunorekishimura.or.jp/history
- Live Tatara Performance
  We will be able to see the operation at Tatara-Ba (Field).

Instruction for Oral/ Poster Presentations

Instruction for Oral Presentations

Speaking Time

- Please check your presentation time in the program in advance and strictly observe the allotted time.
- The chair will open, time and close sessions. Speakers are requested to follow the chairs' lead.
- If you are presenting on site, you are requested to be seated in a chair labeled "Next Speaker", during the presentation in prior to your own with your PC ready.

Plenary Lecture

Plenary Lecture allotted 40 minutes in total.
(40 mins for presentation, Q&A if time allows)

Keynote Lecture

Keynote Lecture allotted 20 minutes in total.
(15 mins for presentation, 5 mins for Q&A)

*The session chair will ring a bell 2 mins before the end of the presentation time for onsite presenters (no bell for online presenters).

Oral Presentation

Oral Presentation allotted 20 minutes in total.
(15 mins for presentation, 5 mins for Q&A)

*The session chair will ring a bell 2 mins before the end of the presentation time for onsite presenters (no bell for online presenters).

Language

The official language of the symposium will be English, and no interpretation to other languages will be provided.

Audio Visual Equipment

- LCD projector and a screen will be set in the room, with a podium. PC will NOT be provided.
- Make sure that the PC you bring in is equipped with an HDMI output, a standard monitor terminal.
- The venue will provide you with output connecting cables. Set-up should be generally handled by the speaker him/herself.
- Mac users should bring their applicable cables and adaptors.
- If the presentation includes moving images, please make sure to test run.
- There is no need to send or register your presentation slides in advance.

Instruction for Poster Presentations

Venue for poster presentations

Foyer of International Conference Hall

Presentation Time [Thu, Nov 24, 11:10 -12:10]

- Please be sure to be available in front of your poster during the core poster presentation time.
- It will be presented in a style where the presenter stands in front of their poster. There will be no audio-visual equipment made available.

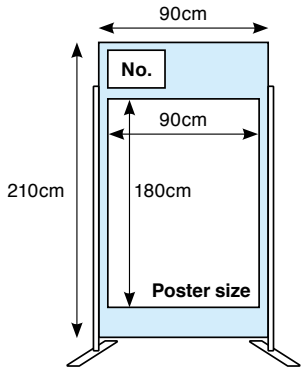
Language

The official language of the symposium will be English, and no interpretation to other languages will be provided.

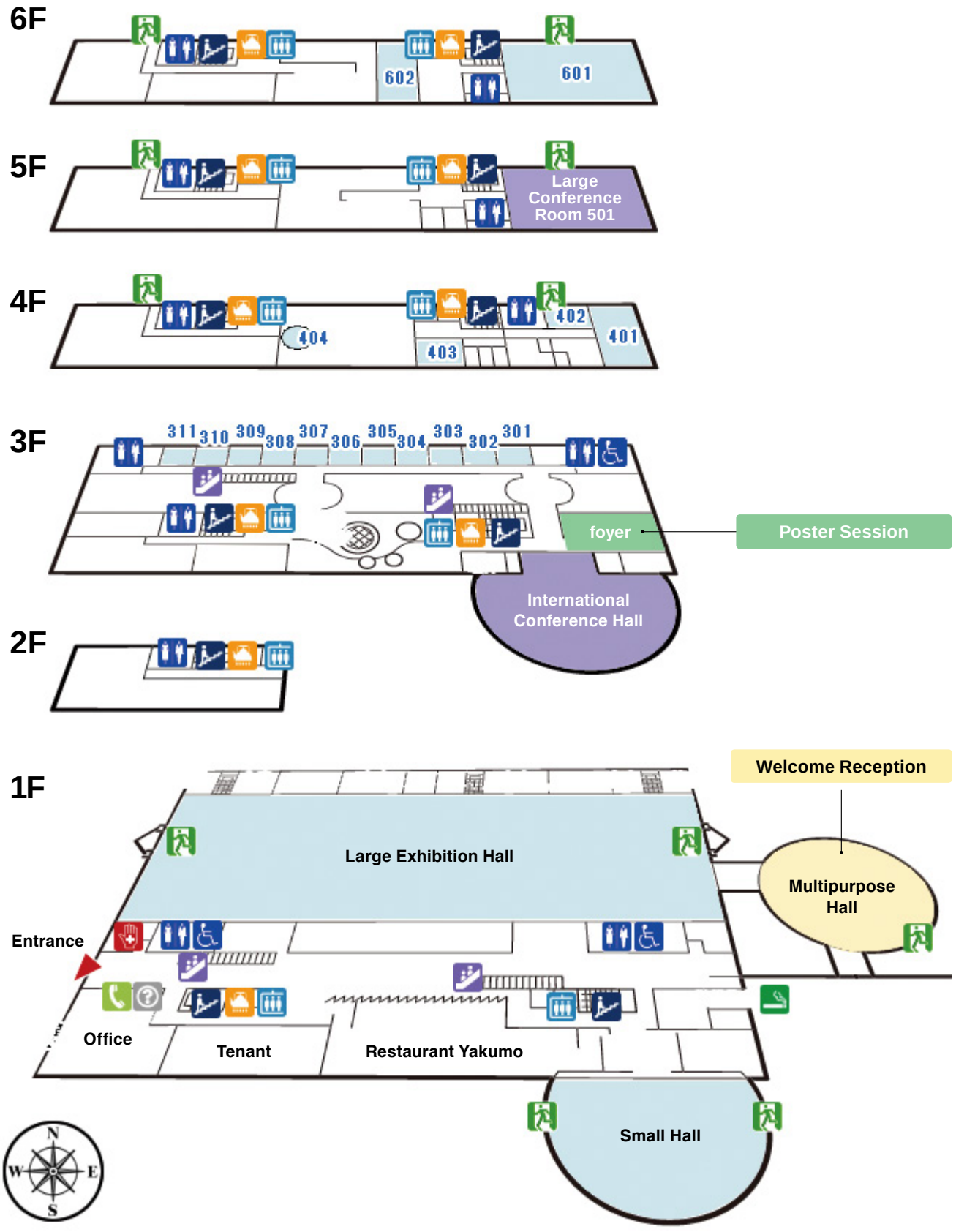
Mounting & Removal

Mounting: From November 23, 13:00 until the Poster Presentation starts.
Removal: By November 25, 16:00.

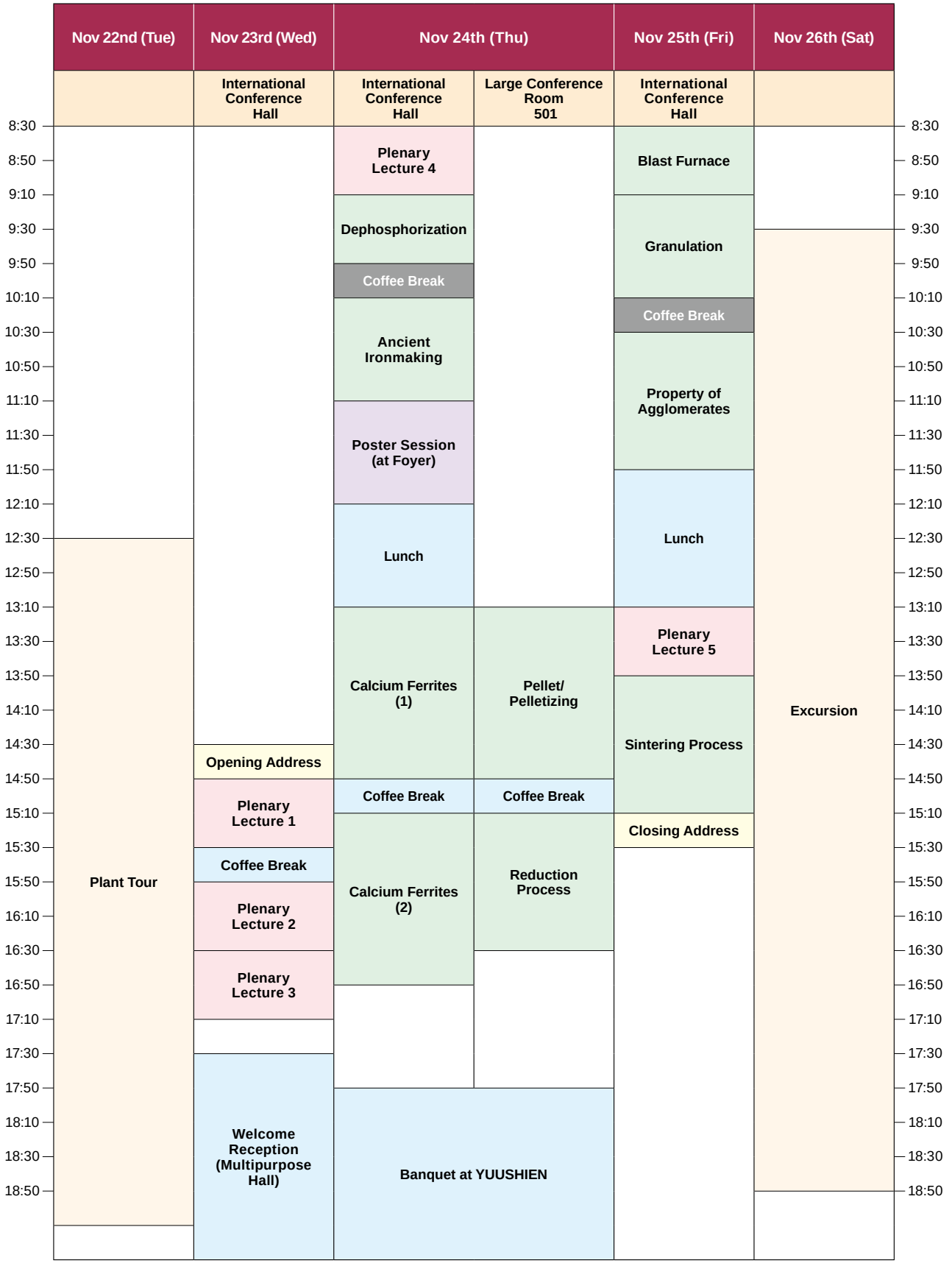
- Please post your poster on the board of your poster number. The number will be available inside the Program booklet handed out at the venue.
- The poster can be displayed and freely left for viewing during the times indicated above.
- Limited number of Push-pin will be prepared on site.
- Posters not removed by the presenter after the Removal Time will be automatically removed and left at the registration desk until the end of the symposium. Non-retrieve posters will be discarded.



Kunibiki Messe Floor Map



Program at a Glance



Program

November 23rd (Wednesday)

[International Conference Hall]

14:30-14:50 **Opening Address**

Eiki Kasai(Tohoku University)

14:50-15:30 **PL-1 Plenary Lecture 1**

Session Chair: Eiki Kasai(Tohoku University)

Innovative technologies to Mitigate CO_2 Emissions during Ironmaking in Japan 4

Kenichi Higuchi*(Nippon Steel Corporation)

15:50-16:30 **PL-2 Plenary Lecture 2**

Session Chair: Takahide Higuchi(JFE Steel Corporation)

Recent advances in low carbon sintering technologies 6

Liming Lu*(CSIRO)

16:30-17:10 **PL-3 Plenary Lecture 3**

Session Chair: Taichi Murakami(Tohoku University)

Utilization of iron ore resource in blast furnace for low-carbon ironmaking 8

Sang-Han Son*(POSCO)

17:30- **Welcome Reception (Multipurpose Hall)**

November 24th (Thursday)

[International Conference Hall]

8:30-9:10 **PL-4** **Plenary Lecture 4**

Session Chair: Hiroshi Nogami(Tohoku University)

High lump use in the blast furnace – implications for sinter quality ····· 12

Tom Honeyands*(University of Newcastle)

[Dephosphorization]

Session Chair: Hiroshi Nogami(Tohoku University)

9:10-9:30 **S1-1** **Analysis of phosphate minerals in iron ore by microscopic Raman/IR method** ····· 52

Sonomi Kawanami*(Nippon Steel Corporation), Reiko Murao

9:30-9:50 **KL-1** **Development of calcium ferrite dephosphorizing compound for steel making thru iron ore sintering process** ····· 22

Srinivas Dwarapudi*(R&D Tata Steel Jamshedpur India), Shaik M Basha, Dhiraj M Kadhe, Tapas Kumar Roy, Saurabh Kundu, Vinay Vasant Mahashabde

[Ancient Ironmaking]

Session Chair: Taichi Murakami(Tohoku University)

10:10-10:30 **KL-2** **Powder ironmaking by Tatara** ····· 25

Kazuhiro Nagata*(Professor Emeritus of Tokyo Institute of Technology)

10:30-10:50 **S2-1** **Searching for parameters in ancient ironmaking technology and elemental analysis of iron sand and its produced iron** ····· 56

Nobuyuki Kinami*(Ritsumeikan University), Eiji Yamasue, Yohei Hayashi

10:50-11:10 **S2-2** **Characterization of mineralogical classification and reduction behavior of "masa" and "akome" iron sand for Japanese traditional iron and steelmaking "Tatara"** ····· 59

Takashi Watanabe*(Tokyo Institute of Technology), Tadahiro Inazumi, Hiroshi Tanii, Miyuki Hayashi

Poster

11:10-12:10 **P-1** **Reduction mechanism of carbon - iron ore composite using uncarbonized biomass** ··· 154

Ryota Higashi*(Tohoku University), Daisuke Maruoka, Taichi Murakami, Eiki Kasai

P-2 **Reduction and dephosphorization of simulated iron ore by electron beam irradiation** ··· 157

Wataru Kameno*(Graduate School of Engineering, Osaka University), Hirokazu Konishi, Masayuki Okugawa, Yuichiro Koizumi

P-3 **Dephosphorization of high phosphorus iron ore by roasting with limestone, reduction, and magnetic separation** ····· 159

Ryuta Minakawa*(Tohoku University), Daisuke Maruoka, Taichi Murakami, Eiki Kasai, Takero Adachi, Takashi Tsushima

P-4 **Design of CaO content in sinter for accelerating magnetite oxidation** ····· 162

Kazuto Miyamaru*(Tohoku University), Masaru Matsumura

P-5 **Effect of hydrogen in the reducing gas of blast furnace on low temperature disintegration mechanism of self-fluxing iron ore pellet** ····· 165

Koki Momma*(Graduate school of Environmental Studies, Tohoku University), Daisuke Maruoka, Taichi Murakami, Eiki Kasai

[Calcium Ferrites1]

Session Chair: Reiko Murao(Nippon Steel Corporation)

[Calcium Ferrites2]

Session Chair: Takahide Higuchi(JFE Steel Corporation)

16:10-16:30 **S4-3** **Separation of calcium ferrite phases in iron ore sinter for evaluation of their reducibility** ··· 85
Nanase Kimura*(Graduate School of Environmental Studies, Tohoku University), Daisuke Maruoka, Taichi Murakami, Eiki Kasai

16:30-16:50 **S4-4** **Reducibility of calcio-wustite originating from silico-ferrite of calcium and aluminum from the perspective of morphology, concentration and hydrogen addition** ····· 88
Miyuki Hayashi*(Tokyo Institute of Technology), Boyuan Cai, Masahiro Susa

[Large Conference Room 501]

[Pellet/Pelletizing]

Session Chair: Koji Osuga(Kobe Steel, LTD.)

13:10-13:30 **S5-1** **Oxidation of magnetite at varied particle size and oxygen partial pressure** ····· 92
Tiago Ramos Ribeiro*(LKAB. Process and Product Development.), T.K. Sandeep Kumar, Klaus Wiegel, Daniel Marjavaara

13:30-13:50 **KL-5** **Effect of using an oxygen-enriched gas during induration of a magnetite pellet bed.** ··· 36
Charlotte Andersson*(Process Metallurgy, Lulea University of Technology), Anna Eriksson, T.K. Sandeep Kumar, Par Semberg, Hesham Ahmed

13:50-14:10 **S5-2** **Pellet-Particle Kinetic Model for Induration of Magnetite Pellet** ····· 96
T.K. Sandeep Kumar*(LKAB, Sweden), Nurni N Viswanathan, Hesham Ahmed, Charlotte Andersson

14:10-14:30 **S5-3** **Potential approach for recycling iron ore pellet fines using novel organic binders for hydrogen-based direct reduction** ····· 100
Karthik Manu*(Department of Materials Science and Engineering, KTH-Royal Institute of Technology), Elsayed Mousa, Hesham Ahmed, Weihong Yang

[Reduction Process]

Session Chair: Daisuke Maruoka(Tohoku University)

15:10-15:30 **S6-1** **Process design and experimental evaluation of multiple fluidized bed reduction system using reformed coke oven gas** ····· 104
Takero Adachi*(KOBE STEEL, LTD.), Daniel Spreitzer, Johannes Schenk

15:30-15:50 **S6-2** **Hydrogen reduction of low-grade banded iron ore** ····· 108
Nikhil Dhawan*(IIT Roorkee), Shrey Agrawal

15:50-16:10 **S6-3** **Organic Bonded Magnetite Pellets for Hydrogen-based Direct Reduction** ····· 112
Harikrishnan Parathodiel*(Department of Chemical Engineering, KTH Royal Institute of Technology), Elsayed Mousa, Hesham Ahmed, Kerstin Forsberg, Charlotte Andersson

16:10-16:30 **S6-4** **Development of Adiabatic Counter Current Moving Bed for Shaft Furnace Simulator** ··· 116
Moritoshi Mizutani*(Ironmaking Resarch Lab., Process Resarch Laboratories, Nippon Steel Corporation), Tsunehisa Nishimura, Takashi Orimoto, Kenichi Higuchi

18:00-21:30 **Banquet (Yuushien)**

November 25th (Friday)

[International Conference Hall]

[Blast Furnace]

Session Chair: Yoshiaki Kashiwaya(Kyoto University)

8:30-8:50 **S7-1** **3-Dimensional Analysis of Single Iron Ore Particle Having Irregular Shape** ····· 120
Jeong-In Kim, Shusei Kubota, Andrey Stephan Siahaan, Shungo Natsui, Hiroshi Nogami*(Tohoku University)

8:50-9:10 **KL-6** **Controlling Property of Sinter Ore for Increasing Gas Permeability of the Blast Furnace** ··· 40
Takayuki Iwama, Shigeru Ueda*(IMRAM, Tohoku University), Ryo Inoue

[Granulation]

Session Chair: Yoshiaki Kashiwaya(Kyoto University)

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Koji Osuga*(Kobe Steel, LTD., Research & Development Laboratory), Takero Adachi, Shintaro Yamazaki, Kazuya Miyagawa

9:30-9:50 **S8-2** **Effect of steam heating granulation on sinter productivity.** ····· 126
Shohei Fujiwara*(Steel Research Lab., JFE Steel Corporation), Toshiyuki Hirosawa, Hiroshi Tanaka, Hiroshi Tanaka, Takahide Higuchi, Kiyoshi Fukada

9:50-10:10 **S8-3** **Effect of Granule Structures of Raw Materials on the Size Distribution and Compositions of Particulate Matters Formed During Iron Ore Sintering** ····· 129
Daisuke Maruoka*(Graduate School of Environmental Studies, Tohoku University), Takumi Fukuchi, Taichi Murakami, Eiki Kasai

[Property of Agglomerates]

Session Chair: Masaru Matsumura(Nippon Steel Corporation)

10:30-10:50 **S9-1** **Metallurgical Properties of Lime Magnetite Pellets** ····· 131
Suneeti Purohit*(CSIRO), Mark I Pownceby

10:50-11:10 **KL-7** **Use of high Alumina Indian iron ore in making super fluxed sinter for high pellet BF operation** ····· 42
Mrigandra Singhai*(JSW Steel Ltd, Dolvi works), Dharmendra Rajak, Rupram Sahu, Sujoy S Hazra

11:10-11:30 **S9-3** **Relationships between iron ore sinter structures and breakage characteristics** ····· 135
Siyu Cheng*(The University of Queensland), Peter Charles Hayes, Evgueni Jak

11:30-11:50 **S9-4** **Disintegration behavior of iron ore sinter under high hydrogen reduction condition and its modeling** ····· 139
Taichi Murakami*(Graduate School of Environmental Studies, Tohoku University), Yuki Takahama, Daisuke Maruoka, Eiki Kasai

13:10-13:50 **PL-5** **Plenary Lecture 5**

Session Chair: Miyuki Hayashi(Tokyo Institute of Technology)

Digital model for iron ore sintering process ····· 19

Xuewei Lv*(Chongqing University)

[Sintering Process]

Session Chair: Miyuki Hayashi(Tokyo Institute of Technology)

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Masaru Matsumura*(Nippon Steel Corporation), Junji Nagata, Kenichi Higuchi, Ryohta Kosugi

14:10-14:30 **KL-8** **Advanced fully automated sinter raw mix and product control** ····· 46

Klaus Zoell*(Primetals Technologies Austria GmbH), Michaela Boeberl, Edmund Fehringer

14:30-14:50 **S10-2** **Green Solutions for Iron Ore Agglomeration: Off-gas Treatment and By-Product Utilization** ····· 144

Alexander Fleischanderl*(Primetals Technologies Austria GmbH), Thomas Steinparzer, Tobias Plattner, Robert Neuhold, Martin Goetz

14:50-15:10 **S10-3** **Construction of Fukuyama No.3 Sinter Plant Application of Data Science Technology** ··· 148

Hayato Yuki*(JFE steel corp.), Masafumi Matsushita, Naoyuki Takeuchi, Yasuhiro Fukumoto

15:10-15:30 **Closing Address**

Eiki Kasai(Tohoku University)

* indicates presenters of each presentation.

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